Risk-averse and self-interested shifts in groups in both median and random rules

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12th April, 2019
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Abstract

This study examines whether attitudes toward risk and altruism are affected by being in a group or being alone. Differing from previous economic studies of group decision-making, we attempt to exclude the effects of group informal discussion, which are thought to be a black box when individuals make decisions in a group. Subjects in our experiment were requested only to show their faces to other members without any further communication. Moreover, we adopted two collective decision rules—namely, the median rule and the random rule—which provide the truth-telling mechanism. In experiments of both anonymous investments and donations, we found that subjects who made decisions in a group offered significantly lower amounts than individuals who made decisions alone, even controlling for individuals’ risk and altruistic preferences. Our results indicate that people are more risk averse and self-interested when they are in a group regardless of which collective decision rules are adopted.

Keywords: Group decision, Individual decision, Altruism, Decision under risk

JEL classification: C91, C92, D81

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1. Introduction

Although a decision maker is almost always assumed to be an individual in normative models of economics, in real-life situations, many important decisions are made by groups, such as company boards, management teams, governments, and legislators. The importance of studies focusing on group decision-making is growing, and thus, economists have come to pay more attention to this area.

There is a long history in social psychology of studying group decision-making. Stoner (1961) reported the first experiment in which decisions made by groups led to riskier positions after the discussion, compared to individuals’ decisions. Moscovici and Zavalloni (1969) noted that decision-making in groups has resulted in both risky and cautious directions, and the authors regarded risky and cautious shifts as a special case of group polarization. A comprehensive survey by Kerr et al. (1996) concluded “there are several demonstrations that group discussion can attenuate, amplify, or simply reproduce the judgment biases of individuals” (p. 693). Furthermore, group interaction and discussion might deliver different results in group decisions.

In previous economic studies of group decision-making, the differentials in preference toward risk and altruism between individuals and groups were examined. Baker et al. (2008), Shupp and Williams (2008), and Maselet et al. (2009) reported that groups were more risk averse than individuals were in a lottery choice experiment, while Mifune et al. (2016) observed a similar tendency by using a kind of stag-hunt game and comparing individual-on-individual treatment with group-on-individual treatment. However, Rockenbach et al. (2007) and Zhang and Casari (2012) found that group decisions display a risky shift in comparison to individual decisions. Harrison et al. (2012) concluded that there were no significant differences between

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1 In social psychology, the two main explanations for these shifts are social comparison theory (Levinger and Schneider 1969) and persuasive argument theory (Burnstein et al. 1973; Brown 1974). Social comparison theory states that people are motivated to perceive and present themselves in a socially desirable way. According to persuasive argument theory, the reason that group decisions lead to a particular direction is that once certain novel arguments are shared during group discussions, these arguments persuade other group members on the issue.

2 In addition, Sunstein (2000, 2002) and Manin (2005) pointed out that groups indeed shifted to more extreme positions but the shifts were not systematic in one direction.

3 Another perspective in economic studies of group decision-making is to explore whether groups are more rational than individuals are (see Bornstein and Yaniv 1998; Cox and Hayne 2006; Kocher and Sutter 2005; Song 2008). Charness and Sutter (2012) concluded that group decision-making was more likely to be close to standard game-theoretic predictions, because groups were more cognitively sophisticated and more productive owing to peer effects, and had more self-interested preferences.
the risk aversion of individuals and groups. With regard to altruistic preference, Cason and Mui (1997) reported that a dictator group was less self-interested than an individual dictator was, whereas Luhan et al. (2009) concluded that a dictator group was more self-interested than an individual dictator was. The method of communication within the dictator group in Cason and Mui (1997) was face-to-face, whereas the method used in Luhan et al. (2009) was online chat. According to Luhan et al. (2009), whether group decision-making is more self-interested than individual decision-making depends on the anonymity within the dictator group.

Since all of the experimental economic literature in the previous paragraphs on group decision-making, except for Masclet et al. (2009) and Harrison et al. (2012), features groups that were allowed to communicate with other group members via face-to-face discussions or electronic chats, the observed decisions of groups were due to the mixed effect of the preference changes of individuals by being in a group and the group’s formal or informal discussion process. Consequently, little is known about pure subjects’ preference differentials in terms of how they decide—alone or in a team. This study differs from that of previous literature for the three points as follows. First, we attempt to exclude the effects of group informal discussion, which are thought to be a “black box” when individuals make decisions. Second, the prior literature adopted different “collective decision rules” on group decision-making (e.g., majority rule, unanimity, and dictator rule), and these rules may affect the final results of the experiments. To our best knowledge, this is the first experiments comparing two collective decision rules, the median rule and random rule, in this area. Although these two rules enhance truth-telling mechanism (see Cason et al. 2006), we here attempt to examine whether there is no difference between both rules on group decision-making indeed. Finally, we collect the data about both individuals’ attitudes toward risk and altruism from same subjects, and our results that the existence of other group members have significant influence on both attitudes no matter which collective decision rules are adopted.

In order to compare the risk and altruistic attitude of groups and individuals, our experiment was composed of two parts. First, all subjects were asked to conduct an individual task. For risk attitude, we implemented a lottery choice task introduced by Holt and Laury (2002). For altruism attitude, we used a standard public goods game (PGG). These variables are utilized as controls for individuals’ preferences toward risk and altruism in our regression model. Second, we separated the subjects into individual-choice and group-choice tasks, and then,
played an anonymous investment game and donation game in each. For a group-choice task, subjects were requested only to show their faces to the other members, and each player made the same decision by the median rule condition and random rule condition, receiving the same payoff for his or her group. We mainly noted that groups exhibit more risk aversion and are more self-interested than individuals are in both collective decision rules, even controlling for individuals’ risk and altruistic preferences in the regression model. Moreover, our results show that the group effects we observed have greater impacts in the random rule than those in the median rule in investment, and more risk-seeking subjects tend to be affected by the group effects to a large extent.

The rest of the paper proceeds as follows. Our experimental design and procedure are introduced in Section 2. Section 3 presents the results of the experiment. Section 4 provides discussion about our results and Section 5 concludes.

2. Experimental Design
All subjects in our experiment were undergraduate students from various disciplines at Kochi University of Technology, Kyoto Sangyo University, and Kansai University, and were recruited via the university website and e-mail solicitation. We conducted 18 sessions between July 2015 and December 2017. No subject participated in more than one session. The experiment was programmed and conducted with the software z-Tree developed by Fischbacher (2007). Subjects were seated individually and in front of a computer screen in a lab.

Table 1 presents our experimental design consisting of two parts. First, all subjects in a session were asked to carry out an individual task as mentioned later in this section (Tasks 1 and 2). Second, for Tasks 3 and 4, in the case of the 24 participating subjects, 12 subjects were assigned randomly to the individual-choice task and 12 subjects to the group-choice task (divided into four groups of three people). For the group-choice task, subjects were assigned to the median rule condition and the random rule condition, both of which provide truth-telling mechanism at the time of group decision-making.

Subjects were told that the members of groups were identical in Tasks 3 and 4. Subjects were not allowed to communicate with each other, because we attempt to exclude the effects of
group discussion from the decision-making processes in groups. However, we considered that if there were no interaction between group members before making decisions as a group, the members would not realize that they were indeed assigned to groups. Therefore, to increase credibility in our experiments, we used the same mutual identification\(^4\) employed in Bohnet and Frey (1999), in which each member of the group would stand up and show their face to the other member in silence. The instruction sheets for both the individual-choice task and the group-choice task were identical except for the parts related to the individual or group task. These were distributed to subjects at the beginning of each task independently and read aloud. There were few questions about the experimental procedures. All required one-shot anonymous decisions,\(^5\) and there was no feedback of any kind until the end of the experiments.

Here, we describe our task in detail. In Task 1, the risk preference elicitation experiment introduced by Holt and Laury (2002) was conducted, where subjects choose between a “safe” (Option A) and a “risky” (Option B) option. All 10 decisions appeared simultaneously, as shown in Table 2, and 110 yen equaled approximately 1 US dollar at the time of the experiment. One decision was chosen randomly by the computer for payment at the end of the experiment. We calculated the coefficient of relative risk aversion based on the constant relative risk aversion (CRRA) utility function:

\[
\begin{align*}
\hat{u}_i(Y_i) &= 
\frac{Y_i^{1-\gamma_i}}{1-\gamma_i} \\
\gamma_i &\text{ is the coefficient of relative risk aversion and } Y_i \text{ represents the lottery outcomes for subject } i. \text{ The coefficient is less than 0 for subjects who are risk seeking, equal to 0 for subjects who are risk neutral, and greater than 0 for subjects who are risk averse.}
\end{align*}
\]

\(\text{[Table 2 about here]}

\[^{4}\text{As for the group decision-making without anonymity, Shupp and Williams (2008), Baker et al. (2008), Rockenbach et al. (2007) and Cason and Mui (1997) used face-to-face discussion with other group members to examine the differentials in preference toward risk or altruism between individuals and groups, as mentioned in the introduction.}\]

\[^{5}\text{He and Villeval (2014) reported that, in groups, people made very different choices between first and final choices after they observed other member’s choices in an ultimatum game and a kind of dictator game. While the authors investigated how individual preferences were aggregated in groups, the purpose of this study was to examine pure subjects’ preference differentials to decide whether to be alone or in a group, and thus, we focus on their choices in each one-shot decision.}\]
In Task 2, a standard public goods game was used to measure the individual altruistic preference. Subjects determined how much of the 200-yen endowment to keep or invest into public goods. Payoffs were determined by contributions of each member being doubled and divided evenly between the members of the group. While Masclet et al. (2009) controlled socio-demographic variables, such as salaried and self-employed workers, we used these variables as controls in the regression model (Task 1: risk preference; Task 2: altruistic preference).

