Hierarchies and decision-making in groups: Experimental evidence

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Abstract

In this study, I investigate differences in decision-making outcomes for groups under different hierarchies using an experimental approach. Many decisions in firms, households, and other contexts are not taken by individuals, but by groups. In addition, most groups, especially in firms, are characterized by hierarchical organization structures. While research in management, sociology and psychology has been investigating the role of hierarchies for a long time, there is a lack of experimental economic research on the effect of various group structures or hierarchies on decision-making and its quality. I compare the choices of groups in Holt and Laury (2002) type lottery choices and in intellective tasks in five different group types: a group without hierarchy, a hierarchy by age (where the oldest group member decides), by merit (where the winner in a financial literacy quiz decides), by chance (where a randomly determined leader decides) and by election (where an elected leader decides). Experimental results suggest that there are no differences in the number of safe choices between the different hierarchy types. However, groups with a leader assigned on the basis of merit perform better in intellective tasks.

Keywords: hierarchies, group decision-making, lottery choice, risk attitude, intellective tasks

JEL codes: C92 (Laboratory, Group Behavior); D91(Role and Effects of Psychological, Emotional, Social, and Cognitive Factors on Decision Making)

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1. Motivation

Individual decision-making is a key research area in microeconomics and a considerable amount of theoretical and experimental research has been devoted to its analysis. However, many decisions in firms, households, and other contexts are taken by groups, not by individuals. In addition, most groups, especially in firms, are characterized by hierarchical organization structures. While hierarchies are a common feature of organizations, surprisingly little is known about their effect on outcomes in economic experiments.

In this study, I analyze the effects of hierarchy on outcomes in a lottery choice task (Holt and Laury 2002) and in intellective tasks (following the group task continuum proposed by Laughlin 1980), compared to the choices of a majority voting group of three. Magee and Galinsky (2008) posit that status and power are the two bases of hierarchy and describe power as related to 'control over valued resources' and status as 'respect one has in the eyes of others'. In order to explain the pervasiveness of hierarchy in social settings, they outline two functions of hierarchy, namely, establishing order and improving decision-making (related to power) and motivating individuals (related to status). In this study, hierarchy is conceptualized as formal authority (power) over a group of three's decision-making in the abovementioned two tasks, i.e. the group leader decides about the group's choices after a group discussion period. The hierarchy is implemented according to four different mechanisms: a hierarchy by vote, by age, by merit and by a random mechanism.

Results suggest that compared to majority voting groups, groups with a leader assigned on the basis of merit are more likely to give correct answers in intellective tasks. No effects are found for the other types of hierarchy investigated in this study, and no differences are found between voting groups and hierarchy groups with respect to the number of safe choices they make in the lottery choice task.

The remainder of this study is organized as follows: In section 2, I briefly discuss related literature in experimental economics, psychology, and management. In section 3, I describe experimental procedures and in section 4, I discuss the results. In section 5, I present the conclusion and an outlook.

2. Literature Review

Experimental economic research has in recent years increasingly focused on group decision-making, while research in management, sociology, and psychology has been investigating group decision-making and the role of hierarchies for a long time using different research methods and analyzing different tasks (see, for example, Granovetter 2005 for an overview of results in sociology). Research results in management typically show mixed effects of hierarchies on outcomes, with some studies suggesting that hierarchies might improve performance because they reduce conflict and promote coordination and other studies suggesting they might reduce performance because hierarchies decrease group members' motivation and stifle innovation (see Bunderson et al. 2016 and the literature cited there).

On a related topic, the effect of different decision rules, such as unanimity or majority voting, has been studied in the political economy literature (Feddersen and Pesendorfer 1998, Messner and Polborn 2004) as well as in psychology (Kerr and Tindale 2004, Tindale and Winget 2019). Nonetheless, these strands of related literature do not analyze tasks such as lottery choice and do not analyze the possible effect of hierarchies on decision-making outcomes using an (economic) experimental approach. Therefore, this study aims to investigate possible differences in decision-making outcomes for groups with different types of hierarchies using an experimental approach, allowing to isolate ceteris paribus effects (Falk and Heckman 2009).

Previous experimental economic research on group decision-making has analyzed group behavior in both games (i.e. decision-making tasks against another player) and in non-strategic situations (i.e. games against nature). As the goal of this study is to focus on the latter, I will only review the literature that analyzes tasks similar to the ones in this study. For a more complete overview, see Kugler et al. (2012).

The finding that "biases" exist in individual decision-making in experiments led researchers to investigate whether these biases persist in groups. There is no clear-cut answer to this research question: in some settings, groups show stronger biases than individuals, while in other settings, the biases become weaker (Kerr et al. 1996). Similarly, research in psychology also suggests that groups' decisions are not necessarily superior to those of individuals (Tindale and Winget 2019).[1] These differences in outcomes might be because mechanisms used for reaching an agreement about a group's choice differ widely. With the exception of Baillon et al. (2013) who compare the majority rule and unanimity rule for decision-making, none of the previous research in economics pays attention to the possible effects of different types of hierarchy or decision-making rules on decision-making outcomes. Baillon et al. (2013) analyze group behavior in lottery choices and find that whereas groups are less likely to violate stochastic dominance, they make riskier choices than individuals in Allais paradox tasks (Allais 1953). With respect to decision-making rules, the unanimity rule is found to improve both group communication and group rationality. Baker et al. (2008) also compare individual and three-person group behavior in lottery tasks and with the unanimity rule and find that the number of safe lotteries chosen by groups is higher than the number of safe lotteries chosen by individual group members. Masclet et al. (2009) compare individual and three-person group behavior with the majority rule and find that groups chose safer lotteries. Rockenbach et al. (2007) find that groups accumulate more expected value at a lower risk than individuals, although both violate expected utility theory. However, Shupp and Williams (2008) find that whereas groups are less risk averse than individuals over lottery choices with high winning probabilities, they become more risk averse as the winning probability decreases.

Bone et al. (1999) and Bateman and Munro (2005) both analyze if individuals and groups differ with respect to violations of expected utility theory. Bateman and Munro (2005) compare couples to individuals and find no differences in behavior. Bone et al. (1999)

[1] However, Charness and Sutter (2012) analyze results from game theoretical experiments where groups are the players and conclude that groups are more likely to make choices that are predicted by game theory.

compare randomly-matched groups of two individuals and find no differences either. Charness et al. (2007) analyse if groups and individuals differ in violation of monotonicity with respect to first-order stochastic dominance. This violation can actually be a decision-making error and not a mere expression of preferences; that is, an individual should always prefer a better chance of winning more money. For groups of two and three and no specified decision rule, they find that groups are less likely to make errors when facing these lottery choices. Deck et al. (2012) analyze differences between individuals and groups of two and find that gender and age influence bargaining strength, and that making a pair decision first increases risk-taking in subsequent individual choices. Ertac and Gurdal (2012) analyze risk-taking behavior on behalf of a group and find that men are more willing to become leaders than women, and that both take fewer risks when deciding on behalf of a group. Maciejovsky et al. (2013) find that groups make choices closer to the rational prediction and learn the solution faster than individuals in challenging probability and reasoning tasks, namely, the Monty Hall problem and the Wason selection task.

