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Hitoshi Matsushima
The University of Tokyo
Toshihiko Shima
The University of Tokyo

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Investment and Ultimatum Games: Experiments[1]

Hitoshi Matsushima[2]
Department of Economics, University of Tokyo

Toshihiko Shima
Graduate School of Economics, University of Tokyo

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Abstract

This paper examines the ultimatum game preceded by a single player's investment decision that is risky in that the business opportunity could fail to be discovered. The experiment's results show that the functioning of social preference connecting the baseline ultimatum game with the investment crucially depends on the model's specifications, such as whether the proposer or the responder is the investor or the riskiness of the investment. The noninvestor/proposer tends to act in consideration of the efficiency of the investment, but not its riskiness. Such tendencies of the noninvestor's/proposer's social preferences are diametrically opposite to that of the investor/proposer.

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Keywords: Ultimatum game, Hold-up problem, Social preference, Investment efficiency, Risky investment, Investor's privilege, Libertarian doctrine.

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[2] Department of Economics, University of Tokyo, Hongo, Bunkyo-ku, Tokyo 113-0033, Japan. E-mail: hitoshi at mark e.u-tokyo.ac.jp

1. Introduction

This paper examines a two-person strategic situation; the *baseline ultimatum game*, where a player as proposer makes a take-it-or-leave-it offer on the share of a fixed pie to the other player, and the other player as responder decides whether to accept or reject his/her offer, is preceded by the stage at which either the proposer or the responder makes a *relation-specific investment*. The description of the model is framed for joint ventures where investment provides the business opportunity to bring about a positive profit, the pie to be divided between the investor and the noninvestor if each other agree about a way to distribute it.

The purpose of this paper is to clarify how the introduction of the investment decision influences the players' behavioral pattern in the baseline ultimatum game; in particular, we focus on how the player's behavioral patterns change depending on whether the investor is the proposer or the responder, or whether the investment involves *riskiness* in the sense that the business opportunity fails to be discovered even if the investor makes a positive investment decision.

In the study of the baseline ultimatum game and its variants, it is necessary to consider that the players do not make their decisions on self-interested motives. In this respect, we demonstrate an experimental approach; we make clear the different types of subjects' motives that can be supported by the experimental data obtained in laboratories.

With the assumption of a self-interested motive, subgame perfection predicts that the responder never rejects any positive offer and the proposer makes a null offer. If the investor is not the proposer, this investor is negative against making a positive investment; since the investment is *sunk*, the noninvestor/proposer has the higher bargaining power to claim a larger share of the profit opportunistically, letting the investor's will to invest decline. This case corresponds to the so-called *hold-up problem*, which has long been examined in contract theory literature. See Klein, Crawford, and Alchian (1978); Grout (1984); Williamson (1985); Grossman and Hart (1986); Hart (1995); and Holmstrom and Roberts (1998), for instance. On the other hand, if the investor is the proposer, he/she is willing to make the full investment; the tide is turned and he/she can enjoy an advantageous position in the negotiation with the noninvestor.

Several experimental researches, however, report that in contrast with these predictions, the subjects in laboratories are motivated not only by their self-interest but also by *social preferences* such as fairness and reciprocity; the responders tend to reject ungenerous offers and the proposers tend to make their offers generous in the baseline ultimatum game. See Güth, Schmittberger, and Schwarze (1982) and Camerer (2003, Chapter 2), for instance. Moreover, several experimental researches on models such as the trust game and gift exchange report that positive reciprocity functions in ways such that a player's generous activity at an early stage induces the other player's altruistic response at a later stage. See Berg, Dickhaut, and McCabe (1995); Fehr and Gächter (2000); and Camerer (2003, Chapter 2), for instance.

Based on these experimental researches, the subjects in laboratories are anticipated to act in consideration of the fact that it is impossible to discover the business opportunity as long as the investor makes the null investment. Hence, in our model, social preference is anticipated to function as a remedy for the hold-up problem caused by the noninvestor's/proposer's opportunism.

The present paper experimentally shows the manner of the functioning of social preference depending on the model's specifications such as whether the investor or the noninvestor is the proposer, whether the investment is risky or not, and the extent of investment efficiency. We classify the social preference that connects the baseline ultimatum game with the investment decision into two criteria, namely, the *investor's privilege* and the *libertarian doctrine*. Because only the investor has the decisive power to discover the business opportunity, he/she should have the privilege of obtaining a larger share of the pie than the noninvestor. The consideration of the investor's privilege is anticipated to be probably enhanced if the investment becomes risky. Moreover, it should be fair, according to the libertarian doctrine, to let the noninvestor bear a part of the investor's monetary cost of investing, even if this cost is sunk. According to this doctrine, subjects are sensitive to investment efficiency in the sense that the less efficient the investment is, the greater is the share that the investor obtains.

In addition, because of the presence of riskiness, the investor's intrinsic burden would be substantially higher than the monetary cost. Hence, it should be fair, according to the libertarian doctrine, to let the noninvestor bear a part of the investor's burden caused by this riskiness. Based on this doctrine, subjects might be sensitive to this riskiness in the sense that the riskier the investment is, the greater is the share that the investor obtains.

The main experimental results of this paper are as follows. When the noninvestor is the proposer, the *mean offer* in the ultimatum game with no-risk investment is *more* generous than that in the baseline ultimatum game, and it is *sensitive* to the investment efficiency; the noninvestor/proposer tends to be motivated by the libertarian doctrine in terms of monetary cost as well as the investor's privilege. These results support the conjecture that social preference functions as a remedy for the hold-up problem.

More importantly, when the noninvestor is the proposer and the investment is *not* extremely risky, the mean offer in the ultimatum game with *risky* investment is almost the *same* as that in the ultimatum game with no-risk investment. This implies that the noninvestor/proposer has a tendency *not* to act in consideration of the riskiness; he/she is *not* motivated on average by either the libertarian doctrine in terms of riskiness or the investor's enhanced privilege.

The hypothetical explanation on this result could be as follows. It is implicit to assume that the investor has no option to negotiate with the noninvestor about the way of sharing the investor's burden if the business opportunity fails to be discovered. In this case, the noninvestor's/proposer's more-generous offer can be regarded as his/her intention of sharing this burden even if the business opportunity fails to be discovered. However, it might be hard for the noninvestor/proposer to really have such a lasting intention as *the noninvestor dislikes compensating the investor for damage that will occur when the business opportunity fails to be discovered*.

On the other hand, when the riskiness in the investment is extremely severe, the tide is turned and the noninvestor/proposer in the laboratory is quite positive about considering the riskiness and he/she tends to make a much more generous offer in the ultimatum game with an extremely risky investment than in the ultimatum game with a no-risk investment.

The experimental results of this paper also show that the functioning of social preference substantially changes when the investor replaces the noninvestor as the proposer. The mean offer by the investor/proposer in the ultimatum game with no-risk investment is *insensitive* to the investment efficiency; the investor/proposer has no tendency on average to be motivated by the libertarian doctrine in terms of monetary cost. Moreover, the mean offer by the investor/proposer is *less* generous in the ultimatum game with risky investment than in the ultimatum game with no-risk investment, as the investor/proposer has a tendency on average to be motivated by the investor's enhanced privilege. These tendencies are diametrically opposite to the noninvestor's/proposer's tendencies.

The experimental results of this paper support that the responder generally tends to behave on the basis of social preference that is compatible with the proposer's motive.

The seminal work by Hackett (1994), which appears to be the first contribution in experimental economics to investigate the hold-up problem or generally the bargaining problem preceded by the investment decisions, is closely related to, but substantially different from, the present paper. Hackett formulated a two-person multistage game in which both players make relation-specific investments at the earliest stage, and then they play a version of alternating offer bargaining with a positive probability of breakdown. Hackett showed that social preference mitigates the hold-up problem by comparing a case where the investments are observable with a case where the investments are not.[3] In contrast to Hackett, the present paper formulates the bargaining procedure as the baseline ultimatum game, assumes that either one of the two players makes the investment decision, and compares various modifications of the ultimatum game that are distinguished by either having a stage of taking an investment decision or not, assuming the investor to be the proposer or responder, or having an element of riskiness in the investment or not.

Based on the experimental results of this paper, we can argue that it depends on the model specifications what kind of investment technology the investor prefers, provided

[3] See also Gantner, Güth, and Konigstein (2001); Ellingsen and Johannesson (2004a, b); Fehr and Schmidt (2003); and Fehr, Kremhelmer, and Schmidt (2008).

he/she can select any investment technology beforehand. When the investor has a disadvantageous position such as that of a responder in negotiation with the noninvestor, the investor is negative about enhancing the investment efficiency, and prefers either a no-risk or an extremely high-risk technology. This is in sharp contrast with the case where the investor has an advantageous position such as that of a proposer in a negotiation and he/she takes a positive attitude toward the enhancement of the investment efficiency and prefers an investment technology that involves medium risk rather than a no-risk or high-risk investment technology.

The organization of this paper is as follows. Section 2 specifies the models of the baseline ultimatum game and its variants. Section 3 explains the features of the design for the experiments conducted for this paper. Section 4 shows the main experimental results, which concern the dependence of the mean offer on the model’s specifications. Section 5 shows further experimental results. Section 6 argues about the investor’s selection of investment technology.

2. Variants of the Ultimatum Game

2.1. Baseline Ultimatum Game (Game B)

The *baseline ultimatum game* (*game B*) is defined as a two-stage game played by a *proposer* and a *responder*. At stage 1, the proposer makes a take-it-or-leave-it offer $s \in [0,1]$ to the responder to divide some amount of the pie $M > 0$. At stage 2, the responder decides whether to accept or reject his/her offer. If the responder accepts it, he/she earns sM and the proposer earns $(1-s)M$. If the responder rejects it, both obtain nothing from this pie. The self-interested payoff for the proposer is defined as

$$H + (1-s)M \quad \text{if the responder accepts,}$$

$$H \quad \text{if the responder rejects,}$$

whereas the self-interested payoff for the responder is defined as

$$H + sM \quad \text{if the responder accepts,}$$

$$H \quad \text{if the responder rejects.}$$ [4]

In the experiments, the description of game B was framed for the situation where the players face a business opportunity that brings about the pie M, if and only if each other agree about a way of the distribution.

It is clear that there exists the unique pure strategy subgame perfect equilibrium where the proposer makes the *null* offer $s = 0$ and the responder accepts *any* offer. However, it is an accepted view in experimental economics that the subjects are motivated by not only their self-interests but also their *social preferences*; in laboratories, the responder tends to reject ungenerous offers and the proposer tends to

[4] Each player can earn a fixed amount $H > 0$ even if the offer is rejected.

make a generous offer.

2.2. Ultimatum Game with No-Risk Investment (Games PI and RI)

The *ultimatum game with no-risk investment* is defined as a three-stage game in which the baseline ultimatum game is preceded by a stage at which either the proposer or the responder makes a relation-specific investment decision. At stage 0, the investor decides how much he/she makes for a quantity of investment $h \in [0, H]$ that is observable to the other player (noninvestor). At stages 1 and 2, they play the baseline ultimatum game, where the investment decision h at stage 0, along with the *investment efficiency* given by $\alpha > 0$, induces the business opportunity with certainty that brings about the pie $M = \alpha h$, if and only if the responder accepts the proposer's offer.

The ultimatum game with no-risk investment is divided into two cases; the first case is called the *ultimatum game with proposer's investment* (*game PI*), where the investor is assumed to be the proposer. The second case is called the *ultimatum game with responder's investment* (*game RI*), where the investor is assumed to be the responder.