In Tasks 3 and 4, we used the anonymous investment and donation game. Subjects received a 200-yen endowment and decided how much money to invest or donate, ranging from 0 yen to 200 yen (intervals of 10 yen). In Task 3, their investment options were as follows: 50% chance to win 2.5 times of their invested amount and 50% chance to lose their entire investment. In Task 4, they donated money to the Japanese Red Cross Society. For the group-choice task, the group decision was determined based on the median rule or the random rule by group members and each team member received the same payoff in the group decision tasks. For the median rule, the instruction sheets explained that the median value is the middle value in sorted order of values, and the group decision is determined based on the median values. For the random rule, subjects were instructed that the group decision was determined based on the choice of group members, randomly selected with a one-third chance. Thus, in the group choice task, each group member showed his or her choice for selection as the group decision and we consider that this choice appropriately reflects his or her altruistic and risk preference when he or she is in a group and shares a common interest with other members in each task. We observed and analyzed these three values for the amount of investment and donation in each group of three people, respectively, and hence, group choice is defined as “individual choice in a group” for the rest of this paper. Following these tasks, we ran some experiments, and subjects were asked to answer the post-experimental questionnaire individually, including questions related to social value orientation (SVO) that we elaborate in the results section.

On average, a session lasted for about 1 hour and 15 minutes, including the post-experimental questionnaire and final payment of subjects. Each participant earned 2,140 yen on average.

3. Results
3.1 Median rule and random rule

Of the 360 subjects in our experiment, we excluded the 8 subjects who switched backed more than twice and the 4 subjects who chose the safe option (Option A) in decision 10 of the risk attitude task (Task 1). As for the rest of our subjects, 320 subjects did not switch back at all and 28 subjects switched backed once. For subjects who switched backed once, we followed the procedure utilized in Lusk and Coble (2005), Harrison et al. (2007), and Anderson and Mellor (2008) to calculate the range of relative risk attitude. Therefore, the sample size we finally used consists of 348 subjects (59.77% male and 40.23% female).

Tables 3 and 4 present the descriptive statistics for group-choice sub sample, and for individual-choice sub sample, respectively. Although the sessions of the median rule condition took place at Kochi University of Technology (87 subjects; 64.37% male) and Kyoto Sangyo University (90 subjects; 77.78% male), and the random rule condition at Kansai University (171 subjects; 47.95% male), we confirmed there was no significant difference between the subsample of both rules except for the proportion of “Male” (group-choice sub sample; 78.26% male vs. 47.67% male; p<0.01, and individual-choice sub sample; 63.53% male vs. 48.24% male; p<0.01, using a chi-square test of independence).

3.2 Risk attitude

In order to extract the effects of being assigned to groups more completely, we ran a regression model, controlling for some other factors. Since our dependent variable is left and right censored variables (takes values from 0 to 200), we ran a Tobit model widely used in economic models. We estimated the investment equation, in which independent variables are individual attitudes measured in Task 1 (about risk), “Group-choice” dummy variables (whether assigned to group-choice tasks or not), an interaction term between “Group-choice” and “Random-rule,”

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6 Because choosing a safe option in the tenth decision means preferring a certain 200 yen over a certain 380 yen, we interpret this as a sign that the subject did not understand the instructions (see Anderson and Mellor 2008, p. 1265).

7 We determined the lower bound of the range by the first choice of risky option and the upper bound by the last choice of safe option (see Anderson and Mellor 2008, p. 1265).
university dummy variables, and gender dummy variables. Model 2 includes the independent variable of contributions in PGG (Task 2) for robustness checks in the equation. We present the marginal effects on the expected value of the censored outcome estimated after the Tobit model. Table 5 shows the estimation results of regression on investment, in which robust standard errors are utilized. Of primary interest here is the estimated marginal effects of “Group-choice” variable. We confirm that it is negative and significant at the level of 0.05, which indicates that subjects in a group tend to be more risk averse than individuals tend to be. According to the estimated marginal effects, subjects were more likely to decrease the investment by approximately 20.3 yen on average in Model 1, and 19.9 yen in Model 2 (subjects were asked to invest in their options, ranging from 0 yen to 200 yen in Task 3). Note that the estimated coefficients of interaction term between “Group-choice” and “Random rule” are not significant in both Models. These results mean that the effects of being assigned to groups have also same impacts no matter which collective decision rules are adopted in investment.

As for other independent variables, the marginal effects of risk attitude assessed by the CRRA is negative and significant at the level of 0.01, which indicates that more risk-averse subjects tend to decrease the amount of investment. With respect to gender effect, males tend to invest more than females tend to by approximately 20 yen on average in both Models 1 and 2 at a significance level of 0.01. Whether Eckel and Grossman (2008) concluded that males are indeed more risk-seeking than females, Filippin and Crosetto (2016), who conducted a meta-analysis of the Holt and Laury risk elicitation method in the experimental literature, reported that gender differences in risk attitudes appear in less than 10% of the available 54 replications studies.

[Table 5 about here]

3.3 Altruistic preferences

Regarding the donation equation in Table 6, Model 2 includes variable of individuals’ risk preference (Task 1) for robustness checks. By focusing on the effects of being assigned to groups, subjects in group-choice tasks significantly decrease their donation compared to those in individual-choice tasks, at a significance level of 0.05. For regression results, we conclude that

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8 For altruism, evidence of gender difference is mixed in previous studies (see Kamas et al. 2008). Our results show there is significant gender difference in the amount of donation (p<0.1).
subjects in a group tend to be more self-interested than individuals tend to be. On average, they
tend to decrease the donation by about 23.8 yen in Model 1 and 23.3 yen in Model 2 (the range
of the donation choice was 0–200 yen in Task 4). We here also observe that the coefficients of
interaction term between “Group-choice” and “Random rule” are not statistically significant in
donation equation. These results indicate that the group effects are robust in both collective
decision rules, the median and random rule. Comparing estimated marginal effects of
“Group-choice” variable and the mean of two dependent variables, investment (mean = 113.89
yen) and donation (mean = 48.12 yen),⁹ it seems that the effects of being assigned to groups on
altruism are greater than those on risk attitudes (marginal effects; 20.3 yen on risk attitudes vs.
23.8 yen on altruism in Model 1).

For other independent variables, the amount of contribution in PGG is positively
associated with the amount of donation at a significance level of 0.01. In order to check the
robustness of the donation equation, we controlled subjects’ prosocial orientation in both
Models, measured by SVO developed by Van Lange et al. (1997, 2007). This SVO variable is
widely known to be associated with the results of the dictator game and it assesses the
individual altruistic preferences (refer to Cornelissen et al. 2011). The dummy variable of
prosocial equals 1 if subjects were defined as prosocial in the SVO method, and are 0 for any
other case.¹⁰ The coefficients of both the contribution and prosocial variables are positive and
statistically significant at the level of 0.01. Hence, we might capture and control the other
aspects of altruism by introducing the prosocial dummy variable, as defined in the SVO method.

⁹ The mean of investment and donation variables, for individual choice are 113.89 yen and 48.12
yen respectively, and for group choice 93.48 yen and 31.52 yen.
¹⁰ In our sample, approximately 45.1% of subjects were defined as “prosocial.” This is consistent
with Au and Kwong (2004), who reported that by meta-analysis, about 45% were categorized as
“prosocial” on average in various studies.

4. Discussion

Based on the above results that the coefficients of interaction term between “Group-choice” and
“Random rule” are not significant in both investment and donation equations confirm that group
effects we observed are robust and have same impacts in both collective decision rules.
However, to examine more precisely whether there is no difference between the median and
random rule on group decision-making, we extract the group-choice subsample (N = 178) and ran a regression model adding “random rule” dummy variables and “random rule” interaction terms to our model.\(^{11}\) In Table 7, Model 1 reports regression results of investment equation, and Models 2 and 3 of donation equation for the group-choice sub sample (Model 3 controls for individuals’ risk preference instead of contributions in Model 2). According to the results of investment (Model 1), the marginal effect of “Random rule” dummy variable is negative and significant at the level of 0.05. This result indicates that subjects were more likely to decrease the investment by approximately 30.7 yen on average when random rule was adopted. In addition, the coefficients of interaction term between “Random rule” and “Risk preference” are positive and significant at the level of 0.05. With reference to Figure 1\(^{12}\) to aid the discussion, this suggests that in the random rule more risk-seeking subjects tend to decrease their investment than more risk-averse subjects do. In seeking a possible explanation for these results, we assumed that whereas the probability (1/3 chance) that his/her choices are selected is obvious in the random rule, the probability of the selection is ambiguous in the median rule. Thus, the group effects (risk-averse shift in groups) have greater impacts in the random rule than those in the median rule, because the subjects realize that his/her choices may be selected indeed for the group decisions. Furthermore, risk-seeking subjects are more affected by group effects than risk-averse subjects are, because the former may understand that their preference is relatively higher than that of other subjects, and thereby decrease the level of investment to a large extent, that is, refrain from risk-taking behavior, by considering the group decisions.