To summarize the experimental literature on group decision-making, there is no consensus about whether groups make better decisions than individuals, or whether they are more rational than individuals. In addition, with the exception of Baillon et al. (2013), no previous research focuses on the possible role of different decision-making rules, especially hierarchies. Therefore, an investigation of choice over lotteries with different hierarchies and performance in intellective tasks presents a worthwhile avenue for research.

The literature on organizational behavior and psychology has mostly focused on the impact hierarchies might have on performance. Following Laughlin (1980), there has been a broad distinction between performance in ‘intellective tasks’ that have a correct answer (e.g. algebra problems) and ‘judgmental tasks’ that do not. In this framework, the lottery choice task belongs to the second category, as there is no correct answer, in contrast to the intellective tasks. Levine and Smith (2013) distinguish between ‘group problem-solving tasks’ that have high demonstrability and are intellective and ‘group decision-making tasks’ that have low demonstrability and are judgmental. In social psychology, much of the second type involves tasks where groups have to choose from among a small number of discrete alternatives (such as lotteries). This study uses tasks of both types and analyses the effect of hierarchies on their outcomes.

According to Halevy et al. (2011), hierarchies are one of the most common forms of organization and often emerge spontaneously. They identify five ways in which hierarchies can enhance performance and success: They fulfil psychological needs, such as power and status; provide an incentive system, therefore motivating both high- and low-ranked individuals; increase coordination; reduce conflict; and improve cooperation. Finally, they also bring about complementary psychological processes. Halevy et al. (2011) also identify three moderators when hierarchy is beneficial for organisations: when there is procedural interdependence, when the hierarchy is legitimate, and when different bases of hierarchy such as competence or power are aligned rather than misaligned. Consequently, when status (i.e. leader's status in a hierarchy) is conferred based on individual characteristics that are irrelevant or even detrimental to goals, hierarchies might not be beneficial (Halevy et al. 2011).

Other authors have focused on why group inequalities such as hierarchy might worsen group performance. Ronay et al. (2012) focus on the role of status conflicts and their potential detrimental effect on group performance. They find that hierarchically-differentiated groups are more productive in a high, rather than low, procedural interdependence task.

There is almost no literature on hierarchy and its possible impact on risk-taking behavior. One exception is the work by Mihet (2013), who does not take an experimental approach but analyzes firm-level data from 51 countries for the effect of 'culture' on corporate risk-taking behavior. This is measured using data from the Corporate Vulnerability Utility (CVU) developed by the IMF using Worldscope and Datastream data. The findings suggest (among other results) that risk-taking is higher in countries with low tolerance for hierarchical relationships.

The previous section has shown that the effect of hierarchies depends on a number of factors, such as the type of task that groups are supposed to perform and the criteria upon which leadership is conferred. Based on the surveyed literature, the following hypotheses are derived:

H1: Groups where the leader has been assigned based on irrelevant characteristics (such as age or using a random assignment mechanism) perform worse on intellective tasks than those where the leader was assigned based on merit.

H2: Groups with a hierarchy make more safe choices in a lottery choice task than those without hierarchy.

3. Experimental Procedures

In the following section, I will describe the experimental procedures in more detail. First, I will describe the experimental design and treatments needed for analyzing the research question. Secondly, I will describe the implementation of 'hierarchy' in experimental treatments. Thirdly, I will describe the decision-making tasks used during the experiments. Finally, I will describe the process of conducting the experiments.

The experiments were conducted using a within-subjects design. To investigate the effect of hierarchy on decision-making outcomes, three treatments were required: an individual decision-making experiment as the baseline case to compare group and individual choices; a group decision-making experiment without hierarchy; and a group decision-making experiment with hierarchy, where different types of hierarchies were investigated. The effect of hierarchy on group decision-making can then be observed by comparing the results between the second and the third treatment.

The second experimental treatment (group without hierarchy) was implemented as group decision-making with majority vote as the decision-making mechanism. With majority vote, every group member's decision has the same weight and there is no hierarchy.

For the third experimental treatment (group with hierarchy), four different types of hierarchies were investigated. The first type of hierarchy was to have an elected leader for every group. The second type was a 'hierarchy by merit', where the group member who performed best on a test was the group leader. The third type was a 'hierarchy by age', where the oldest group member was the group leader. Finally, a 'hierarchy by chance' was also investigated, where the group leader was selected by a random mechanism. In all hierarchies, the leader took the final decision after a ten-minute discussion time with group members.

Similar decision-making tasks were used to enable comparison with previous research on group decision-making. The lottery described in Holt and Laury (2002) was selected because of its widespread use. The fact that this decision-making task has been used in a considerable number of previous studies enables both the replication of previous results and a comparison of the effects of different hierarchies. In addition to this lottery task choice, groups also had to solve intellective tasks, similar to those described in Curseu et al. (2013) and Huang and Wang (2010). Those tasks represented the application of framing effects, the Ellsberg paradox, and basic probability. Examples of all intellective tasks can be found in Appendix 2.

Sessions were conducted as paper-and-pencil experiments due to the lack of an experimental lab at the university where the sessions took place. In line with standard practice in experimental economics, undergraduate students were subjects, with no restrictions based on major, age, or gender. As this was the first economic experiment conducted at the university, there were no restrictions on prior experiment participation either. The instructions were translated into Korean by one person and back into English by another person to check for inconsistencies. Non-Korean subjects were provided with the original English instructions, whereas Korean subjects were provided with translated instructions. The instructions were pre-tested and the overall time needed for completion of all tasks and questionnaires was determined. The experimental sessions were conducted in three sessions, with a total of 99 participants. After deleting observations with missing values, a total of 96 participants in 32 groups remained. As each group participated in five rounds (as a voting group and under all four types of hierarchy investigated in this study), the group dataset consists of $n = 160$ observations. A total of $n = 128$ participants were leaders in one or more types of hierarchies and, therefore, a dataset consisting of leaders is also available for analysis.

Table 12 in the appendix provides basic demographics for the sample.

During all three experimental sessions, subjects were first read the instructions. In sessions with both Korean and non-Korean subjects, the instructions were read aloud in both English and Korean, and in Korean in sessions with Korean subjects only. Subjects then made an individual choice over the lottery and completed three intellective tasks. After individual tasks, subjects were randomly assigned into groups of three where they participated in all five group settings (i.e. the voting group and the four different hierarchy group settings). Participation order in the different types of hierarchies was randomized. After the final treatment, subjects answered a background questionnaire.

Finally, payments were determined and subjects were paid according to their choices in all three treatments (individual, group without hierarchy, and group with hierarchy). For each of the lottery choices, one row was randomly determined by the throw of a ten-sided die to be relevant for the payout. Payment was determined identically, was the same amount for all members of the group in the group treatments and corresponded to the choice that the group made in the respective treatment. In line with standard procedures in experimental economics, subjects were presented with incentivized choices, i.e. paid cash for their participation in the experiment based on the choices they made. In addition, subjects received a show-up fee of 5,000 KRW to ensure they received adequate pay for participation.

Full experimental instructions and financial literacy questions can be found in Appendix B.

4. Results

In this section, I will briefly present and discuss results from the experiments described above. All analyses were carried out using STATA SE 16.1. To give an overview of individual choices, I will first briefly discuss the choices from the first treatment (individual choice) before moving on to group choices as the main research focus of this study.