In game PI, the self-interested payoff for the investor/proposer is defined as

$H - h + (1 - s)\alpha h$ if the noninvestor/responder accepts,

$H - h$ if the noninvestor/responder rejects,

whereas the self-interested payoff for the noninvestor/responder is defined as

$H + s\alpha h$ if the noninvestor/responder accepts,

H if the noninvestor/responder rejects.

There exists the unique pure strategy subgame perfect equilibrium where the investor/proposer makes the *full* investment $h = H$, he/she makes the null offer $s = 0$ at all times, and the responder accepts any offer.

We conjecture that in laboratories, the subjects behave in a different manner; because of social preferences, the investor/proposer tends to make a less-generous offer in game PI than in game B, and the noninvestor/responder is more likely to accept an ungenerous offer in game PI than in game B.

There are two reasons why the subjects tend to behave in this manner. First, because only the investor has the decisive power to discover the business opportunity, he/she should have the *privilege* of obtaining a larger share of the pie compared to the noninvestor. Second, it should be fair, according to the *libertarian doctrine*, to let the noninvestor bear a part of the investor's monetary cost of investing h. Based on this doctrine, the subjects are anticipated to be *sensitive* to the investment efficiency α in that as α decreases, that is, as the investment becomes less efficient, the investor/proposer tends to make his/her offer less generous, and the noninvestor/responder becomes more likely to accept ungenerous offers.

In game RI, where the investor is the responder, the self-interested payoff for the noninvestor/proposer is defined as

$H + (1-s)\alpha h$	if the investor/responder accepts,
H	if the investor/responder rejects,

whereas the self-interested payoff for the investor/responder is defined as

$H - h + s\alpha h$	if the investor/responder accepts,
$H - h$	if the investor/responder rejects.

There exists the unique pure strategy subgame perfect equilibrium where the investor/responder makes the *null* investment $h=0$, the noninvestor/proposer makes the null offer $s=0$ at all times, and the investor/responder accepts any offer. In a similar manner to game PI, we conjecture that in laboratories, the noninvestor/proposer tends to make a more-generous offer in game RI than in game B, and the investor/responder is less likely to accept ungenerous offers in game RI than in game B. Moreover, the subjects are anticipated to be sensitive to the investment efficiency α in that as α decreases, that is, as the investment becomes less efficient, the noninvestor/proposer tends to make his/her offer more generous, and the investor/responder becomes more likely to reject ungenerous offers.

2.3. Ultimatum Games with Risky Investment (Games PRI and RRI)

The ultimatum game with risky investment is defined as a modification of the ultimatum game with no-risk investment; there is *riskiness* in the investment as follows. With a positive probability $p \in (0,1]$, the investment decision h at stage 0 succeeds in discovering the business opportunity $M=\alpha h$, and the players come into stages 1 and 2 to play the baseline ultimatum game. With the remaining probability $1-p$, however, the business opportunity fails to be discovered, and the game ends.

The ultimatum game with risky investment is divided into two cases; the first case is called the *ultimatum game with the proposer's risky investment* (*game PRI*), where the investor is assumed to be the proposer. The second case is called the *ultimatum game with the responder's risky investment* (*game RRI*), where the investor is assumed to be the responder.

In game PRI, the self-interested payoff for the investor/proposer is defined as

$H-h+(1-s)\alpha h$ if the business opportunity is discovered and the noninvestor/responder accepts,

$H-h$ if either the business opportunity fails to be discovered or the noninvestor/responder rejects,

whereas the self-interested payoff for the responder is specified as

$H+s\alpha h$ if the business opportunity is discovered and the noninvestor/responder accepts,

H if either the business opportunity fails to be discovered or the noninvestor/responder rejects.

We assume that the *investment efficiency in expectation*, defined as αp, is greater than unity, that is, $\alpha p>1$. On the risk-neutrality assumption, there exists the unique pure strategy subgame perfect equilibrium where the investor/proposer makes the full investment $h=H$, he/she makes the null offer $s=0$ at all times, and the noninvestor/responder accepts any offer.

Because of social preferences, we conjecture that in laboratories, the investor/proposer tends to make a less-generous offer in game PRI than in game PI, and the noninvestor/responder is more likely to accept ungenerous offers in game PRI than in game PI.

There are two reasons why the players tend to behave differently in game PRI than in game PI. First, the consideration of the investor's privilege may be enhanced by introducing riskiness in the investment. Second, because of the presence of riskiness, the investor's/proposer's intrinsic burden induced by the investment decision at stage 0 would be substantially higher than its monetary cost h. Therefore, according to the libertarian doctrine, it would be fair to let the noninvestor/responder bear even a part of the investor's/proposer's burden caused by this riskiness. Based on this doctrine, the subjects are anticipated to be sensitive to the probability p of discovering the business opportunity; as p decreases, the investor/proposer tends to make his/her offer less generous, and the noninvestor/responder becomes more likely to accept ungenerous offers.

In game RRI, where the investor is the responder, the self-interested payoff for the noninvestor/proposer is defined as

$H+(1-s)\alpha h$	if the business opportunity is discovered and the investor/responder accepts,
H	if either the business opportunity fails to be discovered or the investor/responder rejects,

whereas the self-interested payoff for the responder is defined as

$H-h+s\alpha h$	if the business opportunity is discovered and the investor/responder accepts,
$H-h$	if either the business opportunity fails to be discovered or the investor/responder rejects.

On the risk-neutrality assumption, there exists the unique pure strategy subgame perfect equilibrium where the investor/responder makes the null investment $h=0$, the noninvestor/proposer makes the null offer $s=0$ at all times, and the investor/responder accepts any offer. In the similar manner to game PRI, we conjecture that in laboratories, the noninvestor/proposer tends to make a more-generous offer in game RRI than in game RI, and the investor/responder is less likely to accept ungenerous offers in game RRI than in game RI.

3. Experimental Design

We conducted computerized experiments[5] at the University of Tokyo from October 2006 to March 2007, where subjects were recruited from undergraduate and graduate schools for all fields. The subjects were well-motivated as they could obtain points that were the same amounts as their earned payoffs, which were then converted into yen at a fixed rate per point. They also got the participation fee of 1500 yen in addition to their earned payoffs. We assumed $H = 30$, and the choice of investment h was restricted to $\{0,10,20,30\}$.

The experiments were categorized into three types, that is, $(3, 0.75)$, $(5, 0.5)$, and $(4, 0.35)$, where type (α, p) implies the investment technology where the investment efficiency in games PI, RI, PRI, and RRI, and the probability of discovering the business opportunity in games PRI and RRI, are set equal to α and p, respectively. In each type (α, p), the pie for the baseline ultimatum game (game B) was given by $M = 30\alpha$.

Appendix 1 shows the detailed features of our experimental design. Types $(3, 0.75)$, $(5, 0.5)$, and $(4, 0.35)$ were conducted on October 25 and 26, 2006; January 18, 2007; and March 15 and 16, 2007, respectively. On the dates October 25 and 26, 2006, and January 18, 2007, the subjects played 10, 14, 14, 20, and 20 rounds for the treatments for games B, PI, RI, PRI, and RRI, respectively. On the dates March 15 and 16, 2007, the subjects played 8, 12, 12, 24, and 24 rounds for the treatments for games B, PI, RI, PRI, and RRI, respectively. The subjects were randomly paired with each other for each round and each subject was fixed to a role for the first half of the rounds

[5] The experiment was programmed and conducted with the software z-Tree. See Fischbacher (2007).

for each treatment; his/her role was changed for the latter half. We replaced the treatments in which the investor is the proposer with the treatments in which the investor is the responder across the dates. This replacement, however, did not affect the experimental results.

Each subject was handed the experiment manual for instructions about the rules of the games and the booklet with printed computer screen images that were written in the Japanese language,[6] the contents of which were explained by a recording voice. The description of the games in the manual was framed as a strategic interaction where two players had claims for the pie. On the screens of the computer, the subjects could always see any information necessary for his/her decision making, such as the structure of the game and the previous decisions made in the earlier stages in the same round.

[6] See Appendixes 3 and 4 for the translation of the experiment manual and the computer screen images into English.

4. Experimental Results: Mean Offers

Table 1 shows the *mean offers* for all pairs of the game and types.

[Table 1]

In game B, irrespective of the type, the mean offer was about 30%. In game PI, irrespective of the type, the mean offer was about 5% less than in game B; the investor/proposer tended to make a less-generous offer in game PI than in game B. The extent to which he/she made the offer less generous was irrelevant to the type, that is, the investment efficiency α. Hence, *in game PI, the proposer had a tendency on average to be motivated by the investor's privilege, but not by the libertarian doctrine in terms of monetary cost.*

In game RI, irrespective of the type, the mean offer was more generous than in game B. The extent to which he/she made the offer more generous varied according to the type, that is, the investment efficiency α; the less efficient the investment, the more generous the noninvestor's/proposer's offer. We can see this tendency also in Appendix 2. In game RI, irrespective of the type, the mean offer conditional on the positive investment $h \in \{10, 20, 30\}$ was more generous, and the extent to which this conditional mean offer was more generous was inversely proportional to the investment efficiency α. Hence, *in game RI, the proposer had a tendency on average to be motivated not only by the investor's privilege but also by the libertarian doctrine in terms of monetary cost.*

In game PRI, irrespective of the type, the mean offer was about 2% less than in game PI; the investor/proposer tended to make a less-generous offer in game PRI than in game PI. The extent to which he/she made the offer less generous was irrelevant to the type. We can see this tendency also in Appendix 2; the mean offer conditional on the positive investment in game PRI was less generous than in game PI at all times, except for the pair of type $(4, 0.35)$ and investment $h = 10$. Hence, *in game PRI, the proposer had a tendency on average to be motivated by the investor's enhanced privilege more than in game PI, but not to be motivated by the libertarian doctrine in terms of riskiness.*

In game RRI, the mean offer was about the *same* as in game RI when the type was either $(3, 0.75)$ or $(5, 0.5)$, that is, when the investment was not extremely risky. We can see this tendency also in Appendix 2; the mean offer conditional on the positive investment was almost the same as in game RI whenever the type was either $(3, 0.75)$ or $(5, 0.5)$. To sum up, *in game RRI, as long as the investment was not extremely risky, the proposer had a tendency on average not to act in consideration of the riskiness.*

The hypothetical explanation on this result could be as follows. It is implicit in game RRI to assume that the investor has no option to negotiate with the noninvestor about the way of sharing the investment cost h if the business opportunity fails to be discovered. In this case, the noninvestor's/proposer's more-generous offer can be regarded as his/her intention of sharing the investment cost h even if the business opportunity fails to be discovered. However, the subjects who play the role of the noninvestor/proposer might not really believe such an intention will last as he/she is not responsible for this failure, because the investment decision was the investor/responder's alone. Because of this reason, it is natural that *the noninvestor/proposer dislikes compensating the investor/responder for the damage that* *will occur if the business opportunity fails to be discovered*.

On the other hand, when the type is $(4, 0.35)$, that is, when the investment is extremely risky, the mean offer was *more* generous in game RRI than in game RI. We can see this tendency also in Appendix 2; the mean offer conditional on the positive investment was generally more generous in game RRI than in game RI when the type was $(4, 0.35)$. To sum up, *in game RRI, when the investment was extremely risky, the proposer had a tendency on average to act in consideration of the riskiness by taking a standpoint of either respecting the investor's enhanced privilege or the libertarian doctrine in terms of riskiness.*

5. Other Experimental Results

Table 2 shows the *mean acceptance rates*, that is, the frequency of the responder to accept the offer, for all pairs of the game and types.

[Table 2]

The mean acceptance rate is the lowest in game B among all the games, is higher in game PRI than in game PI, and is higher in game PPI than in game RI. These results hold irrespective of the type. Hence, *the introduction of the investment decision increases the mean acceptance rate, and the introduction of the riskiness further increases it*.