\(^{11}\) Since in our experiments the random rule conditions were only performed at Kansai University, so we exclude university dummy variables from the model.

\(^{12}\) We take values of −2 and 2 for choosing the risky option in decision 1 and the safe option in decisions 10, respectively, as the midpoint of the CRRA interval, following Reynaud and Couture (2012).
significant in all models in Table 7. Thus, we conclude that the significant difference between both rules that we captured as above is not observed in donation task. Since in our experiment, the individual-choice task and the group-choice task were conducted in the same session and the instruction sheets subjects received were identical, so we run same regression model for individual-choice sub sample (N = 170) in Table 8. We confirm that announcing the collective decision rule, the median rule or random rule, does not cause significant difference for the individual-choice task in our experiments.

[Figure 2 about here]

[Table 8 about here]

5. Conclusions

We attempted to investigate pure subjects’ preference differentials toward risk and altruism to decide whether to be alone or in a group. Our experiment was designed to exclude the effects of informal discussion in a group by forbidding communication with members of the group and adopting the two collective decision rules, the median and random rule, both of which enhance truth-telling mechanism at the time of group decision-making. Our results show that subjects who made decisions in a group tended to decrease their amount of investment and donation on average in both rules. These results are in line with some previous economic literature (see Shupp and Williams 2008; Luhan et al. 2009; Masclet et al. 2009, as cited in the introduction).

However, the prior literature discusses communication effects and different “collective decision rules” in order to reach agreement in group decision-making (e.g., majority rule, unanimity, and dictator rule). In this current paper, we conclude that pure subjects’ preferences appear to be more risk averse and self-interested when they are assigned to a group whose members have a common interest in both the median and random rule. In addition, comparing the both rules, we also found that the group effects (risk-averse shift in investment) had greater impacts in the random rule than those in the median rule, and that risk-seeking subjects were more affected by group effects than were risk-averse subjects, that is, they decreased their level of investment more.
Our results shed light on the “black box” of group decision-making, as mentioned in the introduction. Ambrus et al. (2015) found that median group members have a significant influence on group decisions via free discussion in the trust game and risk task of Holt and Laury (2002). Luhan et al. (2009) reported that most self-interested group members had the largest impact on the group decision via electronic chat in a dictator game. While median group members in prior works might have caused preference shifts when assigned to a group, these works focused only on how individual preferences were aggregated to a group attitude (preference aggregation). However, preference shifts also might have occurred by the existence of other group members. We suggest that these two effects (preference shifts and aggregation) were mixed up in prior works.
Acknowledgments

This work was supported by the Japan Society for the Promotion of Science Grant-in-Aid for Scientific Research (B) [grant number JP26285047].
References


Table 1 Our experimental design

<table>
<thead>
<tr>
<th>Part 1</th>
<th>Part 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual task (N = 348)</td>
<td>Individual-choice task (N = 170)</td>
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<tr>
<td>— Task 1</td>
<td>— Task 3</td>
</tr>
<tr>
<td>— Task 2</td>
<td>— Task 4</td>
</tr>
<tr>
<td>Group-choice task (N = 178)</td>
<td>Collective decision rules</td>
</tr>
<tr>
<td>— Task 3</td>
<td>Median rule condition (N = 92)</td>
</tr>
<tr>
<td>— Task 4</td>
<td>Random rule condition (N = 86)</td>
</tr>
</tbody>
</table>
### Table 2. Lottery choice experiment (Holt and Laury, 2002)

| Decision | Option A | | | | Option B | | | | EV(A)-EV(B) | Proportion of subjects |
|----------|----------|---|---|---|---|---|---|---|---|---|---|
|          | Probability | Payoff | Probability | Payoff | Probability | Payoff | Probability | Payoff |          |              |          |
| 1        | 10%       | 200 yen | 90%       | 160 yen | 10%       | 380 yen | 90%       | 10 yen | -147     | 8.7      |
| 2        | 20%       | 200 yen | 80%       | 160 yen | 20%       | 380 yen | 80%       | 10 yen | -114     | 27.0     |
| 3        | 30%       | 200 yen | 70%       | 160 yen | 30%       | 380 yen | 70%       | 10 yen | -101     | 28.4     |
| 4        | 40%       | 200 yen | 60%       | 160 yen | 40%       | 380 yen | 60%       | 10 yen | -81      | 28.4     |
| 5        | 50%       | 200 yen | 50%       | 160 yen | 50%       | 380 yen | 50%       | 10 yen | -61      | 29.7     |
| 6        | 60%       | 200 yen | 40%       | 160 yen | 60%       | 380 yen | 40%       | 10 yen | -41      | 29.7     |
| 7        | 70%       | 200 yen | 30%       | 160 yen | 70%       | 380 yen | 30%       | 10 yen | -21      | 29.7     |
| 8        | 80%       | 200 yen | 20%       | 160 yen | 80%       | 380 yen | 20%       | 10 yen | -1      | 29.7     |
| 9        | 90%       | 200 yen | 10%       | 160 yen | 90%       | 380 yen | 10%       | 10 yen | 11        | 29.7     |
| 10       | 100%      | 200 yen | 0%        | 160 yen | 100%      | 380 yen | 0%        | 10 yen | 180      | 2.9      |

Note: EV(A) and EV(B) represent expected value of Options A and B, respectively. The last column provides the proportions of subjects who chose the risky option (Option B) for the first time in 10 decisions. To calculate the proportions, we here used data from subjects who did not switch back at all in this task. These two columns were not displayed to the subjects.
### Table 3. Descriptive statistics for the group-choice subsample: Median rule (MR) vs. Random rule (RR)

<table>
<thead>
<tr>
<th>Group-choice sub sample</th>
<th>Median Rule</th>
<th>Random Rule</th>
<th>MR - RR</th>
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<tr>
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<td>Mean</td>
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<td>Mean</td>
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<tr>
<td>Investment</td>
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<td>84.65</td>
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<tr>
<td>Donation</td>
<td>31.20</td>
<td>54.39</td>
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<td>0.51</td>
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<td>Contributions</td>
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<td>47.56</td>
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<tr>
<td>Prosocial</td>
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<td>0.50</td>
<td>0.43</td>
</tr>
<tr>
<td>Male</td>
<td>0.78</td>
<td>0.41</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Note: Median rule (N=92), Random rule (N=86). Except for the proportion of “Male,” we confirmed there was no significant difference between median rule and random rule samples regarding the amount of donation and investment, the level of “Risk preference (Task 1)” and “Contributions (Task 2)” (by a non-parametric Mann–Whitney U-test), and also the proportion of subjects who were defined as “Prosocial” in the SVO method (by a chi-square test of independence). Only the proportion of “Male” was significantly different between median rule and random rule samples (78.26 % vs. 47.67 %; p<0.01; chi-square test of independence).
## Table 4. Descriptive statistics for the individual-choice subsample: Median rule (MR) vs. Random rule (RR)

<table>
<thead>
<tr>
<th>Individual-choice sub sample</th>
<th>Median Rule</th>
<th>Random Rule</th>
<th>MR - RR</th>
</tr>
</thead>
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<td>Std. Dev.</td>
<td>Mean</td>
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<td>Donation</td>
<td>52.59</td>
<td>66.92</td>
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<tr>
<td>Risk preference</td>
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<td>0.53</td>
<td>0.53</td>
</tr>
<tr>
<td>Contributions</td>
<td>67.29</td>
<td>69.03</td>
<td>58.59</td>
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<tr>
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<td>0.50</td>
<td>0.51</td>
</tr>
<tr>
<td>Male</td>
<td>0.64</td>
<td>0.48</td>
<td>0.48</td>
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</table>

Note: Median rule (N=85), Random rule (N=85). Only the proportion of “Male” was significantly different between median rule and random rule samples (63.53 % vs. 48.24 %; p<0.01; chi-square test of independence).
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Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.
Table 6. Estimation results: Donation (Tobit model)

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Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.
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Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.
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Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses.
Fig. 1 Scatter plots with a regression line: Investment (Group-choice sub sample)
Appendix A\textsuperscript{13}. Experiment Instructions (in English for the median rule)

1. Introduction

Thank you for participating in our experiment. I now explain our experimental procedure. If you have any questions, please simply raise your hand. In addition, please do not communicate in any way with other subjects and turn off your cellphone during the experiment. To start, ensure that the following materials are on your table.

- Instructions
- Experimental agreement form
- Receipt
- Ballpoint pen

2. Experimental description

In this experiment, you will make four different types of decisions privately using the computer in front of you. You will earn different amounts depending on your decisions. At the end of the experiment, you will be paid in cash based on your decisions as well as 1,100 yen for participating in this experiment. Please make decisions with the objective of earning a lot of money.