Table 1 about here

Table 1 shows the number of safe choices in the lottery for individuals. The average number of safe choices is 4.833. About 6.25% percent of subjects made inconsistent choices, that is, they switched several times between the safe and the risky option. On average, subjects answered 32.29% of the intellective tasks correctly.

In table 2, I compare the choices of five different types of groups: a voting group without a hierarchy, a group with a randomly determined hierarchy, a group with an elected leader, a group where the eldest group member became the leader, and a group where the group member who performed best on a financial literacy test became the leader. Please note that there are n = 160 observations in this data set, as all 32 groups made decisions under the aforementioned five different group settings (a voting group and four different types of hierarchy).

Table 2 about here

As Table 2 shows, groups with an age-based hierarchy make most safe choices (5.1563), followed by a voted leader (5.0938), those with a randomly determined leader and the voting group (5 each), and hierarchy by merit (4.9688). Voting groups and random and age-based hierarchies make fewer inconsistent choices in the lottery than those with an elected leader and hierarchy by merit. However, these differences are not statistically significant (Kruskal-Wallis test, χ^2 = 0.322 for the number of safe choices, χ^2 = 0.634 for the probability of an inconsistent choice). For the intellective tasks, groups with a merit-based hierarchy make by far the most correct choices, while voting groups make by far the most incorrect choices. These differences are statistically significant (Kruskal-Wallis test, χ^2 = 8.199).

In Table 3, I present regression results for the same outcomes (number of safe choices in the lottery, probability of making an inconsistent choice, probability of a correct answer in the intellective task). Column 1 presents the determinants of the number of safe choices in the lottery task, using an ordered probit model. Column 2 presents the determinants of the probability of making an inconsistent choice in the lottery task, using a probit model. Column 3 presents the determinants of the probability of giving a correct answer in the intellective task, using a probit model. The baseline case is the voting group, and four dummy variables denote the aforementioned four different types of hierarchy.

To save space, only the regressors of interest are presented here. Full regression results including the constants for probit and cutpoints for ordered probit models can be found in Table 13 in Appendix A. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

Table 3 about here

There seem to be no effects of different types of hierarchies on the number of safe choices and the probability of making an inconsistent choice in Holt and Laury (2002) type lottery choice tasks. However, compared to voting groups, groups with a leader assigned on the basis of merit are significantly more likely to provide a correct answer in the intellective tasks.

In order to gauge the size of this effect, I also present changes in predicted probabilities for the probability of a making an inconsistent choice in the lottery task and giving a correct answer in the intellective task in Table 4. These were computed the SPost 14 package (Long and Freese 2014). P-values are provided in parentheses. Again, to save space, changes in predicted probabilities using an ordered probit models are only presented in Appendix A, Table 15.

Table 4 about here

Compared to a voting group, having a leader assigned on the basis of merit increases the probability of giving a correct answer in the intellective task by 38.9%. This effect is found to be statistically significant at the 1% level.

The groups' choices might simply be a repetition of the leaders' choices in the first individual choice task, both in the lottery and in the intellective tasks. To investigate this possibility, the following table compares the choices of leaders in the individual tasks to those they made as leaders of groups. This data set consists of the n =128 individuals who were leaders in one or more of the different hierarchy treatments.

Table 5 about here

In all treatments, the number of safe choices made by leaders increased, compared to the choices they made as individuals. The percentage of those who made inconsistent choices decreased or was identical. However, only one of the differences is statistically significant (test statistics for paired sample t-tests are presented in Table 5): leaders by age make more safe choices when they become group leaders.

For the intellective tasks, no statistically significant differences where found for leaders' behaviour as individuals and as leaders.

As there might be other determinants of leaders' behavior, I also present results from a regression analysis of the determinants of leaders' choices, which also allows to control for leaders' characteristics. This data set consists of the n = 128 individuals who were leaders in one or more hierarchy treatments. While this analysis allows to control for leaders' characteristics, it also allows to compare only choices in the hierarchy treatments, not choices in the voting group treatment.

Table 6 presents results for the determinants of the three following outcomes: the number of safe choices (column 1), using an ordered probit model; the probability of making an inconsistent choice (column 2), using a probit model; and the probability of making a correct decision in the intellective task (column 3); using a probit model. In all three regressions, the following variables are included as regressors: a leader's choices in the individual tasks (namely, their number of safe choices, if they made an inconsistent choice in the individual lottery choice task and their number of correct decisions in the individual intellective tasks), their gender (1 if female, 0 if male), the number of group members they had known before the experiment (if any), their citizenship (1 if Korean, 0 if other), and the type of hierarchy under which they were the leader. The merit-based hierarchy is the baseline case and three dummy variables take the value of 1 if the person was a leader in an age-based, vote-based, or random mechanism-based hierarchy. To save space, only the regressors of interest are presented here. Full regression results including the constants and cutpoints can be found in Appendix A, Table 14. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

Table 6 about here

As these estimated coefficients are not very meaningful in non-linear models, I will only briefly discuss them before moving on to a more thorough discussion of marginal effects and changes in predicted probabilities for "ideal types".

For the determinants of the number of safe choices in the lottery task (column 1), a measure of risk aversion, no effect was found for any type of hierarchy, compared to the baseline case of hierarchy by merit. Two individual-level regressors are statistically significant: leaders who made more safe choices in the individual choice task (i.e. leaders who are more risk averse) tend to make more safe choices as the leader as well. Female leaders, interestingly, tend to make fewer safe choices than males.

For the determinants of the probability of making an inconsistent choice in the lottery task (column 2), again, no effect was found for any type of hierarchy, compared to the baseline case of hierarchy by merit. Two individual-level regressors are statistically significant: the more group members a group knew before the experiment, the higher is their probability of making an inconsistent choice. In addition, Koreans are less likely to make an inconsistent choice, compared to non-Koreans.

For the determinants of the probability of making an incorrect choice in the intellective task (column 3), a clear result emerges: compared to leaders who were appointed in hierarchy by merit, all others are significantly less likely to make a correct choice, even after controlling for the leader's number of correct choices in the intellective tasks of the individual choice task and other individual characteristics. In addition, Koreans are significantly less likely to make a correct choice in the intellective task, compared to non-Koreans.

Table 7 presents average marginal effects (AMEs) for the same three regressions. These AMEs were calculated by computing changes for each observation at its observed values and then averaged, using the SPost13 package in Stata 16.1 (Long and Freese, 2014). P-values are reported in parentheses. These average marginal effects were calculated for the change from hierarchy by merit to the respective other type of hierarchy (hierarchy by age, by vote, or a random hierarchy). Marginal effects for the probability of making an inconsistent choice and a correct answer, using a probit model and calculated using the

SPost package will be reported and discussed.

As the interpretation of marginal effects in an ordered probit model with a dependent variable that can take values between 0 and 10 is rather space-consuming and probably not very informative for the research question, estimated coefficients from OLS regression for the number of safe choices were reported here. Marginal effects from an ordered probit model are presented in Appendix A, Table 16.