Table 3 shows the summary statistics for the mean acceptance rates *conditional on the offer*. We calculated the conditional mean acceptance rates by dividing the offers into 0%, and ranges 1% to 10%, 11% to 20%, 21% to 30%, 31% to 40%, 41% to 50%, 51% to 61%, and 61% to 100%.

[Table 3]

The conditional mean acceptance rate is generally higher in game PI than in game B, and is lower in game RI than in game B, irrespective of the type; the responder has a tendency on average to act in consideration of the difference in role between the investor and the noninvestor. The conditional mean acceptance rate is generally higher in game PRI than in game PI, irrespective of the type; the responder has a tendency on average to act in consideration of the riskiness.

When the type is $(4, 0.35)$, that is, the investment is extremely risky, the mean acceptance rates conditional on the ranges 11% to 20%, 21% to 30%, and 31% to 40% are lower in game RRI than in game RI; the responder has a tendency on average to act in consideration of the riskiness.

When the type is either $(3, 0.75)$ or $(5, 0.5)$, that is, the investment is not extremely risky, the mean acceptance rates conditional on the ranges 21% to 30% and 31% to 40% are even higher in game RRI than in game RI; neither the proposer nor the responder has a tendency on average to act in consideration of the riskiness.

To sum up, we can conclude that *in each game, the responder's behavioral pattern tends to be roughly based on the same criteria of social preference as the proposer's behavioral pattern.*

Table 4 shows the *mean investments* for all pairs of the game and types.

[Table 4]

The mean investment is higher in game PI than in game RI, irrespective of the type; the investor has a tendency on average to invest more when he/she is the proposer rather than the responder. The mean investment is higher in game PI than in game PRI, and is higher in game RI than in game RRI, irrespective of the type; the investor has a tendency on average to invest more if there is no riskiness rather than otherwise. In game PI and game RI, the mean investment is higher when the investment is more efficient. In game PRI and game RRI, the higher the mean investment is, the more efficient the investment is in expectation.

Table 5 shows the *mean payoffs* for the proposer and responder for all pairs of the game and types.

[Table 5]

Irrespective of whether the game is B, PI, or RI, the more efficient the investment is, the higher the proposer's mean payoff is. This property also holds for the responder's mean payoff. Irrespective of whether the game is PRI or RRI, the more efficient the investment is in expectation, the higher the proposer's mean payoff is. This property also holds for the responder's mean payoff.

In games B, PI, RI, and RRI, irrespective of the type, the proposer's mean payoff is greater than the responder's mean payoff. Contrary to these games, in game PRI for type $(4, 0.35)$, where the proposer is the investor and the riskiness is extremely severe, the investor's/proposer's mean payoff is even less than the responder's mean payoff.

In game RRI, irrespective of the type, the investor/responder's mean payoff is very small; for types $(3, 0.75)$ and $(4, 0.35)$, it is even smaller than the default payoff 30, though the investor/responder's loss from investment is somewhat made up for by the noninvestor's/proposer's making of a generous offer.

6. Selection of Investment Technology

Based on the experimental results of this paper, we demonstrate the following hypotheses on behavioral pattern:

(1) Irrespective of whether the investor is the proposer or the responder, the subjects are motivated by the investor's privilege.

(2) When the investor is the proposer, the subjects are not motivated by the libertarian doctrine in terms of monetary cost.

(3) When the investor is the responder, the subjects are motivated by the libertarian doctrine in terms of monetary cost.

(4) When the investor is the proposer, the consideration of the investor's privilege is enhanced by introducing the riskiness.

(5) When the investor is the responder and the investment is not extremely risky, the consideration of the investor's privilege is not enhanced by introducing the riskiness.

(6) When the investor is the proposer, the subjects are not motivated by the libertarian doctrine in terms of riskiness.

(7) When the investor is the responder and the investment is not extremely risky, the subjects are not motivated by the libertarian doctrine in terms of riskiness.

(8) When the investor is the responder and the investment is extremely risky, either the consideration of the investor's privilege is enhanced by introducing the riskiness, or the subjects are motivated by the libertarian doctrine in terms of riskiness.

When the investor is the proposer, it follows from hypotheses (2), (4), and (6) that the investor's/proposer's offer is independent of the degree of the investment efficiency, becomes less generous by introducing the riskiness, and is independent of the degree of the riskiness. Hence, we conclude that *the investor/proposer prefers selecting a risky investment technology given by* (α, p) *to its certainty equivalent, a no-risk investment technology given by* (α', p') *where* $\alpha' = \alpha p$ *and* $p' = 1$, if he/she is permitted to select any investment technology beforehand.

On the other hand, when the investor is the responder and the investment is not extremely risky, it follows from hypotheses (3), (5), and (7) that the noninvestor's/proposer's offer is decreasing in investment efficiency, and that it is independent of the element of riskiness. Hence, we conclude that in contrast with the investor/proposer, *the investor/responder prefers a no-risk investment technology to any risky investment technology, and he/she will seriously consider the enhancing of investment efficiency only if an extremely risky investment technology is made available.*

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Table 1: Mean Offers

	(3, 0.75)	(5, 0.5)	(4, 0.35)
B	**0.310**	**0.294**	**0.299**
PI	**0.251**	**0.255**	**0.259**
RI	**0.421**	**0.343**	**0.379**
PRI	**0.228**	**0.234**	**0.225**
RRI	**0.419**	**0.349**	**0.435**

Table 2: Acceptance Rates

	(3, 0.75)	(5, 0.5)	(4, 0.35)
B	**0.733**	**0.807**	**0.789**
PI	**0.849**	**0.864**	**0.849**
RI	**0.812**	**0.838**	**0.856**
PRI	**0.887**	**0.942**	**0.879**
RRI	**0.833**	**0.868**	**0.874**

Table 3 (1): Acceptance Rates Conditional on Offer (Game B)

Game B: Type (3, 0.75)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.016	0.053	0.207	0.200	0.233	0.253	0.011	0.027
Acceptance Rate	0.111	0.207	0.447	0.764	0.828	0.964	1.000	1.000

Game B: Type (5, 0.5)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.021	0.114	0.182	0.118	0.357	0.200	0.007	0.000
Acceptance Rate	0.167	0.375	0.686	0.879	0.910	1.000	1.000	

Game B: Type (4, 0.35)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.010	0.094	0.188	0.227	0.216	0.232	0.031	0.003
Acceptance Rate	0.250	0.472	0.639	0.782	0.904	0.933	1.000	1.000

Table 3 (2): Acceptance Rates Conditional on Offer (Game PI)

Game PI: Type (3, 0.75)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.030	0.012	0.258	0.389	0.250	0.034	0.005	0.021
Acceptance Rate	0.391	0.111	0.694	0.892	0.995	1.000	1.000	1.000

Game PI: Type (5, 0.5)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.003	0.069	0.407	0.189	0.315	0.013	0.005	0.000
Acceptance Rate	0.000	0.519	0.862	0.851	0.951	1.000	1.000	

Game PI: Type (4, 0.35)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.012	0.064	0.223	0.409	0.240	0.040	0.002	0.010
Acceptance Rate	0.000	0.595	0.711	0.885	0.993	1.000	1.000	1.000

Table 3 (3): Acceptance Rates Conditional on Offer (Game RI)

Game RI: Type (3, 0.75)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.020	0.012	0.071	0.073	0.268	0.325	0.090	0.141
Acceptance Rate	0.071	0.125	0.429	0.520	0.777	0.942	0.952	1.000

Game RI: Type (5, 0.5)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.010	0.039	0.191	0.172	0.295	0.198	0.091	0.003
Acceptance Rate	0.000	0.333	0.712	0.848	0.912	0.921	0.971	1.000

Game RI: Type (4, 0.35)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.011	0.020	0.069	0.236	0.198	0.336	0.047	0.082
Acceptance Rate	0.167	0.182	0.684	0.715	0.908	0.968	1.000	1.000

Table 3 (4): Acceptance Rates Conditional on Offer (Game PRI)

Game PRI: Type (3, 0.75)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.007	0.019	0.356	0.439	0.158	0.014	0.001	0.006
Acceptance Rate	0.000	0.467	0.790	0.952	1.000	1.000	1.000	1.000

Game PRI: Type (5, 0.5)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.003	0.071	0.495	0.210	0.207	0.006	0.006	0.000
Acceptance Rate	0.000	0.636	0.954	0.969	1.000	1.000	1.000	

Game PRI: Type (4, 0.35)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	0.012	0.097	0.324	0.410	0.118	0.027	0.003	0.009
Acceptance Rate	0.500	0.636	0.827	0.942	1.000	1.000	1.000	1.000

Table 3 (5): Acceptance Rates Conditional on Offer (Game RRI)

Game RRI: Type (3, 0.75)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	**0.009**	**0.004**	**0.079**	**0.101**	**0.285**	**0.323**	**0.054**	**0.144**
Acceptance Rate	**0.000**	**0.000**	**0.429**	**0.667**	**0.816**	**0.930**	**1.000**	**1.000**

Game RRI: Type (5, 0.5)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	**0.012**	**0.016**	**0.159**	**0.205**	**0.395**	**0.151**	**0.047**	**0.016**
Acceptance Rate	**0.000**	**0.250**	**0.537**	**0.868**	**0.980**	**1.000**	**1.000**	**1.000**

Game RRI: Type (4, 0.35)

Offer	0	0 - 0.1	0.11 - 0.2	0.21 - 0.3	0.31 - 0.4	0.41 - 0.5	0.51 - 0.6	0.61 - 1
Offer Frequency	**0.000**	**0.025**	**0.035**	**0.217**	**0.167**	**0.359**	**0.020**	**0.177**
Acceptance Rate		**0.400**	**0.571**	**0.674**	**0.848**	**1.000**	**1.000**	**1.000**

Table 4: Mean Investments

	(3, 0.75)	(5, 0.5)	(4, 0.35)
PI	**27.9**	**29.5**	**29.0**
RI	**21.6**	**26.4**	**24.4**
PRI	**25.2**	**26.3**	**14.9**
RRI	**14.6**	**17.5**	**8.9**

Table 5: Mean Payoffs

		(3, 0.75)	(5, 0.5)	(4, 0.35)
B	**Proposer**	**72.3**	**111.1**	**93.8**
	Responder	**53.7**	**70.0**	**60.9**
PI	**Investor/Proposer**	**54.2**	**94.3**	**72.4**
	Noninvestor/Responder	**49.1**	**63.8**	**57.1**
RI	**Noninvestor/Proposer**	**58.5**	**100.4**	**79.5**
	Investor/Responder	**32.6**	**43.9**	**39.3**
PRI	**Investor/Proposer**	**44.3**	**59.4**	**32.1**
	Noninvestor/Responder	**42.2**	**47.2**	**34.9**
RRI	**Noninvestor/Proposer**	**44.6**	**59.5**	**35.7**
	Investor/Responder	**27.3**	**30.1**	**26.0**

Appendix 1:
Features of Experimental Design

Type	Date	Turn of Games (Round Number)	Number of Subjects	Yen per Point
(3, 0.75)	October 25, 2006	B (10), PI (14), RI (14), PRI (20), RRI (20)	26	0.8
(3, 0.75)	October 25, 2006	B (10), PI (14), RI (14), PRI (20), RRI (20)	28	0.8
(3, 0.75)	October 26, 2006	B (10), RI (14), PI (14), RRI (20), PRI (20)	28	0.8
(3, 0.75)	October 26, 2006	B (10), RI (14), PI (14), RRI (20), PRI (20)	28	0.8
(5, 0.5)	January 18, 2007	B (10), PI (14), RI (14), PRI (20), RRI (20)	28	0.7
(5, 0.5)	January 18, 2007	B (10), RI (14), PI (14), RRI (20), PRI (20)	28	0.7
(4, 0.35)	March 15, 2007	B (8), PI (12), RI (12), PRI (24), RRI (24)	22	0.9
(4, 0.35)	March 15, 2007	B (8), PI (12), RI (12), PRI (24), RRI (24)	26	0.9
(4, 0.35)	March 16, 2007	B (8), RI (12), PI (12), RRI (24), PRI (24)	22	0.9
(4, 0.35)	March 16, 2007	B (8), RI (12), PI (12), RRI (24), PRI (24)	26	0.9