Now, the first experiment will start. In the remainder of these instructions, ‘Player’ indicates subjects who make decisions in the experiment and ‘Experimenter’ indicates non-players, or we who are conducting the experiment. You can stop participating in the experiment at any time.

\textsuperscript{13} Appendix A-F are not meant to be published.
3. Experimental tasks

3.1 Task 1

In this task, the Player chooses between Option A and Option B as follows.

<table>
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<th>Option A</th>
<th>Option B</th>
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<tbody>
<tr>
<td>Q1</td>
<td>Probability of 10% (200 yen)</td>
<td>Probability of 10% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 90% (160 yen)</td>
<td>Probability of 90% (10 yen)</td>
</tr>
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<td>Probability of 20% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 80% (160 yen)</td>
<td>Probability of 80% (10 yen)</td>
</tr>
<tr>
<td>Q3</td>
<td>Probability of 30% (200 yen)</td>
<td>Probability of 30% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 70% (160 yen)</td>
<td>Probability of 70% (10 yen)</td>
</tr>
<tr>
<td>Q4</td>
<td>Probability of 40% (200 yen)</td>
<td>Probability of 40% (380 yen)</td>
</tr>
<tr>
<td></td>
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<td>Probability of 40% (10 yen)</td>
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<td>Q7</td>
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<td>Probability of 70% (380 yen)</td>
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<td>Probability of 30% (160 yen)</td>
<td>Probability of 30% (10 yen)</td>
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<td>Q8</td>
<td>Probability of 50% (200 yen)</td>
<td>Probability of 50% (380 yen)</td>
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<td>Probability of 20% (160 yen)</td>
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<td>Q9</td>
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<td>Probability of 90% (380 yen)</td>
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For example, in Questions 1, both options are as follows: there is a 10% chance of earning 200 yen and a 90% chance of earning 100 yen (Option A); on the contrary, there is a 10% chance of earning 380 yen and a 90% chance of earning 10 yen (Option B). After making decisions from Questions 1 to 10, one question will be chosen randomly by the computer for payment at the end of the experiment. In more detail, if the computer were to choose the fifth
question, the Player who preferred Option A would have a 50% chance of earning 200 yen and a 50% chance of earning 160 yen. Similarly, the Player who preferred Option B would have a 50% chance of earning 360 yen and a 50% chance of earning 10 yen.

If you have any questions about this task, please simply raise your hand. We now have 1 minute to consider Task 1.

After this instruction, all 10 questions and options will appear on your computer, such as shown in Figure 1. Please make all your decisions and click the OK button on the bottom right of your screen after inputting your decisions.

**Figure 1. Computer screen for Task 1**

<table>
<thead>
<tr>
<th>Question</th>
<th>Option A</th>
<th>Option B</th>
</tr>
</thead>
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<tr>
<td>Q1</td>
<td>Probability of 10% (200 yen)</td>
<td>Probability of 20% (300 yen)</td>
</tr>
<tr>
<td>Q2</td>
<td>Probability of 10% (200 yen)</td>
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<tr>
<td>Q3</td>
<td>Probability of 10% (200 yen)</td>
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</tr>
<tr>
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<td>Probability of 50% (300 yen)</td>
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<td>Q5</td>
<td>Probability of 10% (200 yen)</td>
<td>Probability of 60% (300 yen)</td>
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<tr>
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<td>Q7</td>
<td>Probability of 10% (200 yen)</td>
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<td>Q8</td>
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<td>Q9</td>
<td>Probability of 10% (200 yen)</td>
<td>Probability of 70% (10 yen)</td>
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<tr>
<td>Q10</td>
<td>Probability of 10% (200 yen)</td>
<td>Probability of 80% (10 yen)</td>
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</table>
### 3.2 Task 2

The Player has a 200-yen endowment and this will be assigned randomly to a group of three people. The Player will decide how much of the 200-yen endowment to keep or invest in their group project. The payment will be determined by the contributions of each member being doubled and divided evenly between the members of the group, as follows.

\[
\text{Your earnings} = (\text{All contributions in your group} \times 2 \div 3) + (200 - \text{Your investment})
\]

For example, if each member were to invest the same amount of 200 yen in the group project, each member would earn 400 yen. For another example, if no members were to invest in the group project at all, each member would earn 200 yen.

#### Exercise 1

In a certain group, if one member were to invest 120 yen and two members were to invest 60 yen in their group project, how much money would each group member earn in Task 2?

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<td>Member investing 60 yen:</td>
<td>yen</td>
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#### Exercise 2

In a given group, if two members were to invest 180 yen and one member nothing at all in their group project, how much money would each group member earn in Task 2?

<table>
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<tr>
<th>Member investing 180 yen:</th>
<th>yen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Member investing nothing at all:</td>
<td>yen</td>
</tr>
</tbody>
</table>

If you have any questions, please simply raise your hand. We now have 1 minute to consider Task 2.

After this instruction, the screen will change on your computer, for example, as shown in Figure 2. Please decide how much money to invest in your group project, ranging from 0 yen to
200 yen (in intervals of 10 yen). Click the OK button on the bottom right of your screen after inputting your decision.

**Figure 2. Computer screen for Task 2**

![Computer screen for Task 2](image-url)
In Tasks 3 and 4, the subjects will be divided randomly into two groups: individual-choice and group-choice tasks. The subjects who are assigned to the individual-choice task will make decisions alone until the end of the experiment; on the other hand, subjects assigned to the group-choice task will make decisions in a group until the end of the experiment.

**Individual-choice task**

Subjects assigned to the individual-choice task make decisions by themselves for each task according to their preferences.

**Group-choice task**

Subjects will be assigned randomly to groups, each comprising three people. The members of groups are identical until the end of the experiment. Subjects in the group-choice task make decisions according to their preferences when they are in a group and share common interests with other members of their group for each task. The group decision will be determined based on the median rule by group members and each team member receives the same payoff in the group-decision tasks. We now introduce the members of each group to each other. Please stand up and show your face to the other members when your number is called. In addition, please do not communicate in any way with other members and other subjects during the experiment.
3.3 Task 3

Individual-choice task

The Player has a 200-yen endowment and will decide how much of the 200-yen endowment to invest in the Option, as follows: there is a 50% chance of winning 2.5 times your invested amount and a 50% chance of losing your entire investment.

Your earnings = 200 - Your investment + Profit from the Option

Group-choice task

The Player and other members of the group each have a 200-yen endowment. You will decide how much of the 200-yen endowment to invest in the Option, as mentioned below. The group decision is determined based on the median rule by group members and each group member will receive the same payoff. For example, if the three group members were to decide to invest 0 yen, 50 yen, and 100 yen, respectively, then the group investment decision in the Option would be 50 yen.

Please make a decision according to your desired level of investment in this Option.

Your earnings = 200 - The amount of group decision of investment + Profit from the Option

Note: About median value

The median value is the middle value in sorted order of values. For example, when the observed number in the sorted order is {0, 30, 80, 100, 200}, then the median value is 80.

If you have any questions, please simply raise your hand. We now have 1 minute to consider Task 3.

After this instruction, the screen will change on your computer, such as that shown in Figure 3. Please decide how much money to invest in this Option, ranging from 0 yen to 200 yen (in intervals of 10 yen). Click the OK button on the bottom right of your screen after inputting your decision.
Figure 3. Computer screen for Task 3

For individual-choice task

You were assigned to the individual-choice task. Please decide how much of the 200-yen endowment to invest in the Option.

Your endowment: 200
Your investment: [input field]

OK

For group-choice task

You were assigned to the group-choice task. Please decide how much of the 200-yen endowment to invest in the Option.

Your endowment: 200
Your investment: [input field]

OK
3.4 Task 4

**Individual-choice task**

The Player has a 200-yen endowment and will decide how much of the 200-yen endowment to donate to the Japanese Red Cross Society. The Experimenter will indeed donate the amount of the contribution that was decided in this task to the Japanese Red Cross Society.

Your earnings = 200 − Your Donation

**Group-choice task**

The Player and other members of the group each have a 200-yen endowment. You will decide how much of the 200-yen endowment to donate to the Japanese Red Cross Society. The group decision will be determined based on the median rule by the group members and each group member will receive the same payoff. For example, if the three group members were to decide to denote 0 yen, 50 yen, and 100 yen, respectively, then the group’s donation decision would be 50 yen. Please make a decision according to your desired level of donation to the Japanese Red Cross Society.

Your earnings = 200 − The amount of group decision of donation

Note: About the Japanese Red Cross Society (a direct quote from website)

Japanese Red Cross Society provides protection and assistance to suffering from conflicts, disasters, and diseases. We would appreciate for your donation, blood donation or volunteering with us.

If you have any questions, please simply raise your hand. We now have 1 minute to consider Task 4.

After this instruction, the screen will change on your computer, such as that shown in Figure 4. Please decide how much money to donate to the Japanese Red Cross Society, ranging from 0 yen to 200 yen (in intervals of 10 yen). Click the OK button on the bottom right of your screen after inputting your decision.
Figure 4. Computer screen for Task 4

For individual-choice task

You were assigned to the individual-choice task. Please decide how much of the 200-yen endowment to donate to the Japanese Red Cross Society.