Table 7 about here

The results for determinants of the number of safe choices in the Holt and Laury (2002) lottery task (column 1) will be discussed first. None of the different types of hierarchy have a statistically significant effect on the number of safe choices. The only regressor that shows a statistically significant effect is the leader's number of safe choices in the individual choice task, suggesting that individual risk attitude matters for a leader's choices as well. For every additional safe choice that a group's leader made in the individual choice task, the number of safe choices they make as leaders increases by 0.6757. This estimated coefficient is statistically significant at the 1% level.

Regarding the determinants of the probability of making an inconsistent choice in the lottery task (column 2), there is an effect of having a leader based on age, as opposed to merit. Having a leader based on age decreases the probability of making an inconsistent choice by 5.3%, compared to having a leader based on merit. Also, Korean leaders have a lower probability of making an inconsistent choice, compared to non-Korean leaders, where the probability of making an inconsistent lottery choice as a leader decreases by 6.7%, and this effect is statistically significant at the 1% level.

Finally, for the probability of making an incorrect choice in the intellective task (column 3), the following results can be stated: compared to leaders who were appointed in a hierarchy by merit, all others are significantly less likely to make a correct choice, even after controlling for the leader's number of correct choices in the intellective tasks in the individual choice task. More specifically, compared to leaders appointed by merit, leaders appointed by a random hierarchy are 16.4% less likely to make a correct choice, and this effect is statistically significant at the 5% level. Leaders appointed by vote are 18.6% less likely to make a correct choice, and this effect is statistically significant at the 1% level.

Lastly, leaders appointed by age are 21.9% less likely to make a correct choice in the intellective task, and this effect is statistically significant at the 1% level. In addition, Koreans are significantly less likely to make a correct choice in the intellective task, compared to non-Koreans: the probability that they make a correct choice is 26.3% lower, and this effect is statistically significant at the 1% level.

Lastly, in order to provide a more complete analysis of the possibly heterogeneous effects of type of hierarchy on group decision-making outcomes, I also present changes in predicted probabilities of the probability of making an inconsistent choice and giving a correct answer in the intellective tasks for four different "ideal types" of leaders: a non-Korean woman, a non-Korean man, a Korean woman, and a Korean man. The changes in predicted probabilities here were calculated as the result of a change from the merit-based hierarchy to a vote-based, age-based, and random hierarchy. The other regressors were held constant at the sample means, with the exception of the number of safe choices in individual choice and the number of group members known before the experiment, which were held constant at the sample modes (Tables 8,9,10 and 11).

To save space, again, the results from ordered probit models for the number of safe choices are only presented in Appendix A (Table 17).

Tables 8 to 11 about here

For the predicted probabilities of making an inconsistent choice in the lottery choice task, there are no statistically significant changes. For the predicted probabilities of making a correct answer in the intellective tasks, however, the predicted probabilities decrease for all types of hierarchy and all four "ideal types", compared to a hierarchy by merit. Compared to a hierarchy by merit, the predicted probabilities decrease between 22.7% and 30.8% for a Korean woman, between 17.7% and 29.7% for a non-Korean woman, between 24.2% and 33.5% for a Korean man and between 15.2% and 26.3% for a non-Korean man. The largest decrease in predicted probabilities is found for having a leader by age, compared to a leader by merit, and this effect is always found to be statistically significant.

5. Discussion and Conclusion

This study presents experimental evidence on the choices of groups characterized by different types of hierarchies. The considered choice and decision tasks were a Holt and Laury-type lottery choice task (Holt and Laury, 2002), and intellective tasks, that is, applications of basic probability, framing, and Ellsberg paradox tasks. No evidence was found for an effect of types of hierarchy on the number of safe choices in the lottery choice task, but groups with a leader appointed by merit performed better on the intellective task choices than leaders appointed by a random mechanism, group vote, or age. Comparing these results to previous findings is difficult, as there is only little research on group behavior in experiments and none, to the best of my knowledge, that analyzes the role of hierarchies in group decision-making tasks such as the ones used in this study. When comparing the choices of individuals to those of voting groups, I found that voting groups (i.e. the type of group analyzed in previous research) make more safe choices than individuals, are less likely to make inconsistent choices, and are less likely to give correct answers in intellective tasks. This confirms the previous findings of Maciejovsky et al. (2013), who find that groups make choices closer to the rational prediction and learn the solution faster than individuals in challenging probability and reasoning tasks, Baker et al. (2008), who find that the number of safe lotteries chosen by groups is higher than the number of safe lotteries chosen by individual group members under unanimity voting, Masclet et al. (2009), who find that with the majority rule, groups choose safer lotteries, and Rockenbach et al. (2007), who find that groups accumulate more expected value at a lower risk than individuals. However, it contradicts the findings of Baillon et al. (2013), who find that groups make riskier choices than individuals in Allais paradox tasks (Allais 1953).

Results on the determinants of the quality of group decision-making in psychology have typically also focused on group members' individual characteristics, such as their expertise, or their openness to other opinions (Tindale and Winget 2019). The finding that groups with wiser members usually make better choices is confirmed by the finding that a merit-based leader makes better choices in intellective tasks.

With regard to the research hypotheses posited in this study, H1 (Groups where the leader has been assigned based on irrelevant characteristics (such as age or using a random assignment mechanism) perform worse on intellective tasks than those where the leader was assigned based on merit) was confirmed, but H2 (Groups with a hierarchy make more safe choices in a lottery choice task than those without hierarchy) was rejected. From a policy perspective, these results suggest that the still common practice of assigning leadership based on seniority might lead to decisions of suboptimal quality, while assigning leadership based on merit could improve the quality of decisions.

In future research, it would be worthwhile to analyze the effect of hierarchies on other decision-making tasks, as well as the effect of other types of hierarchies on different types of outcomes.

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Table 1. Number of safe choices, percentage of inconsistent choices for individuals

	# of safe choices	% of inc. choices	% of correct IT answers	*n*
Entire sample	4.8333	6.25%	32.29%	96

Table 2. Number of safe choices, percentage of inconsistent choices and correct number of answers to intellective task for groups

	# of safe choices	% of inc. choices	% of correct IT answers	*n*
Voting group	5.0000	3.125%	16.125%	32
Random hierarchy	5.0000	3.125%	28.125%	32
Hierarchy by vote	5.0938	12.5%	21.875%	32
Hierarchy by age	5.1563	3.125%	21.875%	32
Hierarchy by merit	4.9688	6.25%	53.125%	32

Table 3: Regression results - number of safe choices, probability of inconsistent choices and correct answers to intellective task for groups

	# of safe choices (ordered probit)	prob. of inc. choice (probit)	prob. of correct IT answer (probit)
1 = random hierarchy	0.0079	-0.0000	0.4309
	(0.2549)	(0.6180)	(0.3568)
1 = hierarchy by vote	0.0617	0.7124	0.2336
	(0.2551)	(0.5212)	(0.3648)
1 = age hierarchy	0.0713	-0.0000	0.2336
	(0.2551)	(0.6180)	(0.3648)
1 = merit hierarchy	-0.0430	0.3286	1.0884***
	(0.2550)	(0.5586)	(0.3478)
n	160	160	160

The baseline group is the voting group without a hierarchy. Standard errors are given in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