Appendix 2 (1): Mean Offers and Acceptance Rates Conditional on Investment (Game PI)

Game PI: Type (3, 0.75)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.013	-	-	-
10	0.036	1.000	0.275	0.786
20	0.101	1.000	0.258	0.821
30	0.849	1.000	0.249	0.855

Game PI: Type (5, 0.5)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.003	-	-	-
10	0.018	1.000	0.286	0.714
20	0.010	1.000	0.325	1.000
30	0.969	1.000	0.254	0.866

Game PI: Type (4, 0.35)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.002	-	-	-
10	0.010	1.000	0.188	0.667
20	0.076	1.000	0.264	0.864
30	0.911	1.000	0.259	0.850

Appendix 2 (2):
Mean Offers and Acceptance Rates Conditional on Investment
(Game RI)

Game RI: Type (3, 0.75)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.108	-	-	-
10	0.147	1.000	0.434	0.832
20	0.223	1.000	0.421	0.779
30	0.522	1.000	0.417	0.821

Game RI: Type (5, 0.5)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.023	-	-	-
10	0.069	1.000	0.367	0.852
20	0.153	1.000	0.309	0.817
30	0.755	1.000	0.347	0.841

Game RI: Type (4, 0.35)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.045	-	-	-
10	0.090	1.000	0.368	0.827
20	0.248	1.000	0.383	0.909
30	0.616	1.000	0.379	0.839

Appendix 2 (3):
Mean Offers and Acceptance Rates Conditional on Investment
(Game PRI)

Game PRI: Type (3, 0.75)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.045	-	-	-
10	0.100	0.664	0.263	0.904
20	0.142	0.763	0.235	0.908
30	0.714	0.780	0.223	0.881

Game PRI: Type (5, 0.5)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.077	-	-	-
10	0.070	0.564	0.264	0.955
20	0.071	0.575	0.248	0.957
30	0.782	0.603	0.231	0.939

Game PRI: Type (4, 0.35)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.323	-	-	-
10	0.207	0.456	0.270	0.927
20	0.129	0.463	0.226	0.899
30	0.340	0.411	0.194	0.839

Appendix 2 (4):
Mean Offers and Acceptance Rates Conditional on Investment
(Game RRI)

Game RRI: Type (3, 0.75)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.323	-	-	-
10	0.174	0.660	0.411	0.810
20	0.226	0.735	0.423	0.858
30	0.277	0.734	0.419	0.826

Game RRI: Type (5, 0.5)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.263	-	-	-
10	0.180	0.634	0.353	0.875
20	0.125	0.586	0.357	0.854
30	0.432	0.632	0.345	0.869

Game RRI: Type (4, 0.35)

Investment	Investment Frequency	Success Frequency	Mean Offer	Acceptance Rate
0	0.500	-	-	-
10	0.246	0.339	0.447	0.896
20	0.118	0.346	0.428	0.872
30	0.136	0.350	0.418	0.836

Appendix 3:
Experiment Manual
(October 25–26, 2006, Translation from Japanese into English)

Thank you very much for participating in the experiments today. Please check the contents of the envelope and the items that have been distributed. The list of distributed items consists of:

1. Ballpoint pen - 1
2. Experiment manual - 1 copy
3. Booklet with printed computer screen images - 1 copy
4. Bank remittance form - 1 sheet
5. Memo paper - 1 sheet

If any of the distributed items are missing, please quietly raise your hand. The distributed items will be collected after the experiments, except for the memo paper, which you can take with you.

Please look at the experiment manual. You will be asked to make selections on a computer terminal and depending on the results, you will be awarded “points.” These points will be converted into funds at an exchange rate of 0.8 yen per point, which will be paid to you as compensation, in addition to the participation fee of 1,500 yen. Therefore, the amount of money you will receive from these experiments will be:

Total number of points awarded × 0.8 yen + participation fee of 1,500 yen

Please do not speak to or exchange signals with anyone during the experiments, or you may be asked to leave. Furthermore, you will not be allowed to leave during the experiments, except under unavoidable circumstances. Please turn off your cell phones during the experiments. Also, do not perform any operation on the computer unless it is in the experiment manual or you have been instructed to do so. If you have any questions, please quietly raise your hand and the administrative staff will respond to you.

Summary of experiments

We will conduct 5 experiments today, which are all independent from each other and the results of one experiment will not have any impact on the others. You will be asked to make the selections described below multiple times, during each experiment. We shall refer to these frequencies as “Round 1,” “Round 2,” “Round 3,” and so forth. Points will be determined for each of these rounds.

You will be assigned the role of either "Player 1" or "Player 2" and an equal number of people will be divided into either of these roles. "Player 1" and "Player 2" will be paired up to make decisions. People will be paired up randomly by the computer and these pairs will be changed for each round. All your interactions during the experiments will be conducted through the computer terminals and will be recorded.

Those who have any questions, please quietly raise your hand.

Experiment 1

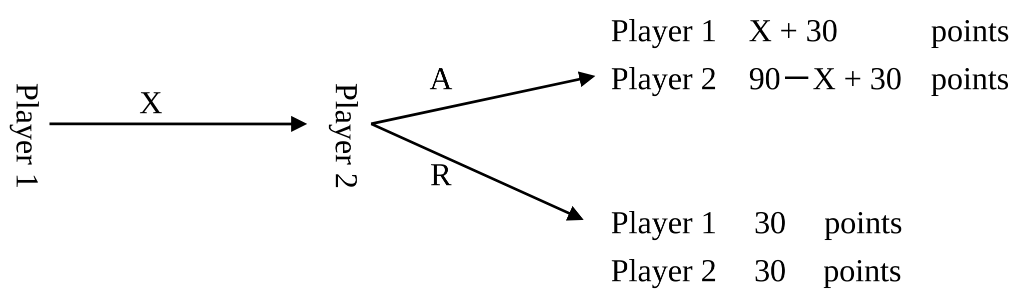
Experiment 1 comprises 10 Rounds and each Round will proceed in the following manner: Player 1 selects an integer, Integer X, from integers 0 to 90. Player 2 observes Integer X, then selects either A or R. When A is selected:

Player 1 is awarded	**X + 30**	points.
Player 2 is awarded	**90 – X + 30**	points.

When R is selected:

Both players are awarded	**30**	points.

Please consider that you are facing the following situation: Both "Player 1" and "Player 2" already have 30 points each. Furthermore, there is a joint project, which if executed, may entitle you to a total of 90 additional points. Player 1 indicates Proposal X to Player 2, which provides X points to Player 1 and the remaining 90 – X points to Player 2. Player 2 either accepts Proposal X (A) or rejects (R) it. If the proposal is accepted (A), the joint project will be executed and the 90 points will be distributed as indicated by the Proposal X; if rejected (R), the joint project will not be executed and the 90 points will not be added. Look at the following diagram to verify how the points are awarded.



As soon as the experiment starts, you will be assigned the role of either Player 1 or Player 2, and you will remain in that role to make decisions until the first 5 rounds have been completed. Then the players will switch roles and the person who was Player 1 becomes Player 2, and vice versa, and the decision making proceeds with these switched roles for the next 5 rounds. Please note that the partner you are paired up with will be selected randomly and change for each round.

Those who have any questions, please quietly raise your hand.

Description of screen displays and operations for computers

Please look at the booklet with printed computer screen images.

Please look at Screen 1, which shows whether you are to be Player 1 or Player 2 at the beginning of Round 1. In this example, it shows that you are Player 1. After 3 seconds, the display automatically moves onto the next screen.

Please look at Screen 2 where Player 1 selects a number for X, which is displayed on the upper left section of the screen. In this example, it shows that a decision is currently being made for Round 2. An archive of the previous rounds, including the value of X that Player 1 selected and the A or R selection chosen by Player 2, is displayed on the left side of the screen. In this example, 50 for X and A has been chosen. The lower right section of the screen is the location for decision-making operations. Enter Integer X inside the frame of the box for an entry using single-byte numbers and click the **OK** button. The amount of time allowed for making a decision is 18 seconds, so please make your entry before the remaining time displayed at the upper right section of the screen becomes 0. While Player 1 is making a decision, a standby screen is displayed for Player 2.

Please look at Screen 3, where Player 2 can select either A or R. The number of the round is displayed on the upper left section of the screen, an archive of previous rounds is displayed on the left side of the screen, and the value of X selected by Player 1 for the current Round is shown on the right side of the screen. In this example, the value 65 has been selected for X. Click to select either A or R, and then the **OK** button at the lower right section within the stipulated time of 18 seconds. While Player 2 is making a decision, a standby screen is displayed for Player 1.

Please look at Screen 4 where the points awarded to you from this round are displayed. In this example, the screen indicates that you are Player 2 and your partner, Player 1, has selected the value 65 for X and you have chosen A. Therefore, you are awarded 90 – X + 30 = 90 – 65 + 30 = 55 points, while your partner is awarded X + 30 = 65 + 30 = 95 points. After 5 seconds, the display automatically moves onto the next round and the roles of the players are reassigned.

Please look at Screen 5, which shows the switched roles. Player 1 now becomes Player 2 and vice versa. In this example, it shows that your role was previously that of Player 1, but it has now switched to Player 2. After 3 seconds, the display automatically moves onto the next screen.

Those who have any questions, please quietly raise your hand.

Experiment 2

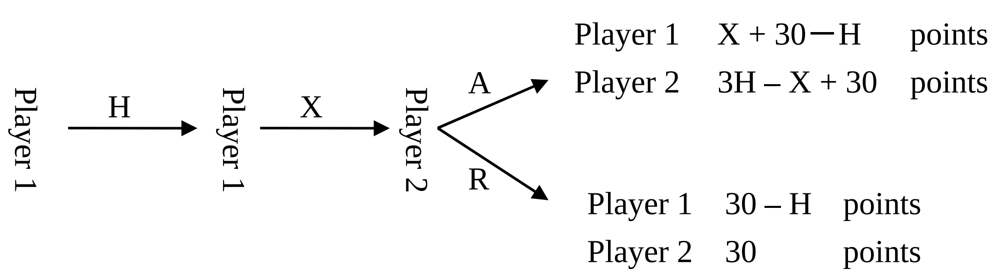
Experiment 2 comprises of 14 Rounds, and each Round will proceed in the following manner: Player 1 selects an integer, Integer H, from among 4 available integers 0, 10, 20, and 30. Player 1 then selects an integer, Integer X, from integers 0 to 3H. Player 2 observes Integer X, then selects either A or R. When A is selected:

Player 1 is awarded	**X + 30 – H**	points.
Player 2 is awarded	**3H – X + 30**	points.

When R is selected:

Player 1 is awarded	**30 – H**	points.
Player 2 is awarded	**30**	points.