Your endowment: 200
Your donation: 1

OK

For group-choice task

You were assigned to the group-choice task. Please decide how much of the 200-yen endowment to donate to the Japanese Red Cross Society.

Your endowment: 200
Your donation: 1

OK
Appendix B. Experiment Instructions (in English for the random rule)

1. Introduction

Thank you for participating in our experiment. I now explain our experimental procedure. If you have any questions, please simply raise your hand. In addition, please do not communicate in any way with other subjects and turn off your cellphone during the experiment. To start, ensure that the following materials are on your table.

- Instructions
- Experimental agreement form
- Receipt
- Ballpoint pen

2. Experimental description

In this experiment, you will make four different types of decisions privately using the computer in front of you. You will earn different amounts depending on your decisions. At the end of the experiment, you will be paid in cash based on your decisions as well as 1,100 yen for participating in this experiment. Please make decisions with the objective of earning a lot of money.

Now, the first experiment will start. In the remainder of these instructions, ‘Player’ indicates subjects who make decisions in the experiment and ‘Experimenter’ indicates non-players, or we who are conducting the experiment. You can stop participating in the experiment at any time.
3. Experimental tasks

3.1 Task 1

In this task, the Player chooses between Option A and Option B as follows.

<table>
<thead>
<tr>
<th></th>
<th>Option A</th>
<th>Option B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1.</td>
<td>Probability of 10% (200 yen)</td>
<td>Probability of 10% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 90% (160 yen)</td>
<td>Probability of 90% (10 yen)</td>
</tr>
<tr>
<td>Q2.</td>
<td>Probability of 20% (200 yen)</td>
<td>Probability of 20% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 80% (160 yen)</td>
<td>Probability of 80% (10 yen)</td>
</tr>
<tr>
<td>Q3.</td>
<td>Probability of 30% (200 yen)</td>
<td>Probability of 30% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 70% (160 yen)</td>
<td>Probability of 70% (10 yen)</td>
</tr>
<tr>
<td>Q4.</td>
<td>Probability of 40% (200 yen)</td>
<td>Probability of 40% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 60% (160 yen)</td>
<td>Probability of 60% (10 yen)</td>
</tr>
<tr>
<td>Q5.</td>
<td>Probability of 50% (200 yen)</td>
<td>Probability of 50% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 50% (160 yen)</td>
<td>Probability of 50% (10 yen)</td>
</tr>
<tr>
<td>Q6.</td>
<td>Probability of 60% (200 yen)</td>
<td>Probability of 60% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 40% (160 yen)</td>
<td>Probability of 40% (10 yen)</td>
</tr>
<tr>
<td>Q7.</td>
<td>Probability of 70% (200 yen)</td>
<td>Probability of 70% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 30% (160 yen)</td>
<td>Probability of 30% (10 yen)</td>
</tr>
<tr>
<td>Q8.</td>
<td>Probability of 80% (200 yen)</td>
<td>Probability of 80% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 20% (160 yen)</td>
<td>Probability of 20% (10 yen)</td>
</tr>
<tr>
<td>Q9.</td>
<td>Probability of 90% (200 yen)</td>
<td>Probability of 90% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 10% (160 yen)</td>
<td>Probability of 10% (10 yen)</td>
</tr>
<tr>
<td>Q10.</td>
<td>Probability of 100% (200 yen)</td>
<td>Probability of 100% (380 yen)</td>
</tr>
<tr>
<td></td>
<td>Probability of 0% (160 yen)</td>
<td>Probability of 0% (10 yen)</td>
</tr>
</tbody>
</table>

For example, in Questions 1, both options are as follows: there is a 10% chance of earning 200 yen and a 90% chance of earning 100 yen (Option A); on the contrary, there is a 10% chance of earning 380 yen and a 90% chance of earning 10 yen (Option B). After making decisions from Questions 1 to 10, one question will be chosen randomly by the computer for payment at the end of the experiment. In more detail, if the computer were to choose the fifth
question, the Player who preferred Option A would have a 50% chance of earning 200 yen and a 50% chance of earning 160 yen. Similarly, the Player who preferred Option B would have a 50% chance of earning 360 yen and a 50% chance of earning 10 yen.

If you have any questions about this task, please simply raise your hand. We now have 1 minute to consider Task 1.

After this instruction, all 10 questions and options will appear on your computer, such as shown in Figure 1. Please make all your decisions and click the OK button on the bottom right of your screen after inputting your decisions.

**Figure 1. Computer screen for Task 1**
3.2 Task 2

The Player has a 200-yen endowment and this will be assigned randomly to a group of three people. The Player will decide how much of the 200-yen endowment to keep or invest in their group project. The payment will be determined by the contributions of each member being doubled and divided evenly between the members of the group, as follows.

Your earnings = (All contributions in your group × 2 ÷ 3) + (200 − Your investment)

For example, if each member were to invest the same amount of 200 yen in the group project, each member would earn 400 yen. For another example, if no members were to invest in the group project at all, each member would earn 200 yen.

Exercise 1
In a certain group, if one member were to invest 120 yen and two members were to invest 60 yen in their group project, how much money would each group member earn in Task 2?

Member investing 120 yen: _________ yen

Member investing 60 yen: _________ yen

Exercise 2
In a given group, if two members were to invest 180 yen and one member nothing at all in their group project, how much money would each group member earn in Task 2?

Member investing 180 yen: _________ yen

Member investing nothing at all: _________ yen

If you have any questions, please simply raise your hand. We now have 1 minute to consider Task 2.

After this instruction, the screen will change on your computer, for example, as shown in Figure 2. Please decide how much money to invest in your group project, ranging from 0 yen to
200 yen (in intervals of 10 yen). Click the OK button on the bottom right of your screen after inputting your decision.

**Figure 2. Computer screen for Task 2**
In Tasks 3 and 4, the subjects will be divided randomly into two groups: individual-choice and group-choice tasks. The subjects who are assigned to the individual-choice task will make decisions alone until the end of the experiment; on the other hand, subjects assigned to the group-choice task will make decisions in a group until the end of the experiment.

**Individual-choice task**

Subjects assigned to the individual-choice task make decisions by themselves for each task according to their preferences.

**Group-choice task**

Subjects will be assigned randomly to groups, each comprising three people. The members of groups are identical until the end of the experiment. Subjects in the group-choice task make decisions according to their preferences when they are in a group and share common interests with other members of their group for each task. The group decision will be determined based on the choice of group members, randomly selected with a one-third chance, and each team member receives the same payoff in the group-decision tasks. We now introduce the members of each group to each other. Please stand up and show your face to the other members when your number is called. In addition, please do not communicate in any way with other members and other subjects during the experiment.
3.3 Task 3

*Individual-choice task*

The Player has a 200-yen endowment and will decide how much of the 200-yen endowment to invest in the Option, as follows: there is a 50% chance of winning 2.5 times your invested amount and a 50% chance of losing your entire investment.

Your earnings = \(200 - \text{Your investment} + \text{Profit from the Option}\)

*Group-choice task*

The Player and other members of the group each have a 200-yen endowment. You will decide how much of the 200-yen endowment to invest in the Option, as mentioned below. The group decision is determined based on the choice of group members, randomly selected with a one-third chance and each group member will receive the same payoff. Please make a decision according to your desired level of investment in this Option.

Your earnings = \(200 - \text{The amount of group decision of investment} + \text{Profit from the Option}\)

If you have any questions, please simply raise your hand. We now have 1 minute to consider Task 3.

After this instruction, the screen will change on your computer, such as that shown in Figure 3. Please decide how much money to invest in this Option, ranging from 0 yen to 200 yen (in intervals of 10 yen). Click the OK button on the bottom right of your screen after inputting your decision.
Figure 3. Computer screen for Task 3

For individual-choice task

You were assigned to the individual-choice task.
Please decide how much of the 200-yen endowment to invest in the Option.

Your endowment: 200
Your investment: [blank]

OK

For group-choice task

You were assigned to the group-choice task.
Please decide how much of the 200-yen endowment to invest in the Option.

Your endowment: 200
Your investment: [blank]

OK
3.4 Task 4

*Individual-choice task*

The Player has a 200-yen endowment and will decide how much of the 200-yen endowment to donate to the Japanese Red Cross Society. The Experimenter will indeed donate the amount of the contribution that was decided in this task to the Japanese Red Cross Society.

Your earnings = 200 − Your Donation

*Group-choice task*

The Player and other members of the group each have a 200-yen endowment. You will decide how much of the 200-yen endowment to donate to the Japanese Red Cross Society. The group decision is determined based on the choice of group members, randomly selected with a one-third chance and each group member will receive the same payoff. Please make a decision according to your desired level of donation to the Japanese Red Cross Society.

Your earnings = 200 − The amount of group decision of donation

Note: About the Japanese Red Cross Society (a direct quote from website)

Japanese Red Cross Society provides protection and assistance to suffering from conflicts, disasters, and diseases. We would appreciate for your donation, blood donation or volunteering with us.

If you have any questions, please simply raise your hand. We now have 1 minute to consider Task 4.