Table 4: Changes in predicted probabilities, probability of inconsistent choices and correct answers to intellective task for groups

	Prob. of inconsistent choice	Prob. of correct IT answer
1 = random hierarchy	-0.000	0.148
	(1.000)	(0.251)
1 = hierarchy by vote	0.126	0.077
	(0.329)	(0.541)
1 = age hierarchy	-0.000	0.077
	(1.000)	(0.541)
1 = merit hierarchy	0.045	0.389***
	(0.633)	(0.000)

The baseline group is the voting group without a hierarchy. P-values are given in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

Table 5. Leader's choices in individual choice and as leaders

	No. of safe choices	% of inc. choices	% of correct IT answers	*n*
Individual choice	4.875	0.0938	0.2917	32
Random hierarchy	5	0.0313	0.2813	32
t	-0.4865	1.0000	0.1203	
Individual choice	5.0000	0.0938	0.2292	32
Hierarchy by vote	5.2188	0.1250	0.2500	32
t	-0.8515	-0.4416	-0.2260	
Individual choice	4.7500	0.0625	0.2604	32
Hierarchy by age	5.1250	0.0313	0.2188	32
t	-1.7510*	0.5712	0.4941	
Individual choice	4.7188	0.0938	0.3958	32
Hierarchy by merit	4.8438	0.0938	0.5313	32
t	-0.4592	0.0000	-1.2687	

***, **, and * indicate significance levels of 1%, 5%, and 10%, respectively from paired sample t-tests.

Table 6. Determinants of leaders' choices: estimated coefficients

	No. of safe choices (ordered probit)	Prob. of inc. choice (probit)	Prob. of correct IT answer (probit)
1 = random leader	0.0607	-0.7767	-0.6459*
	(0.2646)	(0.7705)	(0.3365)
1 = elected leader	0.2159	-0.0428	-0.7622**
	(0.2711)	(0.5610)	(0.3535)
1 = leader by age	0.2067	-1.1516	-0.9695***
	(0.2655)	(0.8655)	(0.3565)
No. of safe choices	0.5712***	0.1189	-0.0786
in ind. choice	(0.0674)	(0.1526)	(0.0745)
1 = inconsistent choice	-0.5400	1.0948	0.1068
in ind. choice	(0.3708)	(0.8372)	(0.4996)
Percentage of correct	0.2539	-0.5745	0.2063
ind. IT choices	(0.3371)	(0.9299)	(0.4474)
1 = female	-0.4773**	-0.6540	-0.1642
	(0.2125)	(0.7813)	(0.2801)
No. of team members	0.0733	0.7028*	-0.0506
known before	(0.1165)	(0.3780)	(0.1567)
1 = Korean	0.2085	-2.2046***	-1.3389***
	(0.3219)	(0.7617)	(0.4192)
n	128	128	128

The baseline group is leaders by merit. Standard errors are given in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively. Full regression results including cutpoints for the ordered probit and constants for the probit model estimates can be found in the appendix.

Table 7: Type of hierarchy and leaders' choices – OLS estimates, marginal effects

	No. of safe choices (OLS)	Prob. of inc. choice (Probit)	Prob. of correct IT answer (Probit)
1 = random leader	0.0303	-0.042	-0.164**
	(0.3197)	(0.028)	(0.065)
1 = elected leader	0.1922	-0.003	-0.186***
	(0.3257)	(0.041)	(0.062)
1 = leader by age	0.2318	-0.053**	-0.219***
	(0.3210)	(0.023)	(0.052)
# of safe choices	0.6757***	0.010	-0.024
in ind. choice	(0.0662)	(0.013)	(0.022)
1=inconsistent choice	-0.6115	0.131	0.033
in ind. choice	(0.4492)	(0.131)	(0.159)
Percentage of correct	0.2897	-0.034	0.065
ind. IT choices	(0.4091)	(0.041)	(0.147)
1 = female	-0.5442**	-0.037	-0.048
	(0.2541)	(0.033)	(0.078)
No. of team members	0.0962	0.072	-0.015
known before	(0.1410)	(0.047)	(0.047)
1 = Korean	0.2744	-0.067***	-0.263***
	(0.3892)	(0.000)	(0.042)
Constant	1.5058**		
	(0.6304)		
N	128	128	128

The baseline group is leaders by merit. Standard errors are given in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively. Full regression results including cutpoints for the ordered probit and constants for the probit model estimates can be found in the appendix.

Table 8: Changes in predicted probabilities, Korean woman

	Prob. of inconsistent choice	Prob. of correct IT answer
1 = random leader	-0.001 (0.780)	-0.227* (0.054)
1 = elected leader	-0.000 (0.940)	-0.259** (0.027)
1 = leader by age	-0.001 (0.779)	-0.308*** (0.006)

Table 9: Changes in predicted probabilities, non-Korean woman

	Prob. of inc. choice	Prob. of correct IT answer
1 = random leader	-0.116 (0.432)	-0.177 (0.108)
1 = elected leader	-0.010 (0.939)	-0.218* (0.079)
1 = leader by age	-0.137 (0.393)	-0.297** (0.018)

Table 10: Changes in predicted probabilities, Korean man

	Prob. of inc. choice	Prob. of correct IT answer
1 = random leader	-0.005 (0.661)	-0.242* (0.051)
1 = elected leader	-0.001 (0.940)	-0.278** (0.023)
1 = leader by age	-0.005 (0.659)	-0.335*** (0.005)

Table 11: Changes in predicted probabilities, non-Korean man

	Prob. of inc. choice	Prob. of correct IT answer
1 = random leader	-0.229 (0.365)	-0.152 (0.156)
1 = elected leader	-0.016 (0.939)	-0.190 (0.135)
1 = leader by age	-0.290 (0.359)	-0.263** (0.046)

The baseline group is leaders by merit. P-values are given in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively. The changes in predicted probabilities are for a binary change to the respective type of hierarchy (random, elected, or by age).

All estimates contain the following control variables: an individual's number of safe choices (held constant at the sample mode), the probability that an individual made an inconsistent choice (held at the sample mean), their percentage of correct IT answers in individual choice (held at the sample mean), and the number of team members they knew before the experiment (held at the sample mode).

Appendix A: Additional statistics and results

Table 12: Sample demographics

	Mean	Std. Dev.	Min	Max
No. of safe choices in ind. choice	4.8333	1.7147	1	10
1 = inconsistent choice in ind. choice	0.0625	0.2433	0	1
% of correct ind. IT choices	0.3229	0.2534	0	1
Female	0.3854	0.4892	0	1
No. of members known before	0.9583	0.8325	0	2
Korean	0.9072	0.2916	0	1

Table 13: Regression results - number of safe choices, percentage of inconsistent choices and correct number of answers to intellective task for groups, full estimation results