Please consider that you are facing the following situation: Both “Player 1” and “Player 2” already have 30 points each. Player 1 will discover that there is a joint project and if executed with an investment of H points, there is a prospect of gaining a total of 3H points. Player 1 indicates Proposal X to Player 2 for the distribution of the 3H points, which provides X points to Player 1 and the remaining 3H –X points to Player 2. Player 2 either accepts Proposal X (A) or rejects (R) it. If the proposal is accepted (A), the joint project will be executed and the 3H points will be distributed as indicated by Proposal X; if rejected (R), the joint project will not be executed and the 3H points will not be added. Look at the following diagram to verify how the points are awarded. The investment of H points is deducted from the points awarded to Player 1, regardless of whether or not the joint project is executed.



As soon as the experiment starts, you will be assigned the role of either Player 1 or Player 2, and you will remain in that role to make decisions until the first 7 rounds have been completed. Then the players will switch roles and the person who was Player 1 becomes Player 2, and vice versa. The players proceed with decision making in these switched roles for the next 7 rounds. Please note that the partner you are paired up with will be selected randomly and change for each round.

Those who have any questions, please quietly raise your hand.

Description of screen displays and operations for computers

Please look at the booklet with printed computer screen images.

Please look at Screen 6 where Player 1 selects a number for H. The lower right section of the screen is the location for decision-making operations. Click to select one integer from among 0, 10, 20, and 30, and then the **OK** button within the stipulated time of 18 seconds.

Please look at Screen 7 where Player 1 selects a number for X. The value of H selected by Player 1 for the current Round is shown on the right side of the screen. In this example, the value selected for H is 20; therefore, the additional points for the joint project are 3H = 60 points. Enter Integer X inside the frame of the box for entries using single-byte numbers between 0 and 60 and click **OK** within the stipulated time of 18 seconds.

Please look at Screen 8 where Player 2 selects either A or R. Values of H and X selected by Player 1 for the current Round are shown on the right side of the screen. In this example, H is 20 and X is 45; therefore, if A is selected, Player 1 will be awarded X + 30 – H = 45 + 30 – 20 = 55 points, while Player 2 will be awarded 3H – X + 30 = 60 – 45 + 30 = 45 points. Click to select either A or R and then click **OK** within the stipulated time of 18 seconds.

The points awarded to you for the Round are displayed on a screen similar to Screen 4 for 5 seconds before the screen moves onto the next Round.

Those who have any questions, please quietly raise your hand.

Experiment 3

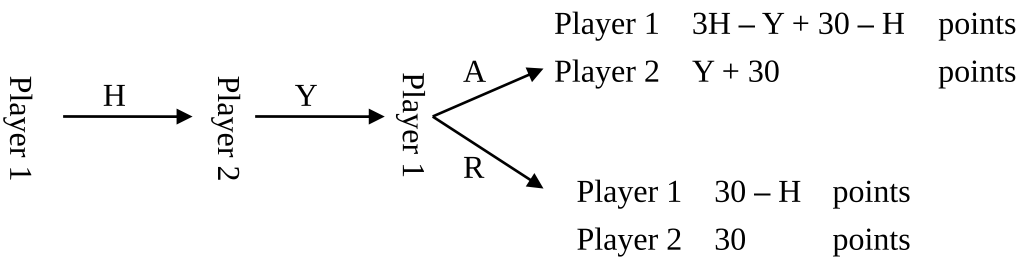
Experiment 3 comprises 14 Rounds and each Round will proceed in the following manner: Player 1 selects an integer, Integer H, from among 4 available integers 0, 10, 20, and 30. Next, Player 2 selects an integer, Integer Y, from integers 0 to 3H. Player 1 observes Integer Y, then selects either A or R. When A is selected:

Player 1 is awarded	**3H – Y + 30 – H**	points.
Player 2 is awarded	**Y + 30**	points.

When R is selected:

Player 1 is awarded	**30 – H**	points.
Player 2 is awarded	**30**	points.

Please consider that you are facing the following situation: Both "Player 1" and "Player 2" already have 30 points each. Player 1 will discover that there is a joint project and if executed with an investment of H points, there is a prospect of gaining a total of 3H points. Player 2 indicates Proposal Y for the distribution of the 3H points, which provides Y points to Player 2 and the remaining 3H – Y points to Player 1. Note that it is not Player 1 who spent the awarded points for H points, but Player 2 who makes the proposal. Player 1 either accepts Proposal Y (A) or rejects (R) it. If the proposal is accepted (A), the joint project will be executed and the points will be distributed as indicated by Proposal Y. If the proposal is rejected (R), the joint project will not be executed. Look at the following diagram to verify how the points are awarded. The investment of H points is deducted from the points awarded to Player 1, regardless of whether or not the joint project is executed.



As soon as the experiment starts, you will be assigned the role of either Player 1 or Player 2, and you will remain in that role to make decisions until the first 7 rounds have been completed. Then the players will switch roles and the person who was Player 1 becomes Player 2, and vice versa. The players proceed with decision making in these switched roles for the next 7 rounds. Please note that the partner you are paired up with will be selected randomly and change in each round.

Those who have any questions, please quietly raise your hand.

Experiment 4

Experiment 4 comprises 20 Rounds and each Round will proceed in the following manner. Player 1 selects an integer, Integer H, from among 4 available integers 0, 10, 20, and 30. Once Integer H has been selected, this round immediately finishes with a probability of 25%, then:

Player 1 is awarded	**30 – H**	points.
Player 2 is awarded	**30**	points.

The round continues with the remaining 75% of the probability. Player 1 selects an integer, Integer X, from integers 0 to 3H. Player 2 observes Integer X, and then selects either A or R. When A is selected:

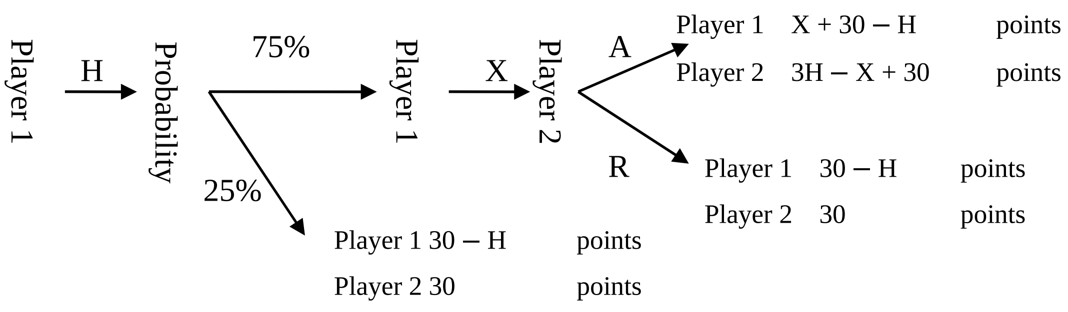
Player 1 is awarded	**X + 30 – H**	points.
Player 2 is awarded	**3H – X + 30**	points.

When R is selected:

Player 1 is awarded	**30 – H**	points.
Player 2 is awarded	**30**	points.

Please consider that you are facing the following situation: Both “Player 1” and “Player 2” already have 30 points each. Player 1 discovers with a probability of 75% that there is a joint project, and if executed with an investment of H points, there is a prospect of gaining a total of 3H points. Player 1 then indicates Proposal X to Player 2 for the distribution of these 3H points, which provides X points to Player 1 and the remaining points of 3H – X to Player 2. Player 2 either accepts Proposal X (A) or rejects (R) it. If the proposal is accepted (A), the joint project will be executed and the 3H points will be distributed as indicated by Proposal X; if rejected (R), the joint project will not be executed and the 3H points will not be added.

There is a 25% probability that Player 1 will not be able to find the joint project, even if an investment of H points is made. Whether the joint project can be found or not is determined by probability, with each Round being independent from the others. Look at the following diagram to verify how the points are awarded. The investment of H points is deducted from the points awarded to Player 1, regardless of whether or not the joint project is discovered and executed.



As soon as the experiment starts, you will be assigned the role of either Player 1 or Player 2, and you will remain in that role to make decisions until the first 10 rounds have been completed. Then the players will switch roles and the person who was Player 1 becomes Player 2, and vice versa, proceeding with decision making in these switched roles for the next 10 rounds. Please note that the partner you are paired up with will be selected randomly and change for each round.

Those who have any questions, please quietly raise your hand.

Descriptions of screen displays and operations for computers

Please look at the booklet with computer screen images printed.

Please look at Screen 9 where Player 1 selects a number for H. Click to select one integer from among 0, 10, 20, and 30 in the section at the lower right section of the screen where decision-making operations are performed, then click the **OK** button within the stipulated time of 18 seconds. Once Integer H has been selected, this Round finishes with a probability of 25% and continues with a probability of 75%.

Please look at Screen 10 to verify if the Round is finished or will be continued. In this example, it shows that the Round will continue. After 3 seconds, the display automatically moves onto the next screen.

Please look at Screen 11 where Player 1 selects a number for X. Look at the archive of past rounds displayed on the left side of the screen, which indicates if each Round was immediately finished or continued after the value for H was selected. The value of H selected by Player 1 for the current Round is shown on the right side of the screen. In this example, the value selected for H is 20; therefore, the additional points for the joint project are 3H = 60 points. Enter Integer X inside the frame of the box for entries using single-byte numbers between 0 and 60 and then click the **OK** button in the lower right section within the stipulated 18 seconds.

Please look at Screen 12 where Player 2 selects either A or R. The value of H and X selected by Player 1 for the current Round are shown on the right side of the screen. In this example, H is 20 and X is 45, and it shows that if A is selected, Player 1 will be awarded X + 30 – H = 45 + 30 – 20 = 55 points, while Player 2 will be awarded 3H – X + 30 = 60 – 45 + 30 = 45 points. Click to select either A or R, then click **OK** within the stipulated 18 seconds.

The points awarded to you for the Round are displayed on a screen similar to that of Screen 4. If Screen 10 displays immediately after the value of H is selected, then it indicates that the Round has finished; Screens 11 and 12 will not be displayed after Screen 10 and after 5 seconds, the display automatically moves onto the next Round.

Those who have any questions, please quietly raise your hand.

Experiment 5

Experiment 5 comprises 20 Rounds and each Round will proceed in the following manner.

Player 1 selects an integer, Integer H, from among 4 available integers 0, 10, 20, and 30. Once Integer H has been selected this Round immediately finishes with a probability of 25%, then:

Player 1 is awarded	**30 – H**	points.
Player 2 is awarded	**30**	points.

When the Round continues in the remaining 75% of the probability, Player 2 selects an integer, Integer Y, from integers 0 to 3H. Player 1 observes Integer Y, then selects either A or R. When A is selected:

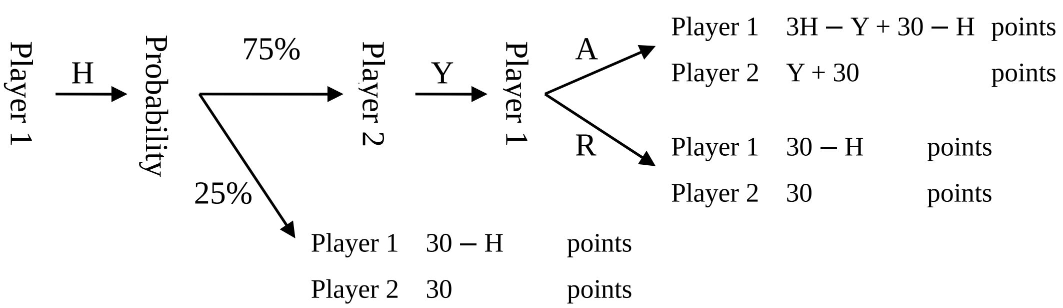
Player 1 is awarded	**3H – Y + 30 – H**	points.
Player 2 is awarded	**Y + 30**	points.

When R is selected:

Player 1 is awarded	**30 - H**	points.
Player 2 is awarded	**30**	points.