After this instruction, the screen will change on your computer, such as that shown in Figure 4. Please decide how much money to donate to the Japanese Red Cross Society, ranging from 0 yen to 200 yen (in intervals of 10 yen). Click the OK button on the bottom right of your screen after inputting your decision.
Figure 4. Computer screen for Task 4

For individual-choice task

You were assigned to the individual-choice task.
Please decide how much of the 200-yen endowment to donate to the Japanese Red Cross Society.

Your endowment: 200
Your donation: [ ]

OK

For group-choice task

You were assigned to the group-choice task.
Please decide how much of the 200-yen endowment to donate to the Japanese Red Cross Society.

Your endowment: 200
Your donation: [ ]

OK
Appendix C. Experiment Instructions (original Japanese version for the median rule)

実験インストラクション

1. はじめに
この度は、実験にご参加頂き、誠にありがとうございます。これから行う実験について説明いたします。ご不明な点がございましたら、手を挙げて質問してください。なお、実験が終了するまで私語は慎み、携帯電話の電源は切ってください。最初に、以下の配布物が手元にあることを確認してください。

●実験インストラクション（本紙）
●実験の同意書
●謝金の領収書
●筆記用具

2. 実験の概要
本日、お集まり頂いた方には、これからコンピュータを使用して4種類の異なる実験に参加して頂きます。各実験の意思決定の結果に応じて、皆さまの実験報酬が決定されます。実験終了後、実験報酬に参加報酬1,100 円を加えた金額を現金にて支払います。是非、多くの現金を獲得してください。

これより、実験1を行います。実験インストラクションにおいて、「プレイヤー」とは皆さまであり、「実験者」とは実験を実施する私たちを指します。なお、実験の途中において、いかなる理由により退席された場合にも、皆さまが不利益を被ることはございません。
3.1. 実験

この実験では、あなた自身にとって、以下の「オプション A」と「オプション B」のどちらがより好ましいかを選択して頂きます。

<table>
<thead>
<tr>
<th></th>
<th>オプションA</th>
<th>オプションB</th>
</tr>
</thead>
</table>
| Q1. | 確率10%(200円)  
確率90%(160円) | 確率10%(380円)  
確率90%(10円) |
| Q2. | 確率20%(200円)  
確率80%(160円) | 確率20%(380円)  
確率80%(10円) |
| Q3. | 確率30%(200円)  
確率70%(160円) | 確率30%(380円)  
確率70%(10円) |
| Q4. | 確率40%(200円)  
確率60%(160円) | 確率40%(380円)  
確率60%(10円) |
| Q5. | 確率50%(200円)  
確率50%(160円) | 確率50%(380円)  
確率50%(10円) |
| Q6. | 確率60%(200円)  
確率40%(160円) | 確率60%(380円)  
確率40%(10円) |
| Q7. | 確率70%(200円)  
確率30%(160円) | 確率70%(380円)  
確率30%(10円) |
| Q8. | 確率80%(200円)  
確率20%(160円) | 確率80%(380円)  
確率20%(10円) |
| Q9. | 確率90%(200円)  
確率10%(160円) | 確率90%(380円)  
確率10%(10円) |
| Q10. | 確率100%(200円)  
確率0%(160円) | 確率100%(380円)  
確率0%(10円) |

例えば、Q1 では、
「オプション A：確率 10%で 200 円、確率 90%で 160 円を獲得」と「オプション B：確率 10%で 380 円、確率 90%で 10 円を獲得」のどちらのオプションが、あなたにとってより好ましいかを選択してください。実験では、Q1 から Q10 まで、それぞれ「オプション A」または「オプション B」を同様に選択して頂き、最後にコンピュータがランダムにくじ（1番から 10 番）を引き、皆様が実際に獲得する金額を決定いたしました。
す。具体的には、コンピュータのくじ引きにおいて「5番」が出た場合には、Q5で「オプション A」を選択されている回答者は、「オプション A：確率 50%で 200 円、確率 50%で 160 円を獲得」が実現します。「オプション B」を選択されている回答者も同様に獲得金額が実現します。

ここまでの説明で質問などはございますか。それではこれから、意思決定について考えて頂くため、1分間のシンキングタイムを取ります。

1分間経過したので、これから意思決定を行って頂きます。目の前のPCの画面に注目してください。以下の画面が表示されましたら、Q1からQ10までそれぞれ「オプション A」または「オプション B」の選択を入力してください。入力後は、「OK」ボタンをクリックし、そのままお待ちください。

【入力画面（「オプション」の選択）】
3.2. 実験 2
プレイヤーは、はじめに 200 円を所持し、それぞれランダムに 3 人から構成されたグループに所属しています。その 200 円の内のいくらかをグループのプロジェクトに貢献する金額を決定して頂きます。プロジェクトへの貢献は 200 円の内のいくらでも構いません (0 円から 200 円までの金額)。グループの全メンバー (3 人) からプロジェクトに貢献された総額の 2 倍の金額が、グループ全員に平等に分配されます。各プレイヤーが受け取る獲得金額は、以下の通りです。

獲得金額=（全メンバーの貢献額 × 2 ÷ 3 ）+（200 −あなたの貢献額）

例えば、グループ内の 3 人全員がそれぞれ 200 円を貢献した場合、全メンバーの貢献額は 600 円となり、あなたはこの実験より 400 円を獲得します。一方、3 人全員が全く貢献をしない場合は、全メンバーの貢献額は 0 円となり、あなたはこの実験において 200 円を獲得します。

＜練習問題＞
問 1. ある 1 つのグループで、1 人のメンバーが「120 円」を貢献し、2 人が「60 円」を貢献した場合に、それぞれのメンバーの獲得金額はいくらですか。
「120 円」を貢献したメンバー: 円
「60 円」を貢献したメンバー: 円

問 2. ある 1 つのグループで、2 人のメンバーが「180 円」を貢献し、1 人が全く貢献をしなかった場合 (= 貢献額「0 円」)、それぞれのメンバーの獲得金額はいくらですか。
「180 円」を貢献したメンバー: 円
貢献額「0 円」のメンバー: 円

ここまでの説明で質問などはございますか。それではこれから、意思決定について考えて頂くため、1 分間のシンキングタイムを取ります。1 分間経過したので、これから意思決定を行って頂きます。目の前の PC の画面に注目してください。以下の画面 (次ページ) が表示されましたが、あなた自身の貢献額を入力してください（0 円から 200 円までの金額）。貢献額の入力は、10 円単位で行うことがで。入力後は、「OK」ボタンをクリックし、そのままお待ちください。
【入力画面（貢献額の決定）】

あなたの所持金額：200円
プロジェクトに貢献する金額を入力してください。

あなた所持金額

あなたの貢献額

OK
実験2まで終了いたしました。続いて、実験3から実験4を順次行います。これ以降、各実験では皆様に「1人の意思決定」または「3人グループの意思決定」をして頂きます。どちらの意思決定を行って頂くかは、コンピュータによりランダムに決定されます。「1人の意思決定」の方は、すべての実験終了まで「1人の意思決定」をして頂きます。同様に、「3人グループの意思決定」に選ばれた方はすべての実験終了まで「3人グループの意思決定」をして頂きます。

（Ⅰ）1人の意思決定：皆さまには、ご自身1人の場合を考えて、各実験における意思決定をして頂きます。あなたにとって、最も望ましい値を入力してください。

（Ⅱ）3人グループの意思決定：皆さまは、これからメンバーがランダムに構成された3人のグループに所属します。グループのメンバーは、すべての実験終了まで同じです。あなたは、グループの意思決定をどのようにしたら良いか、正直にお答えください。実際のグループにおける選択は、後述の通りグループ内の「中央値（実験3〜4）」のルールにより決定します。中央値で決定する場合には、皆さんにとって正直に回答することが最適な選択であると知られております。多数決の場合にも、あなた自身のお考えを正直に回答してください。

同一グループのメンバーは、各実験において上記のルールに従い、同じ行動をし全員同額の金額を獲得します。

これから、グループのメンバーを紹介します。座席番号を呼ばれた方はご起立をお願いします。ただし、すべての実験終了までグループのメンバーと相談をしたり、話すことはできません。
3.3. 実験 3

<1人の意思決定の方>
プレイヤーは、はじめに 200 円を所持しています。その 200 円の内のいくらかを以下の「オプション」に投資することができます。投資は 200 円の内のいくらでも構いません（0 円から 200 円までの金額）。

【オプション：確率 50%で投資額の 2.5 倍の金額を得る、確率 50%で投資額を失う】

あなたが受け取る獲得金額は、以下の通りです。
獲得金額 = 200 円 - あなたの投資額 + オプションから得た金額
実際にオプションから得られる金額は、コンピュータのくじ引きにより決定します。

<3人グループの意思決定の方>
あなたとグループの他のメンバーは、それぞれ 200 円を所持しており、その内のいくらかをグループとして「オプション」に投資するかを、あなた自身のご判断で入力してください。投資は 200 円の内のいくらでも構いません。グループとしての投資額は、メンバーの投資額の中央値により決定します。例えば、それぞれのメンバーの投資額が「0 円」、「50 円」、「100 円」であれば、中央値の「50 円」がグループの投資額となります。同一グループのすべてのメンバーは、上記に従い同額を投資し同じ金額を獲得します。3 人グループの意思決定の場合も、グループにおいて最も望ましいと思う投資額を入力してください。あなたが受け取る獲得金額は、以下の通りです。
獲得金額 = 200 円 - グループの投資額 + オプションから得た金額