	# of safe choices	prob. of inc. choice	prob. of correct IT answer
1 = random hierarchy	0.0079	-0.0000	0.4309
	(0.2549)	(0.6180)	(0.3568)
1 = hierarchy by vote	0.0617	0.7124	0.2336
	(0.2551)	(0.5212)	(0.3648)
1 = age hierarchy	0.0713	-0.0000	0.2336
	(0.2551)	(0.6180)	(0.3648)
1 = merit hierarchy	-0.0430	0.3286	1.0884
	(0.2550)	(0.5586)	(0.3478)***
cut1 (constant)	-1.9417	-1.8627	-1.0100
	(0.2651)***	(0.4370)***	(0.2679)***
cut2	-1.6272		
	(0.2323)***		
cut3	-0.9407		
	(0.2001)***		
cut4	-0.2664		
	(0.1897)		
cut5	0.3057		
	(0.1896)		
cut6	1.0842		
	(0.2029)***		
cut7	1.4175		
	(0.2172)***		
cut8	1.8014		
	(0.2464)***		
cut9	1.9809		
	(0.2675)***		
n	160	160	160

Standard errors are given in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

Table 14: Ordered probit estimates, number of safe choices, full estimation results

	Number of safe choices
1 = random leader	0.0607
	(0.2646)
1 = elected leader	0.2159
	(0.2711)
1 = leader by age	0.2067
	(0.2655)
No. of safe in ind. choice	0.5712
	(0.0674)***
1 = inc. choice in ind. choice	-0.5400
	(0.3708)
% of correct ind. IT choices	0.2539
	(0.3371)
1 = female	-0.4773
	(0.2125)**
knewbefore	0.0733
	(0.1165)
1 = korean	0.2085
	(0.3219)
cut1	0.2017
	(0.5777)
cut2	0.6567
	(0.5558)
cut3	1.6274
	(0.5520)***
cut4	2.5551
	(0.5609)***
cut5	3.3490
	(0.5751)***
cut6	4.4920
	(0.6088)***
cut7	4.8989
	(0.6272)***
cut8	5.5424
	(0.6746)***
cut9	6.1069
	(0.7774)***
n	128

Standard errors are given in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

Table 15: Groups, predicted probabilities, number of safe choices

	1	2	3	4	5	6	7	8	9	10
1 = random	0.000	0.000	-0.001	-0.001	0.000	0.001	0.001	0.001	0.000	0.000
	(0.975)	(0.975)	(0.975)	(0.975)	(0.989)	(0.975)	(0.975)	(0.975)	(0.976)	(0.976)
1 = vote	-0.003	-0.003	-0.009	-0.008	0.000	0.009	0.005	0.004	0.001	0.004
	(0.798)	(0.803)	(0.806)	(0.814)	(0.909)	(0.803)	(0.811)	(0.814)	(0.818)	(0.821)
1 = age	-0.004	-0.003	-0.010	-0.010	-0.001	0.011	0.005	0.005	0.002	0.004
	(0.766)	(0.772)	(0.776)	(0.786)	(0.896)	(0.772)	(0.783)	(0.787)	(0.792)	(0.795)
1 = merit	0.003	0.002	0.006	0.006	0.000	-0.007	-0.003	-0.003	-0.001	-0.002
	(0.872)	(0.870)	(0.867)	(0.863)	(0.937)	(0.868)	(0.865)	(0.863)	(0.863)	(0.861)
Average predictions	0.025	0.025	0.119	0.219	0.225	0.244	0.062	0.044	0.012	0.025

Table 16: Ordered probit estimates, number of safe choices, marginal effects

	1	2	3	4	5	6	7	8	9	10
1 = random	-0.003	-0.002	-0.006	-0.006	0	0.007	0.003	0.003	0.002	0.002
(+1)	(0.011)	(0.008)	(0.027)	(0.024)	(0.003)	(0.03)	(0.013)	(0.015)	(0.007)	(0.007)
1 = elected	-0.008	-0.006	-0.021	-0.02	-0.003	0.023	0.011	0.013	0.006	0.006
(+1)	(0.009)	(0.008)	(0.026)	(0.027)	(0.008)	(0.027)	(0.014)	(0.018)	(0.01)	(0.01)
1 = age	-0.008	-0.006	-0.021	-0.02	-0.003	0.022	0.01	0.012	0.006	0.006
(+1)	(0.009)	(0.008)	(0.026)	(0.027)	(0.007)	(0.027)	(0.014)	(0.018)	(0.009)	(0.009)
No. of safe in ind. choice	-0.017**	-0.015*	-0.052***	-0.057***	-0.019**	0.051***	0.029***	0.038***	0.02	0.021**
(+1)	(0.008)	(0.008)	(0.011)	(0.01)	(0.008)	(0.012)	(0.01)	(0.014)	(0.013)	(0.011)
1 = inc. choice in ind. choice	0.023	0.018	0.056	0.048	0.002	-0.063	-0.026	-0.03	-0.014	-0.014
(marginal)	(0.019)	(0.015)	(0.04)	(0.034)	(0.007)	(0.044)	(0.019)	(0.023)	(0.013)	(0.012)
% of correct ind. IT choices	-0.011	-0.008	-0.026	-0.023	-0.001	0.03	0.012	0.014	0.006	0.006
(marginal)	(0.015)	(0.012)	(0.036)	(0.031)	(0.003)	(0.04)	(0.016)	(0.019)	(0.009)	(0.009)
1 = female	0.028	0.018	0.051**	0.034***	-0.01	-0.062**	-0.02**	-0.021	-0.009	-0.009*
(+1)	(0.02)	(0.013)	(0.024)	(0.012)	(0.011)	(0.029)	(0.01)	(0.011)	(0.006)	(0.005)
knewbefore	-0.003	-0.002	-0.007	-0.007	-0.001	0.008	0.004	0.004	0.002	0.002
(+1)	(0.005)	(0.004)	(0.012)	(0.011)	(0.002)	(0.013)	(0.006)	(0.007)	(0.003)	(0.003)
1 = korean	-0.008	-0.006	-0.021	-0.02	-0.003	0.023	0.01	0.013	0.006	0.006
(+1)	(0.011)	(0.009)	(0.031)	(0.032)	(0.009)	(0.032)	(0.017)	(0.021)	(0.011)	(0.011)
Average predictions	0.026	0.027	0.121	0.211	0.22	0.252	0.053	0.049	0.021	0.021

Standard errors are given in parentheses. ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

Table 17: Predicted probabilities from ordered probit models, no of safe choices

Korean woman

No of safe choices	1	2	3	4	5	6	7	8	9	10
Random = 0	0.008	0.017	0.137	0.314	0.292	0.201	0.019	0.009	0.001	0
Random = 1	0.007	0.015	0.125	0.305	0.298	0.216	0.022	0.011	0.002	0

No of safe choices	1	2	3	4	5	6	7	8	9	10
Vote = 0	0.008	0.017	0.137	0.314	0.292	0.201	0.019	0.009	0.001	0
Vote = 1	0.004	0.011	0.1	0.277	0.306	0.254	0.029	0.016	0.003	0.001

No of safe choices	1	2	3	4	5	6	7	8	9	10
Age = 0	0.008	0.017	0.137	0.314	0.292	0.201	0.019	0.009	0.001	0
Age= 1	0.004	0.011	0.101	0.279	0.306	0.252	0.029	0.016	0.003	0.001

Non-Korean woman

No of safe choices	1	2	3	4	5	6	7	8	9	10
Random = 0	0.014	0.026	0.178	0.341	0.268	0.155	0.012	0.005	0.001	0
Random = 1	0.012	0.023	0.165	0.334	0.276	0.168	0.014	0.006	0.001	0