Please consider that you are facing the following situation. Both "Player 1" and "Player 2" already have 30 points each. Player 1 discovers with a probability of 75% that there is a joint project and if executed with an investment of H points, there is a prospect of gaining a total of 3H points. Player 2 discovers this and indicates Proposal Y for the distribution of 3H points, which provides Y points to Player 2 and the remaining points of 3H –Y to Player 1. It is not Player 1 who spent the awarded points for H points, but Player 2 who makes the proposal. Player 1 either accepts Proposal Y (A) or rejects (R) it. If the proposal is accepted (A), the joint project will be executed and the 3H points will be distributed as indicated by Proposal Y; if rejected (R), the joint project will not be executed and the 3H points will not be added.

On the other hand, there is a 25% probability that Player 1 will not be able to find the joint project, even if an investment of H points is made. Whether the joint project can be found or not is determined by probability, with each Round being independent from the others. Look at the following diagram to verify how the points are awarded. The investment of H points is deducted from the points awarded to Player 1, regardless of whether or not the joint project is discovered and executed.



As soon as the experiment starts you will be assigned the role of either Player 1 or Player 2 and will remain in that role to make decisions until the first 10 rounds have been completed. Then the players switch roles and the person who was Player 1 becomes Player 2, and vice versa, with the players proceeding with decision making in these switched roles for the next 10 rounds. Please note that the partner you are paired up with will be selected randomly and change for each round.

Those who have any questions, please quietly raise your hand.

At this time, all of the experiments have been completed and all the points awarded to everyone are recorded on the computer.

Please enter your details on a survey form that will now be distributed.

Furthermore, please take out the bank remittance form from the envelope and enter the details accurately. Please note that unless all the necessary details are provided, we will not be able to pay you for your awarded amounts.

Those who have any questions, please quietly raise your hand.

Please verify that all your details are provided on the survey form and on the bank remittance form.

Those who have any questions, please quietly raise your hand.

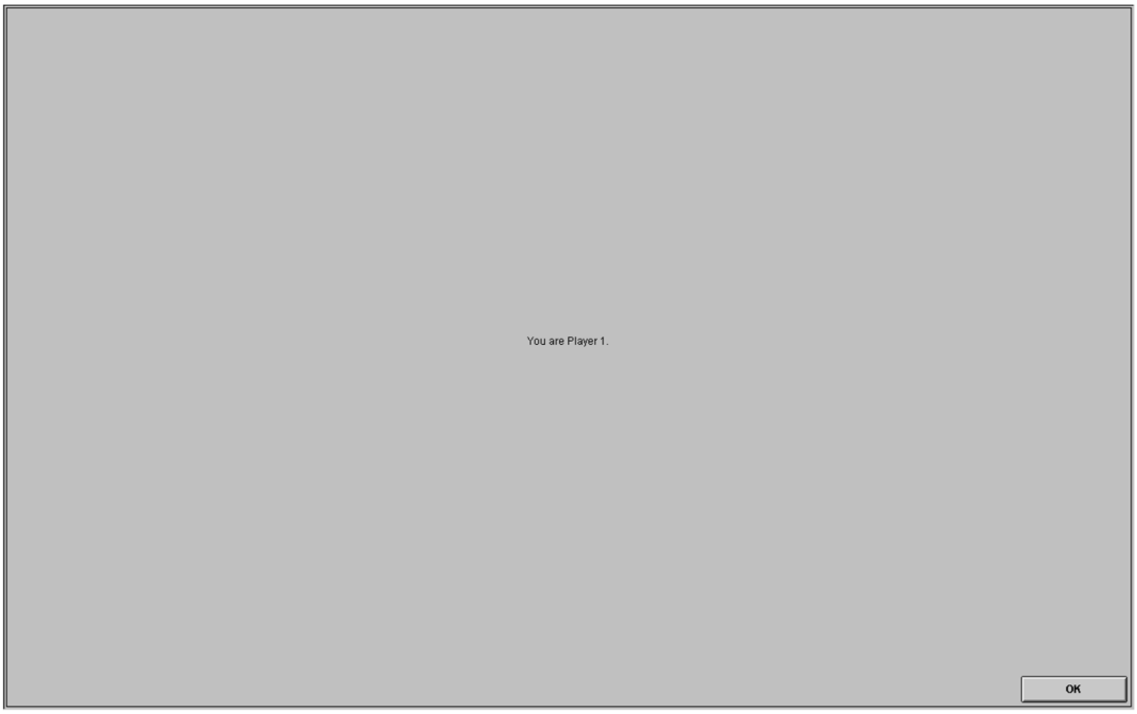
Please place all the documents inside the envelope. You are welcome to take the memo paper with you. Please leave the ball-pointed pen and ink pad on the desk. Also make sure you take all your belongings with you when you leave.

Please do not to talk about or divulge any details regarding today’s experiments to anyone until Saturday. Thank you very much for your participation. We will now ask you to leave in an orderly manner.

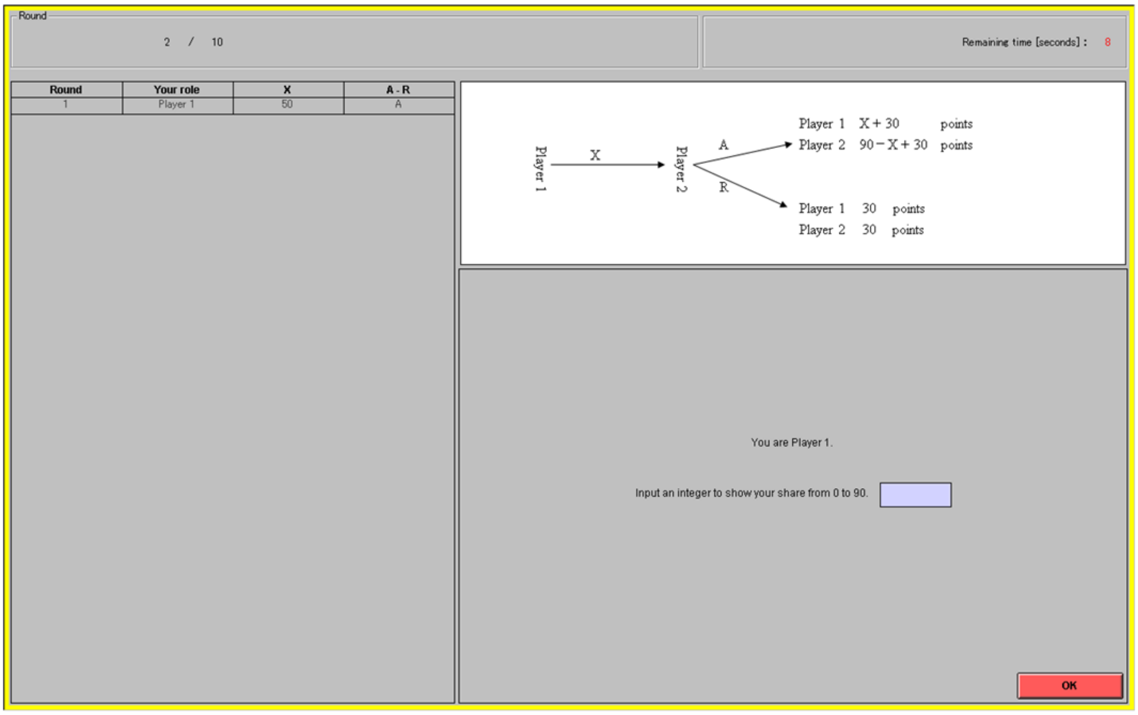
First, the people in the two rows along the corridor side of the room please leave the room and then the people in the two rows in the middle of the room. Finally, the people in the two rows on the window side of the room please leave the room.

Appendix 4:
Computer Screen Images
(October 25–26, 2006, Translation from Japanese into English)