※中央値とは
データを大きさの順に並べたときに、ちょうど中央に位置するデータのことである。例えば、(0, 30, 80, 100, 200) における中央値は、「80」である。

ここまでの説明で質問などはございますか。それではこれから、意思決定について考えて頂くため、1 分間のシンキングタイムを取ります。
1 分間経過したので、これから意思決定を行って頂きます。目の前の PC の画面に注目してください。以下の画面が表示されましたら、投資額を入力してください（0 円から 200 円までの金額）。投資は、10 円単位で行うことができます。入力後は、「OK」ボタンをクリックし、そのままお待ちください。

【入力画面（「投資額」の決定）】

＜1 人の意思決定の方＞

＜3 人グループの意思決定の方＞
3.4 実験4

＜1人の意思決定の方＞
プレイヤーは、はじめに200円を所持しています。その200円の内のいくらかを「日本赤十字社」に寄付することができます。寄付は200円内のいくらでも構いません（0円から200円までの金額）。皆さまに入力して頂いた寄付額は、実験者から実際に「日本赤十字社」へ寄付いたします。あなたが受け取る獲得金額は、以下の通りです。

獲得金額 = 200 −寄付額

＜3人グループの意思決定の方＞
あなたとグループの他のメンバーは、それぞれ200円を所持しており、その内のいくらかをグループとして「日本赤十字社」に寄付するかを、あなた自身のご判断で入力してください。寄付は200円内のいくらでも構いません。グループとしての寄付額は、メンバーの寄付額の中央値により決定します。例えば、それぞれのメンバーの寄付額が「0円」、「50円」、「100円」であれば、中央値の「50円」がグループの寄付額となります。同一グループのすべてのメンバーは、上記に従い同額を寄付し同じ金額を獲得します。3人グループの意思決定の場合も、グループにおいて最も望ましいと思う寄付額を入力してください。あなたが受け取る獲得金額は、以下の通りです。

獲得金額 = 200 −グループの寄付額

※日本赤十字社とは
日本赤十字社は、紛争・災害・病気などで苦しむ人を救うためあらゆる支援をしています。皆様の寄付・献血・ボランティアをお待ちしております（日本赤十字社HPより引用）。

日本赤十字社

ここまでの説明で質問などはございますか。それではこれから、意思決定について考えて頂くため、1分間のシンキングタイムを取ります。
1分間経過したので、これから意思決定を行って頂きます。目の前のPCの画面に注目してください。以下の画面（次ページ）が表示されましたら、寄付額を入力してください。
い（0 円から 200 円までの金額）。寄付は、10 円単位で行うことができます。入力後は、「OK」ボタンをクリックし、そのままお待ちください。

【入力画面（「寄付額」の決定）】

＜1人の意思決定の方＞

＜3人グループの意思決定の方＞
Appendix D. Experiment Instructions (original Japanese version for the random rule)

実験インストラクション

1. はじめに
この度は、実験にご参加頂き、誠にありがとうございます。これから行う実験について説明いたします。ご不明な点がございましたら、手を挙げて質問してください。なお、実験が終了するまで私語は慎み、携帯電話の電源は切ってください。最初に、以下の配布物が手元にあることを確認してください。

●実験インストラクション（本紙）
●実験の同意書
●謝金の領収書
●筆記用具

2. 実験の概要
本日、お集まり頂いた方には、これからコンピュータを使用して4種類の異なる実験に参加して頂きます。各実験の意思決定の結果に応じて、皆さまの実験報酬が決定されます。実験終了後、実験報酬に参加報酬1,100円を加えた金額を現金にて支払います。是非、多くの現金を獲得してください。
これより、実験1を行います。実験インストラクションにおいて、「プレイヤー」とは皆さまであり、「実験者」とは実験を実施する私たちを指します。なお、実験の途中において、いかなる理由により退席された場合にも、皆さまが不利益を被ることはございません。
3.1. 実験1
この実験では、あなた自身にとって、以下の「オプション A」と「オプション B」のどちらがより好ましいかを選択して頂きます。

<table>
<thead>
<tr>
<th></th>
<th>オプションA</th>
<th>オプションB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1.</td>
<td>確率10%(200円) 確率90%(160円)</td>
<td>確率10%(380円) 確率90%(10円)</td>
</tr>
<tr>
<td>Q2.</td>
<td>確率20%(200円) 確率80%(160円)</td>
<td>確率20%(380円) 確率80%(10円)</td>
</tr>
<tr>
<td>Q3.</td>
<td>確率30%(200円) 確率70%(160円)</td>
<td>確率30%(380円) 確率70%(10円)</td>
</tr>
<tr>
<td>Q4.</td>
<td>確率40%(200円) 確率60%(160円)</td>
<td>確率40%(380円) 確率60%(10円)</td>
</tr>
<tr>
<td>Q5.</td>
<td>確率50%(200円) 確率50%(160円)</td>
<td>確率50%(380円) 確率50%(10円)</td>
</tr>
<tr>
<td>Q6.</td>
<td>確率60%(200円) 確率40%(160円)</td>
<td>確率60%(380円) 確率40%(10円)</td>
</tr>
<tr>
<td>Q7.</td>
<td>確率70%(200円) 確率30%(160円)</td>
<td>確率70%(380円) 確率30%(10円)</td>
</tr>
<tr>
<td>Q8.</td>
<td>確率80%(200円) 確率20%(160円)</td>
<td>確率80%(380円) 確率20%(10円)</td>
</tr>
<tr>
<td>Q9.</td>
<td>確率90%(200円) 確率10%(160円)</td>
<td>確率90%(380円) 確率10%(10円)</td>
</tr>
<tr>
<td>Q10.</td>
<td>確率100%(200円) 確率0%(160円)</td>
<td>確率100%(380円) 確率0%(10円)</td>
</tr>
</tbody>
</table>

例えば、Q1 では、「オプション A：確率 10%で 200 円、確率 90%で 160 円を獲得」と「オプション B：確率 10%で 380 円、確率 90%で 10 円を獲得」のどちらのオプションが、あなたにとってより好ましいかを選択してください。実験では、Q1 から Q10 まで、それぞれ「オプション A」または「オプション B」を同様に選択して頂き、最後にコンピュータがランダムにくじ（1番から10番）を引き、皆様が実際に獲得する金額を決定いたします。
す。具体的には、コンピュータのくじ引きにおいて「5番」が出た場合には、Q5で「オプションA」を選択されている回答者は、「オプション A：確率 50%で 200 円、確率 50%で 160 円を獲得」が実現します。「オプション B」を選択されている回答者も同様に獲得金額が実現します。

ここまでの説明で質問などはございますか。それではこれから、意思決定について考えて頂くため、1分間のシンキングタイムを取ります。

1 分間経過したので、これから意思決定を行って頂きます。目の前の PC の画面に注目してください。以下の画面が表示されましたら、Q1からQ10までそれぞれ「オプションA」または「オプション B」の選択を入力してください。入力後は、「OK」ボタンをクリックし、そのままお待ちください。

【入力画面（「オプション」の選択）】

以下のような画面が表示され、Q1からQ10までそれぞれ「オプションA」または「オプション B」の選択を入力してください。

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
<th>Q5</th>
<th>Q6</th>
<th>Q7</th>
<th>Q8</th>
<th>Q9</th>
<th>Q10</th>
</tr>
</thead>
<tbody>
<tr>
<td>確率30%、200円</td>
<td>確率30%、200円</td>
<td>確率30%、200円</td>
<td>確率30%、200円</td>
<td>確率30%、200円</td>
<td>確率30%、200円</td>
<td>確率30%、200円</td>
<td>確率30%、200円</td>
<td>確率30%、200円</td>
<td>確率30%、200円</td>
</tr>
<tr>
<td>確率50%、160円</td>
<td>確率50%、160円</td>
<td>確率50%、160円</td>
<td>確率50%、160円</td>
<td>確率50%、160円</td>
<td>確率50%、160円</td>
<td>確率50%、160円</td>
<td>確率50%、160円</td>
<td>確率50%、160円</td>
<td>確率50%、160円</td>
</tr>
</tbody>
</table>

入力後は、「OK」ボタンをクリックし、そのままお待ちください。
3.2. 実験 2

プレイヤーは、はじめに 200 円を所持し、それぞれランダムに 3 人から構成されたグループに所属しています。その 200 円の内のいくらかをグループのプロジェクトに貢献する金額を決定して頂きます。プロジェクトへの貢献は 200 円の内いくらでも構いません (0 円から 200 円までの金額)。グループの全メンバー (3 人) からプロジェクトに貢献された総額の 2 倍の金額が、グループ全員に平等に分配されます。各プレイヤーが受け取る獲得金額は、以下の通りです。

獲得金額 = (全メンバーの貢献額 × 2 ÷ 3) + (200 – あなたの貢献額)

例えば、グループ内の 3 人全員がそれぞれ 200 円を貢献した場合、全メンバーの貢献額は 600 円となり、あなたはこの実験より 400 円を獲得します。一方、3 人全員が全く貢献をしない場合は、全メンバーの貢献額は 0 円となり、あなたはこの実験において 200 円を獲得します。