No of safe choices	1	2	3	4	5	6	7	8	9	10
Vote = 0	0.014	0.026	0.178	0.341	0.268	0.155	0.012	0.005	0.001	0
Vote = 1	0.008	0.017	0.135	0.313	0.293	0.203	0.019	0.01	0.002	0

No of safe choices	1	2	3	4	5	6	7	8	9	10
Age = 0	0.014	0.026	0.178	0.341	0.268	0.155	0.012	0.005	0.001	0
Age= 1	0.008	0.017	0.137	0.315	0.292	0.201	0.019	0.009	0.001	0

Korean man

No of safe choices	1	2	3	4	5	6	7	8	9	10
Random = 0	0.002	0.006	0.064	0.224	0.306	0.318	0.045	0.028	0.006	0.001
Random = 1	0.002	0.005	0.057	0.211	0.303	0.332	0.05	0.032	0.007	0.002

No of safe choices	1	2	3	4	5	6	7	8	9	10
Vote = 0	0.002	0.006	0.064	0.224	0.306	0.318	0.045	0.028	0.006	0.001
Vote = 1	0.001	0.003	0.042	0.179	0.291	0.366	0.062	0.043	0.01	0.003

No of safe choices	1	2	3	4	5	6	7	8	9	10
Age = 0	0.002	0.006	0.064	0.224	0.306	0.318	0.045	0.028	0.006	0.001
Age= 1	0.001	0.003	0.043	0.181	0.291	0.364	0.062	0.042	0.01	0.002

Non-Korean man

No of safe choices	1	2	3	4	5	6	7	8	9	10
Random = 0	0.004	0.009	0.091	0.267	0.308	0.267	0.032	0.018	0.003	0.001
Random = 1	0.003	0.008	0.083	0.255	0.309	0.282	0.036	0.021	0.004	0.001

No of safe choices	1	2	3	4	5	6	7	8	9	10
Vote = 0	0.004	0.009	0.091	0.267	0.308	0.267	0.032	0.018	0.003	0.001
Vote = 1	0.002	0.005	0.063	0.222	0.305	0.32	0.046	0.029	0.006	0.001

No of safe choices	1	2	3	4	5	6	7	8	9	10
Age = 0	0.004	0.009	0.091	0.267	0.308	0.267	0.032	0.018	0.003	0.001
Age= 1	0.002	0.006	0.064	0.224	0.306	0.318	0.045	0.028	0.006	0.001

These tables present changes in predicted probabilities for a random hierarchy, a vote-based hierarchy and an age-based hierarchy, compared to a hierarchy by merit. All estimates include controls for the number of safe choices a leader made in the individual choice task, if they made an inconsistent choice in the individual choice task, and the percentage of intellective tasks they answered correctly in the individual task. The controls were held fixed at their sample means, except for the number of safe choices in individual choice and the number of group members that they knew before the experiment. Those variables were held fixed at the sample mode.

Appendix B: Experimental instructions and decision sheets

Instructions

You will now participate in an experiment on decision-making. First, you will make decisions alone and then you will make the same decisions as groups in five different settings. After each group decision-making session and after finishing the last group decision-making session, you will answer a short questionnaire about the experiment. Finally, at the end of the experiment, you will be paid.

Your decision sheet shows ten Decisions listed. Each decision is a choice between "Option A" and "Option B." You will make ten choices and record these in the final column. However, only one of them will be used in the end to determine your earnings. Before you start making your ten choices, please let me explain how the choices you made will determine your earnings for this part of the experiment.

Here is a ten-sided die that will be used to determine payoffs; the faces are numbered from 1 to 10 (the "0" face of the die will serve as 10).

After you have made all of your choices, we will throw this die twice. With the first throw of the die, we will select one of the ten decisions to be used. With the second throw of the die, we will determine what your payoff is for the Option you chose, A or B, for the particular decision selected.

Even though you will make ten decisions, only one of these will end up affecting your earnings, but you will not know in advance which decision will be used.

Obviously, each decision has an equal chance of being used to determine your payment in the end.

Now, please look at decision 1 at the top of your decision sheet. Option A pays 2000 Won if we roll 1, and it pays 1600 Won if we roll 2-10. Option B pays 3850 Won if we roll 1, and it pays 100 Won if we roll 2-10. The other decisions are similar, except that as you move down the table, the chances of the higher payoff for each option increase. In fact, for decision 10 in the bottom row, the die will not be needed since each option pays the highest payoff for sure, so your choice here is between 2000 Won or 3850 Won.

To summarize, you will make ten choices: for each decision you will have to choose between Option A and Option B. You may choose A for some decisions and B for others, and you may change your choices and make them in any order. At the end of the experiment, you will come to our desk and we will throw the ten-sided die to select which of the ten decisions will be used. Then we will throw the die again to determine your money earnings for the option you chose for that decision. Earnings (in Won) for this choice will be added to your show-up fee, and you will be paid all earnings via bank transfer.

So now please look at the empty boxes on the right side of the record sheet. You will have to choose between A or B in each of these boxes, and at the end of the experiment, a die throw will determine which one is going to count for your payment. We will look at the Decision that you made for the choice that counts, and circle it, before throwing the die again to determine your earnings for this choice. Then you will write your earnings in the blank at the bottom of the page.

On the second page of the record sheet, there are three short questions. Please also answer those questions.

Are there any questions? Now you may begin making your choices. Please don't talk with anyone while we are doing this; raise your hand if you have a question.

Decision Sheet

Participant ID:

Date:

Time:

	Option A	Option B	Your choice
Decision 1	2000 W [1] 1600 W [2, 3, 4, 5, 6, 7 ,8, 9, 10]	3850 W [1] 100 W [2, 3, 4,5, 6, 7, 8, 9, 10]	Option A ◻ Option B ◻
Decision 2	2000 W [1, 2] 1600 W [3, 4, 5, 6, 7, 8, 9, 10]	3850 W [1, 2] 100 W [3, 4, 5, 6, 7, 8, 9, 10]	Option A ◻ Option B ◻
Decision 3	2000 W [1, 2, 3] 1600 W [4, 5, 6, 7, 8, 9, 10]	3850 W [1, 2, 3] 100 W [4, 5, 6, 7, 8, 9, 10]	Option A ◻ Option B ◻
Decision 4	2000 W [1, 2, 3, 4] 1600 W [5, 6, 7, 8, 9, 10]	3850 W [1, 2, 3, 4] 100 W [5, 6, 7, 8, 9, 10]	Option A ◻ Option B ◻
Decision 5	2000 W [1, 2, 3, 4, 5] 1600 W [6, 7, 8, 9, 10]	3850 W [1, 2, 3, 4, 5] 100 W [6, 7, 8, 9, 10]	Option A ◻ Option B ◻
Decision 6	2000 W [1, 2, 3, 4, 5, 6] 1600 W [7, 8, 9, 10]	3850 W [1, 2, 3, 4, 5, 6] 100 W [7, 8, 9, 10]	Option A ◻ Option B ◻
Decision 7	2000 W [1, 2, 3, 4, 5, 6, 7] 1600 W [8, 9, 10]	3850 W [1, 2, 3, 4, 5, 6, 7] 100 W [8, 9, 10]	Option A ◻ Option B ◻
Decision 8	2000 W [1, 2, 3, 4, 5, 6, 7, 8] 1600 W [9, 10]	3850 W [1, 2, 3, 4, 5, 6, 7, 8] 100 W [9, 10]	Option A ◻ Option B ◻
Decision 9	2000 W [1, 2, 3, 4, 5, 6, 7, 8, 9] 1600 W [10]	3850 W [1, 2, 3, 4, 5, 6, 7, 8, 9] 100 W [10]	Option A ◻ Option B ◻
Decision 10	2000 W [1, 2, 3, 4, 5, 6, 7, 8, 9, 10] 1600 W [-]	3850 W [1, 2, 3, 4, 5, 6, 7, 8, 9, 10] 100 W [-]	Option A ◻ Option B ◻