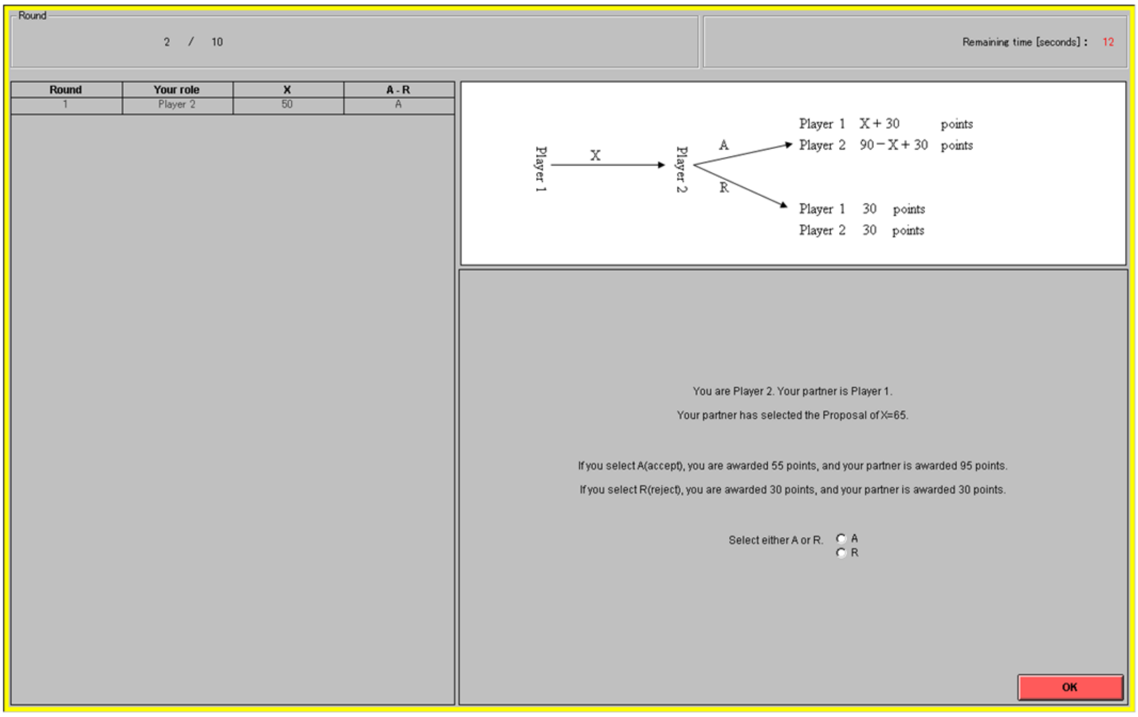
Screen 1



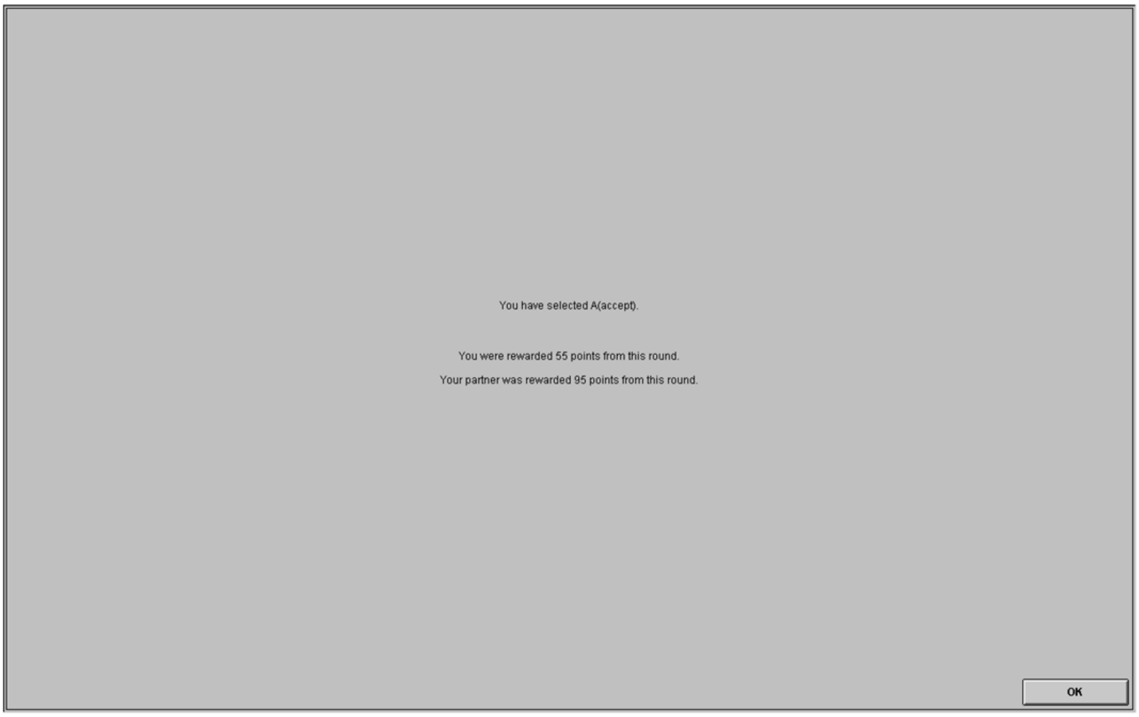
Screen 2



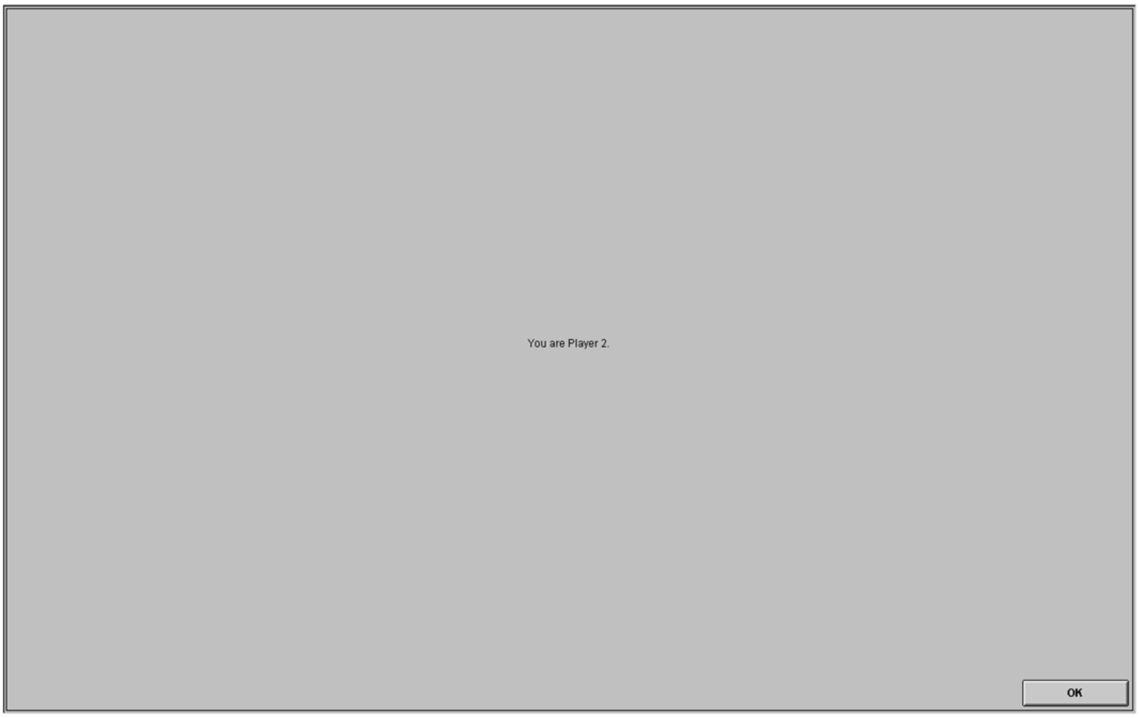
Screen 3



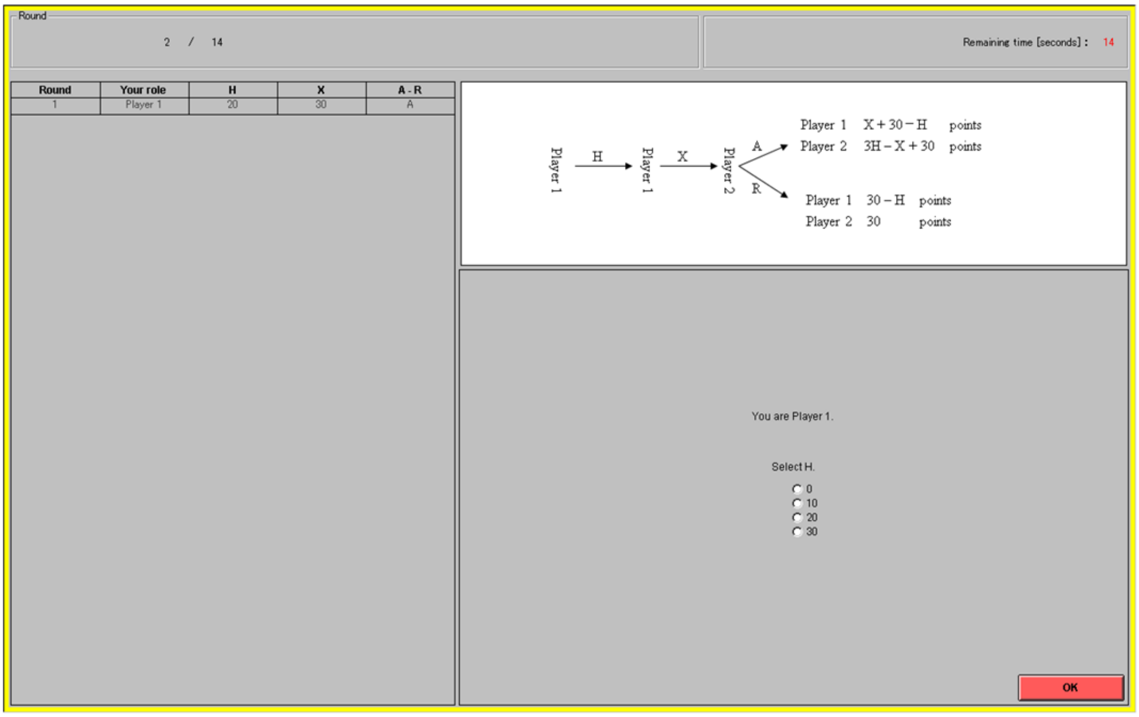
Screen 4



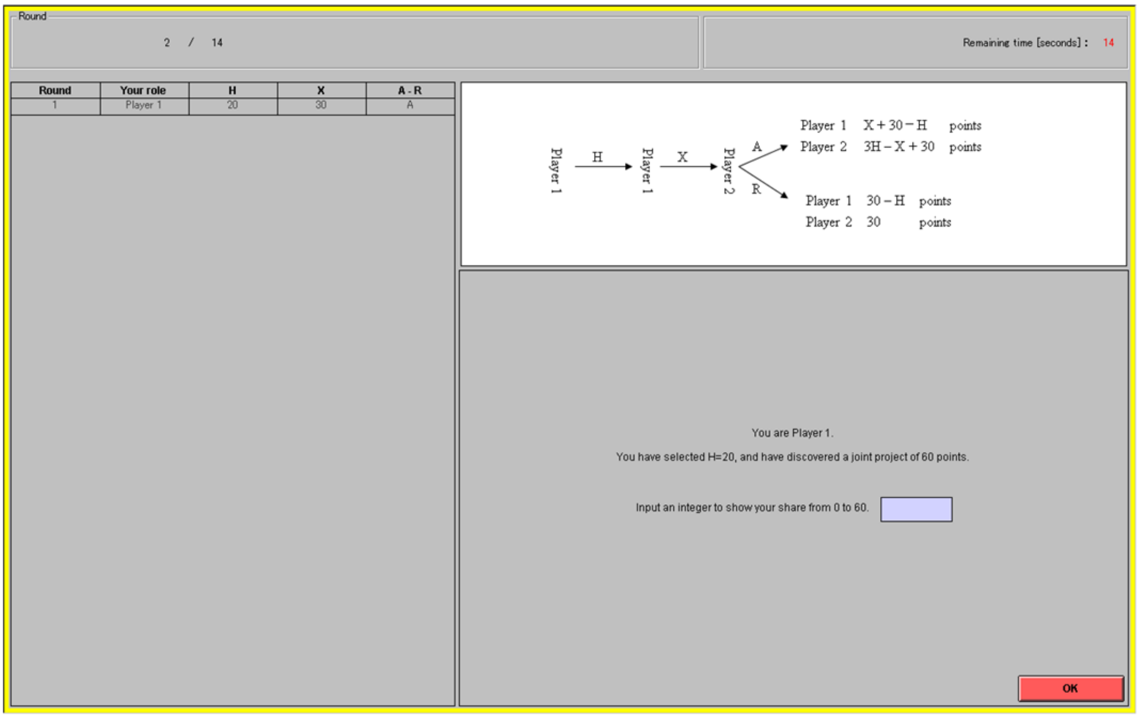
Screen 5



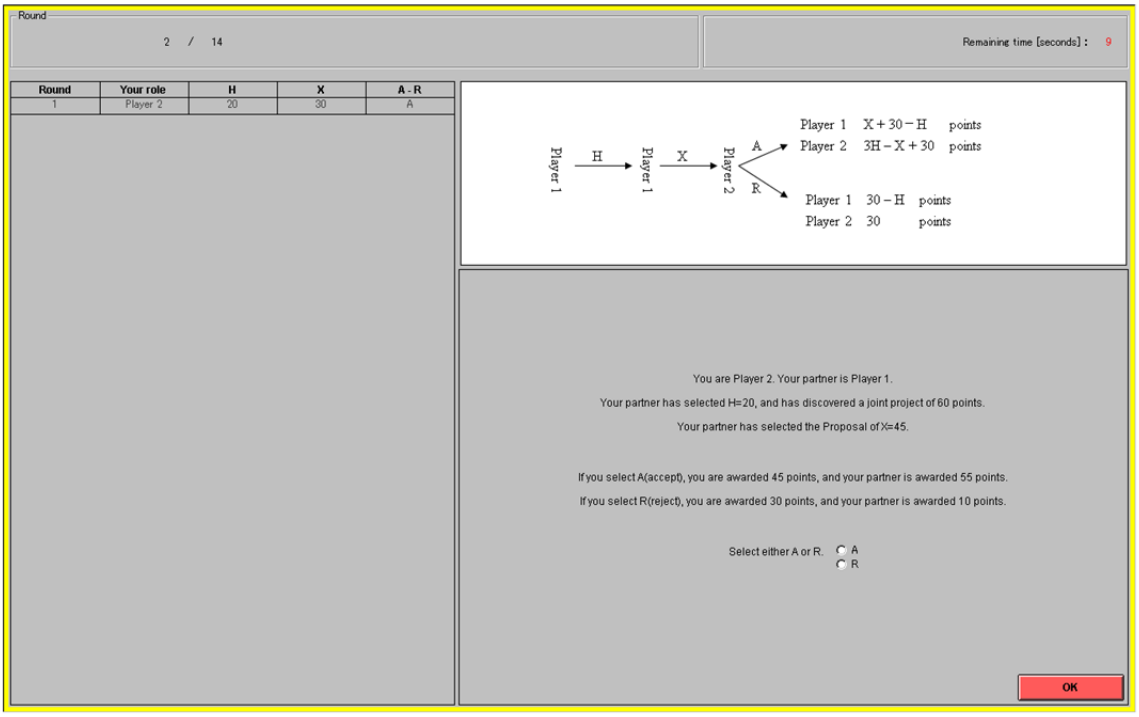
Screen 6



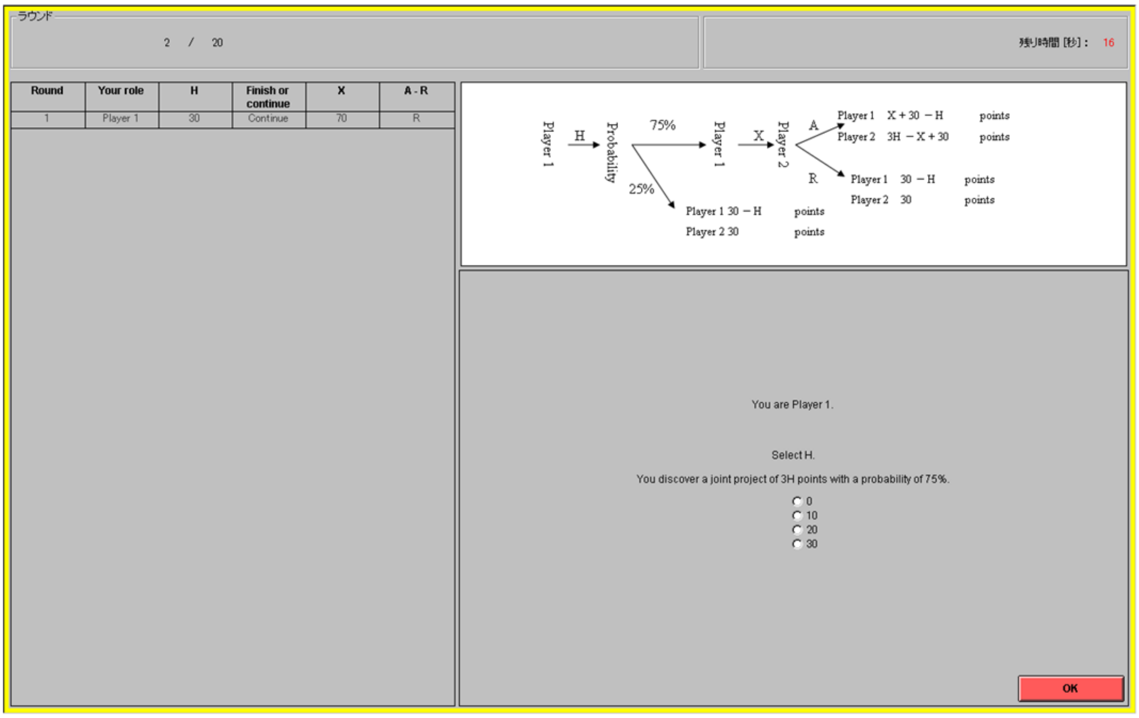
Screen 7



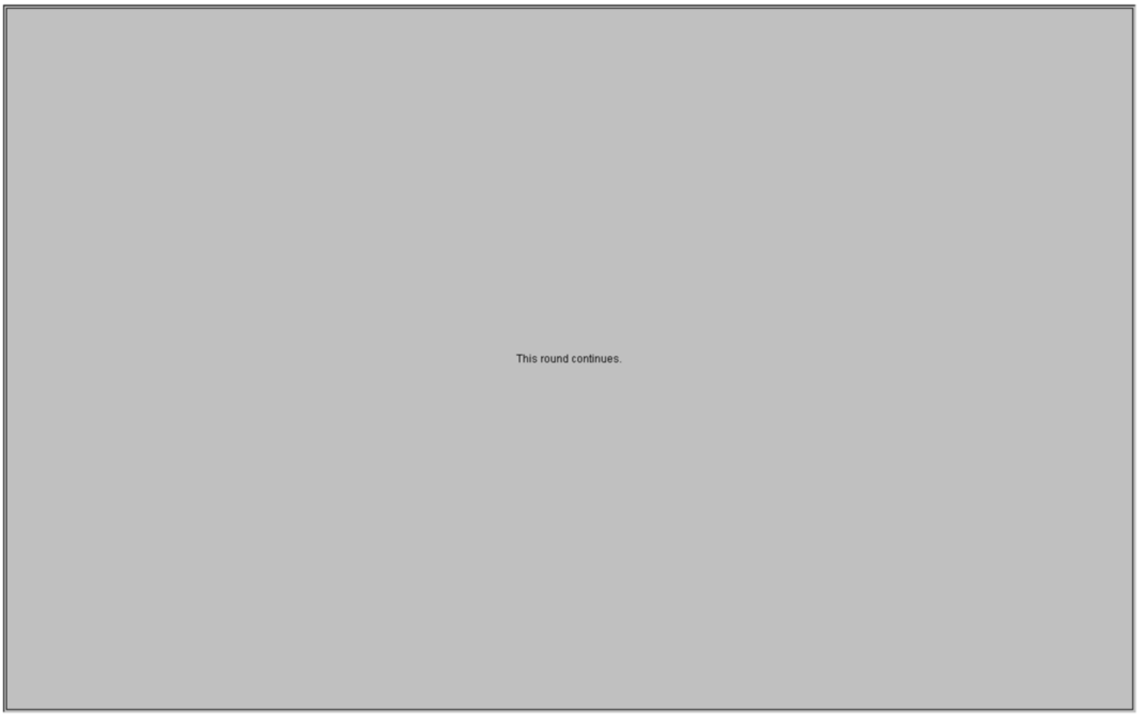
Screen 8



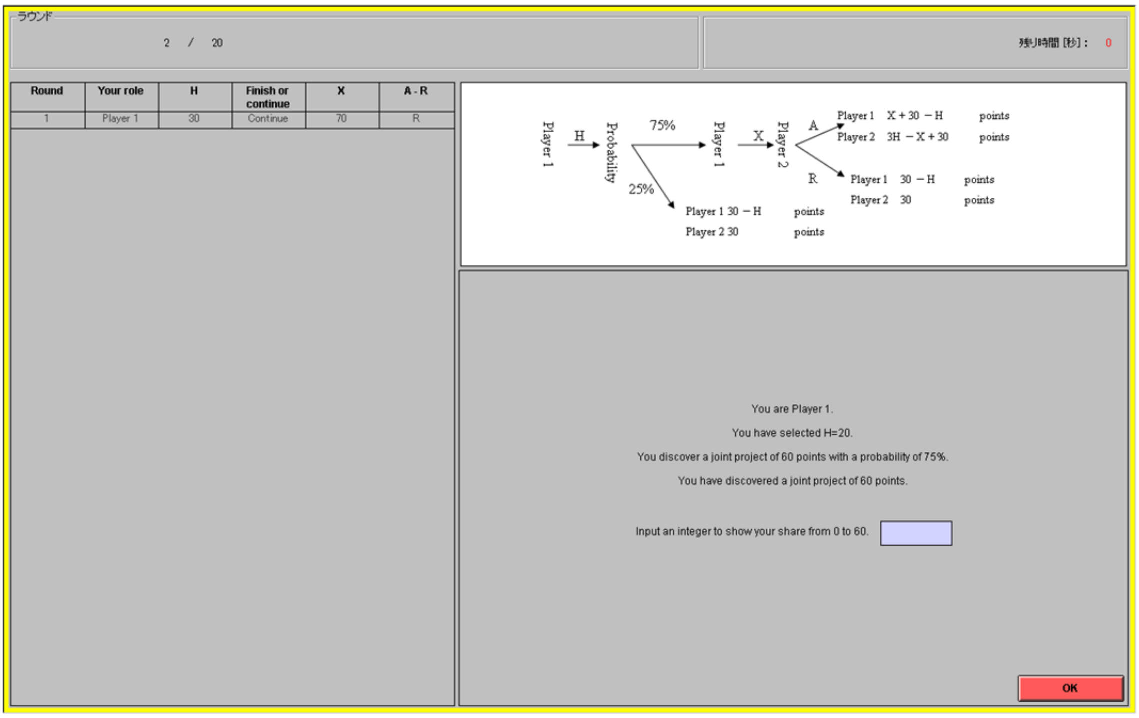
Screen 9



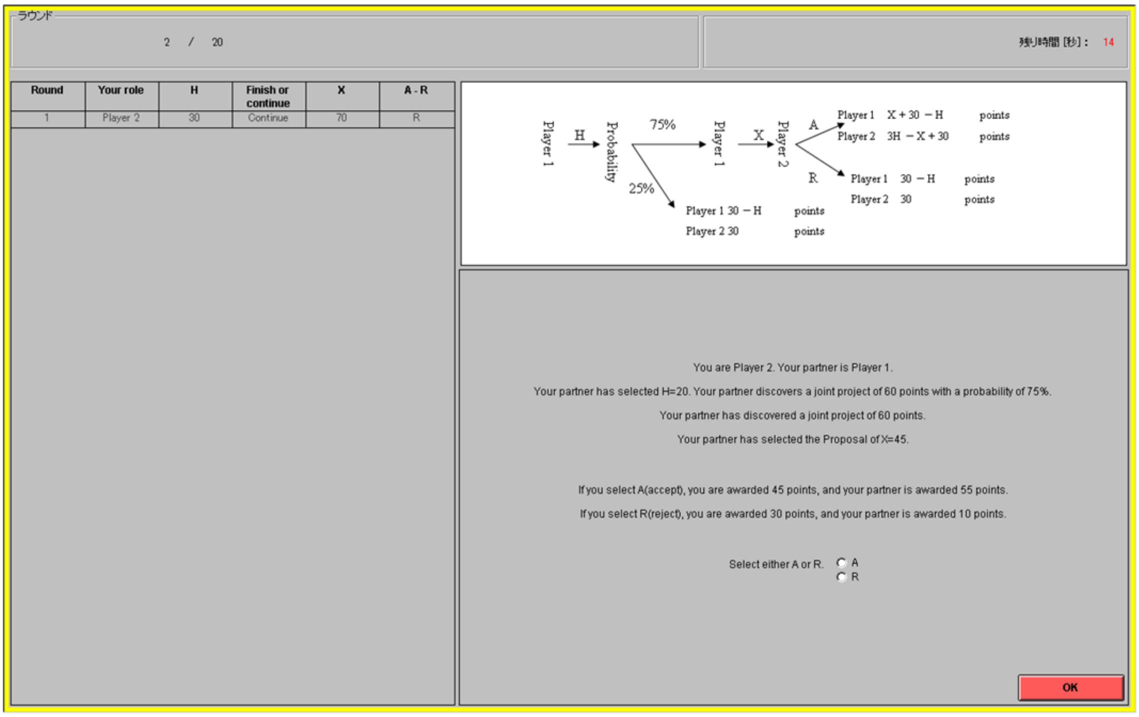
Screen 10



Screen 11



Screen 12


ラウンド
2 / 20
残り時間 [秒]： 14
Round | Your role | H | Finish or continue | X | A - R
1 | Player 2 | 30 | Continue | 70 | R
Player 1
H
Probability
75%
25%
Player 1
X
Player 2
A
Player 1 X + 30 − H points
Player 2 3H − X + 30 points
R
Player 1 30 − H points
Player 2 30 points
Player 1 30 − H points
Player 2 30 points
You are Player 2. Your partner is Player 1.
Your partner has selected H=20. Your partner discovers a joint project of 60 points with a probability of 75%.
Your partner has discovered a joint project of 60 points.
Your partner has selected the Proposal of X=45.
If you select A(accept), you are awarded 45 points, and your partner is awarded 55 points.
If you select R(reject), you are awarded 30 points, and your partner is awarded 10 points.
Select either A or R.
A
R
OK