＜練習問題＞

問 1. ある 1 つのグループで、1 人のメンバーが「120 円」を貢献し、2 人が「60 円」を貢献した場合に、それぞれのメンバーの獲得金額はいくらですか。

「120 円」を貢献したメンバー： 円
「60 円」を貢献したメンバー： 円

問 2. ある 1 つのグループで、2 人のメンバーが「180 円」を貢献し、1 人が全く貢献をしなかった場合 (貢献額「0 円」)、それぞれのメンバーの獲得金額はいくらですか。

「180 円」を貢献したメンバー： 円
貢献額「0 円」のメンバー： 円

ここまでの説明で質問などはございますか。それではこれから、意思決定について考えて頂くため、1 分間のシンキングタイムを取ります。

1 分間経過したので、これから意思決定を行って頂きます。目の前のPC の画面に注目してください。以下の画面（次ページ）が表示されましたが、あなた自身の貢献額を入力してください (0 円から 200 円までの金額)。貢献額の入力は、10 円単位で行うことができます。入力後は、「OK」ボタンをクリックし、そのままお待ちください。
【入力画面（貢献額の決定）】

あなたの所納金額 200
あなたの貢献額

OK
実験2まで終了いたしました。続いて、実験3から実験4を順次行います。これ以降、各実験では皆様に「1人の意思決定」または「3人グループの意思決定」をして頂きます。どちらの意思決定を行って頂くかは、コンピュータによりランダムに決定されます。「1人の意思決定」の方は、すべての実験終了まで「1人の意思決定」をして頂きます。同様に、「3人グループの意思決定」に選ばれた方はすべての実験終了まで「3人グループの意思決定」をして頂きます。

（Ⅰ）1人の意思決定：皆さまには、ご自身1人の場合を考えて、各実験における意思決定をして頂きます。あなたにとって、最も望ましい値を入力してください。

（Ⅱ）3人グループの意思決定：皆さまは、これからメンバーがランダムに構成された3人のグループに所属します。グループのメンバーは、すべての実験終了まで同じです。あなたは、グループの意思決定をどのようにしたら良いか、正直にお答えください。実際のグループにおける選択は、確率1/3でグループ内の誰かの意思決定が選択されます。同一グループのメンバーは、各実験において上記のルールに従い、同じ行動をし全員同額の金額を獲得します。

これから、グループのメンバーを紹介します。座席番号呼ばれた方はご起立をお願いします。ただし、すべての実験終了までグループのメンバーと相談をしたり、話すことはできません。
3.3. 実験3

＜1人の意思決定の方＞
プレイヤーは、はじめに200円を所持しています。その200円の内のいくらかを以下の「オプション」に投資することができます。投資は200円の内のいくらでも構いません（0円から200円までの金額）。

【オプション：確率50%で投資額の2.5倍の金額を得る、確率50%で投資額を失う】
あなたが受け取る獲得金額は、以下の通りです。

獲得金額 = 200 -あなたの投資額 + オプションから得た金額
実際にオプションから得られる金額は、コンピュータのくじ引きにより決定します。

＜3人グループの意思決定の方＞
あなたとグループの他のメンバーは、それぞれ200円を所持しており、その内のいくらかをグループとして「オプション」に投資するかを、あなた自身のご判断で入力してください。投資は200円の内のいくらでも構いません。グループとしての投資額は、確率1/3でグループ内の誰かの投資額が選択されます。同一グループのすべてのメンバーは、上記に従い同額を投資し同じ金額を獲得します。3人グループの意思決定の場合も、グループにおいて最も望ましいと思う投資額を入力してください。あなたが受け取る獲得金額は、以下の通りです。

獲得金額 = 200 - グループの投資額 + オプションから得た金額
ここまでの説明で質問などはございますか。それではこれから、意思決定について考えて頂くため、1分間のシンキングタイムを取ります。
1分間経過したので、これから意思決定を行って頂きます。目の前のPCの画面に注目してください。以下の画面が表示されましたら、投資額を入力してください（0円から200円までの金額）。投資は、10円単位で行うことができます。入力後は、「OK」ボタンをクリックし、そのままお待ちください。
【入力画面（「投資額」の決定）】

＜1人の意思決定の方＞
お名前：あなたの名前
あなたの投資額 200
あなたの投資額

＜8人グループの意思決定の方＞
お名前：あなたの名前
あなたの投資額 200
あなたの投資額
3.4 実験 4

＜1人の意思決定の方＞
プレイヤーは、はじめに 200 円を所持しています。その 200 円の内のいくらかを「日本赤十字社」に寄付することができます。寄付は 200 円の内のいくらでも構いません (0 円から 200 円までの金額)。皆さまに入力して頂いた寄付額は、実験者から実際に「日本赤十字社」へ寄付いたします。あなたが受け取る獲得金額は、以下の通りです。

獲得金額 = 200 − 寄付額

＜3 人グループの意思決定の方＞
あなたとグループの他のメンバーは、それぞれ 200 円を所持しており、その内のいくらかをグループとして「日本赤十字社」に寄付するかを、あなた自身のご判断で入力してください。寄付は 200 円の内のいくらでも構いません。グループとしての寄付額は、確率 1/3 でグループ内の誰かの寄付額が選択されます。
同一グループのすべてのメンバーは、上記に従い同額を寄付し同じ金額を獲得します。3 人グループの意思決定の場合も、グループにおいて最も望ましいと思う寄付額を入力してください。あなたが受け取る獲得金額は、以下の通りです。

獲得金額 = 200 − グループの寄付額

※日本赤十字社とは
日本赤十字社は、紛争・災害・病気などで苦しむ人を救うためあらゆる支援をしています。皆様の寄付・献血・ボランティアをお待ちしております (日本赤十字社 HP より引用)。

ここまでの説明で質問などはございますか。それではこれから、意思決定について考えて頂くため、1 分間のシンキングタイムを取ります。

1 分間経過したので、これから意思決定を行って頂きます。目の前の PC の画面に注目してください。以下の画面（次ページ）が表示されましたら、寄付額を入力してください（0 円から 200 円までの金額）。寄付は、10 円単位で行うことができます。入力後に
は、「OK」ボタンをクリックし、そのままお待ちください。

【入力画面（「寄付額」の決定）】

＜1人の意思決定の方＞

あなたには、「1人の意思決定」をしていただきます。
寄付する金額を入力してください。

あなたの寄付金額 200
あなたの寄付額

＜3人グループの意思決定の方＞

あなたには、「3人グループの意思決定」をしていただきます。
寄付する金額を入力してください。

あなたの寄付金額 200
あなたの寄付額
Appendix E. Summary of the Experimental Design

1. Individuals’ risk and altruistic preferences (Tasks 1 and 2)
   In order to control for individuals’ risk and altruistic preferences, we implemented two experiments: a lottery-choice task developed by Holt and Laury (2002) for risk preference (Task 1), and a standard public goods game for altruism attitude (Task 2). These are used for control variables in our regression model (Tables 3–8).

2. An anonymous one-shot investment game and a donation game (Tasks 3 and 4)
   To compare the risk and altruistic attitudes of groups and individuals, we used an anonymous one-shot investment game and a donation game. For the investment task, subjects decided how much money to invest in their options, ranging from 0 yen to 200 yen. The investment options were as follows: a 50% chance of winning 2.5 times of their invested amount and a 50% chance of losing their entire investment. For the donation task, subjects decided how much money to donate to the Japanese Red Cross Society, ranging from 0 yen to 200 yen.

3. Experimental design
   In our experiment, we implemented four different types of tasks, as mentioned below. In the current paper, we investigated the differences between individual and group decision making in an anonymous one-shot investment game and a donation game (Tasks 3 and 4).
   Subjects were divided randomly into two groups: individual-choice and group-choice tasks. For the group-choice task, the subjects were requested only to show their faces to other members without any further communication. The group decision was determined based on the median rule by group members, or the choice of group members, randomly selected with a one-third chance (the random rule). Each team member received the same payoff. Subjects
were told that the members of groups were identical until the end of the experiment.

All subjects in our experiment were undergraduate students at Kochi University of Technology, Kyoto Sangyo University, and Kansai University with the following breakdown:

Kochi University of Technology, individual-choice task (N=48) and group-choice task (N=42);
Kyoto Sangyo University, individual-choice task (N=48) and group-choice task (N=48); Kansai University, individual-choice task (N=87) and group-choice task (N=87).

Appendix F. Selection and Eligibility of Subjects

All subjects in our experiment were undergraduate students from various disciplines at Kochi University of Technology, Kyoto Sangyo University, and Kansai University, and who have native-level Japanese language skills (almost all our subjects were Japanese undergraduate students). They were recruited via the university website and e-mail solicitation, as follows: at Kochi University of Technology (Sona systems, URL: https://kutexp.sona-systems.com/Default.aspx?p_language=JA); at Kyoto Sangyo University (KEEL, URL: https://www.cc.kyoto-su.ac.jp/~aquirax/index.php?KEEL).

We conducted 18 sessions between July 2015 and December 2017. No subject participated in more than one session.