Earnings:

Examples of intellective tasks:

Imagine that your country is preparing for the outbreak of an unusual new disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed: Program A and Program B.
If Program A is adopted, 200 people will be saved.
If Program B is adopted, there is a 1/3 probability that 600 people will be saved, and a 2/3 probability that no people will be saved.
Assuming that these are the exact scientific estimates of the consequences of the programs, which one will you choose as the most effective?
(a) Program A □
(b) Program B □
(c) Both programs are equally effective □
(d) I cannot decide □

You have the chance of buying a lottery ticket. Suppose that on the first ticket the numbers are 7, 12, 18, 24, 33 and 45 and on the second ticket, the numbers listed are 1, 2, 3, 4, 5 and 6.
Which one do you think has the higher chance of being winner?
(a) The first ticket □
(b) The second ticket □
(c) Both tickets have equal chances of being a winner □
(d) I cannot decide □

Suppose you have an urn with 90 balls, 30 yellow and 60 red or blue. You don't know how many red or how many blue balls there are, but that the total number of red balls plus the total number of blue equals 60. The balls are well mixed so that each individual ball is as likely to be drawn as any other. You can draw one ball from the urn and you have to bet on the color of the ball. If you correctly guess the color of the ball, you can earn $100. Which color do you think has the highest probability of being drawn?
(a) Yellow □
(b) Red □
(c) Both have equal probability of being drawn □
(d) I cannot decide □

Instructions 2 (no hierarchy - voting group)

In this round, you will make choices as a group about the same decisions as before. You will have 10 minutes to discuss your decisions before you will have to make choices about the options.

The decision-making rule in this round is as follows: you will vote as a group about your choice in each decision, and the option that gets most votes will be adopted.

The payment that is relevant for your earnings will be decided the same way as before: At the end of the experiment, you will come to our desk and we will throw the ten-sided die to select which of the ten decisions will be used. Then we will throw the die again to determine your money earnings for the option you chose for that decision. Earnings (in Won) for this choice will be added to your show-up fee and your previous earnings, and you will be paid all earnings via bank transfer for the Korean students.

Please also answer the question on the second page of the decision sheet.

Each group member will get the same payment.

Instructions 3 (hierarchy - random leader)

In this round, you will again make choices as a group about the same Decisions as before.

However, the rule to decide about your choices will be changed.

Instead of voting about your choices, a group leader will be chosen and make choices on behalf of the entire group. The group leader will be chosen randomly by throwing a die.

Before making a decision, there will be a ten-minute discussion time with all group members. Your payment will be determined based on the group leader's decision, and each group member will get the same payment.

The payment that is relevant for your earnings will be decided the same way as before: At the end of the experiment, you will come to our desk and we will throw the ten-sided die to select which of the ten Decisions will be used. Then we will throw the die again to determine your money earnings for the Option you chose for that Decision. Earnings (in Won) for this choice will be added to your show-up fee and your previous earnings, and you will be paid all earnings via bank transfer.

Please also answer the question on the second page of the decision sheet.

Again, each group member will get the same payment.

Instructions 4 (hierarchy - elected leader)

In this round, you will again make choices as a group about the same Decisions as before.

However, the rule to decide about your choices will be changed.

Instead of voting about your choices, a group leader will be chosen by all group members and make choices on behalf of the entire group.

Before making a decision, there will be a ten-minute discussion time with all group members. Your payment will be determined based on the group leader's decision, and every group member will get the same payment.

The payment that is relevant for your earnings will be decided the same way as before: At the end of the experiment, you will come to our desk and we will throw the ten-sided die to select which of the ten Decisions will be used. Then we will throw the die again to determine your money earnings for the Option you chose for that Decision. Earnings (in

Won) for this choice will be added to your show-up fee and your previous earnings, and you will be paid all earnings via bank transfer.

Please also answer the question on the second page of the decision sheet.

Again, each group member will get the same payment.

Instructions 5 (hierarchy – leader by age)

In this round, you will again make choices as a group about the same Decisions as before.

However, the rule to decide about your choices will be changed.

Instead of voting about your choices, a group leader will be chosen and make choices on behalf of the entire group. The group leader will be the oldest person in your group.

Before making a decision, there will be a ten-minute discussion time with all group members. Your payment will be determined based on the group leader's decision, and every group member will get the same payment.

The payment that is relevant for your earnings will be decided the same way as before: At the end of the experiment, you will come to our desk and we will throw the ten-sided die to select which of the ten Decisions will be used. Then we will throw the die again to determine your money earnings for the Option you chose for that Decision. Earnings (in Won) for this choice will be added to your show-up fee and your previous earnings, and you will be paid all earnings via bank transfer.

Please also answer the question on the second page of the decision sheet.

Again, each group member will get the same payment.

Instructions 6 (hierarchy – leader by merit)

In this round, you will again make choices as a group about the same Decisions as before.

However, the rule to decide about your choices will be changed.

Instead of voting about your choices, a group leader will be chosen and make choices on behalf of the entire group. The group leader will be the person in your group who performs best on the short test that you can find at the back of these instructions.

Before making a decision, there will be a ten-minute discussion time with all group members. Your payment will be determined based on the group leader's decision, and every group member will get the same payment.

The payment that is relevant for your earnings will be decided the same way as before: At the end of the experiment, you will come to our desk and we will throw the ten-sided die to select which of the ten Decisions will be used. Then we will throw the die again to determine your money earnings for the Option you chose for that Decision. Earnings (in Won) for this choice will be added to your show-up fee and your previous earnings, and you will be paid all earnings via bank transfer.

Please also answer the question on the second page of the decision sheet.

Again, each group member will get the same payment.

Financial literacy test questions (used to appoint leaders by merit)

Suppose you have $100 in a savings account earning 2 percent interest a year. After five years, how much would you have?

Exactly $102 □
Less than $102 □
More than $102 □
Don't know □

Imagine that the interest rate on your savings account is 1 percent a year and inflation is 2 percent a year. After one year, would the money in the account buy more than it does today, exactly the same or less than today?

Less □
Same □
More □
Don't know □

If interest rates rise, what will typically happen to bond prices? Rise, fall, stay the same, or is there no relationship?

Rise □
Fall □
Stay the same □
No relationship □

True or false: A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage but the total interest over the life of the loan will be less.

True □
False □
Don't know □

True or false: Buying a single company's stock usually provides a safer return than a stock mutual fund.

True □
False □
Don't know □