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ABSTRACT

Committee Search with Ex-ante Heterogeneous Agents: Theory and Experimental Evidence*

The paper develops a committee search model with *ex-ante* heterogeneous agents and designs laboratory experiments to test theoretical predictions. In the theoretical part of the study, there exists one and only one pivotal voter, who can perfectly and dominantly control the voting results of the committee search activities. The most important prediction is that nonpivotal voters become less picky in committee search than in single-agent search, but that a pivotal voter's voting behavior remains unchanged, regardless of the type of voting rules for the search. However, our experimental results did not support this prediction; not only the nonpivotal voters but also the pivotal voter became less picky in the committee search games. In addition, we found gender differences in voting behavior; females show more concern for other group members' payoff as well as themselves than do males.

JEL Classification: C91, D72, D83

Keywords: experiments, committee search, plurality voting rules

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1 Introduction

The sequential decision-making processes in dynamic models have been considered in many fields of economics, including industrial organization, housing economics, labor economics, monetary economics, and macroeconomics. The focus has been on individual decision-making, but recently interest in collective or committee decision-making has increased [1]. One of the main theoretical findings relating to committee search decision-making is that an agent becomes less picky about his or her own reservation level in the committee search decision-making than in a single-agent decision-making process (Albrecht, Anderson, and Vroman 2010). The fact that the agent becomes less picky is attributable to the negative externality that arises in the committee search activity by voting.

In this paper, to understand the agent's search behavior in more detail, we examine the voting behavior of members within a committee consisting of *ex-ante* heterogeneous members. This enables direct comparisons with the model developed by Albrecht et al. (2010) (referred to as the AAV model), in which a committee consisting of *ex-ante* homogeneous members is considered. We first construct a simple theoretical model to provide clear predictions and then conduct lab experiments of sequential search by committee to test the theoretical predictions [2].

There are additional studies on search models into which committee decision-making is incorporated. Wilson (2001) and Compte and Jehiel (2010) develop collective search games where committee members decide whether or not to accept an alternative over

[1]Surveys of group or committee decision-making are provided by Li and Suen (2009) in economics and Kerr and Tindale (2004) in psychology.

[2]In recent years, many studies have used laboratory experiments to test implications obtained from search models in economics (e.g., Boone, Sadrieh, and van Ours 2009; Cox and Oaxaca 1989, 1996; Harrison and Morgan 1990; Hey 1981, 1982,1987; Houser and Winter 2004; Kogut 1990; Schunk 2009; Schunk and Winter 2009; Sonnemans 1998, 2000). Decision-making in the sequential search model has been the subject of experimental work in social psychology and management as well (Zwick et al. 2003; Bearden and Rapoport 2005; Bearden et al. 2005; Bearden et al. 2006). However, these studies focused on the single-agent or individual search environments.

bargaining. Relating to Compte and Jehiel (2010), Messner and Polborn (2012) develop the search model in which whether or not to stop searching is made by a committee through voting, and the committee members learn their preferences over time. Alpern et al. (2010) extend the standard collective search game to consider an environment where committee members are allowed to veto an alternative. Moldovanu and Shi (2013) analyze a committee search model in which a committee member's preference is heterogeneous and interdependent in that each committee member privately puts a higher weigh on the quality of his/her own attribute (or specialty) than any other attributes. Some studies focused on an effect of aggregation of private information possessed by committee members. Chan et al. (2017) construct a committee search model in which committee members decide whether to stop searching by voting or continue to search after deliberation (costly aggregation of private information).

There is increasing literature on experimental studies of committee decision-making. Goeree and Yariv (2011) conducted an experiment of deliberation in committee search. Strulovici (2010) consider an experimentation on collective decision-making in which heterogeneity of preferences among committee members is gradually revealed. He found that strategic manipulation made by a pivotal voter reduced a socially efficient level of experimentation. Hizen et al. (2013) conducted an experimentation on the AAV model in which committee members are risk neutral and homogeneous with respect to preferences, and each draws an alternative from an independent and identical distribution across members. This paper explicitly designs that committee members are heterogeneous in that each member is given the different amount of bonus, which reveals who is a pivotal voter in the committee. Interest in sequential search by committee or group has increased in areas of social psychology and management as well. Mak et al. (2014) conducted an experiment of the sequential search model (secretary problem) by two-person group and compared subjects ' search behavior when the group members ' preferences are shared or not.

Many components of our theoretical model follow the AAV model; in both models, a committee randomly draws an option from a distribution of options in an infinite-horizon and sequential search activity and, under various voting rules, the committee members collectively decide whether to accept the draw and finish searching, or to reject the draw and then draw another option. Our model differs from the AAV model in that we newly incorporate into the model *ex-ante heterogeneity* of members with respect to the private value of accepting a draw. We assume that the payoff that a member earns by accepting a drawn option consists of a common value plus a private value (bonus) given *ex ante* to each member. Whereas the common value is randomly drawn from a distribution of options in each round over the search activity and shared by all committee members, the private value is fixed throughout the search activity and differs between members. Each member can observe other members' private values as well as his/her own private value; therefore, each member understands his/her own place within the group. For example, a group consists of three members and each has a private value, x, y, and z, before the search starts, where $x > y > z$. The three members realize that the three private values x, y, and z are assigned to their own group members. Suppose that the group draws a common value v and accepts it by voting. The three members earn $x + v$, $y + v$, and $z + v$ each. When the search activity fails, however, the three members earn zero. Because members are heterogeneous with respect to the private value of accepting a drawn option, the voting behavior differs among the members; a member with the high private value prefers to finish searching even if the common value is relatively low, whereas a member who has the low private value prefers to reject the low common value and to continue to search for a higher common value.

The model provides some testable predictions. The first prediction is that, in the single-agent search case, the expected search duration is shorter as a member's private value is higher. The second and more important prediction is that an agent's behavior is different between the single-agent case and the committee search case with voting. In our model with heterogeneity of members with respect to private values, there exists one and only one pivotal voter who possesses the perfectly dominant power to make a group decision throughout the search activity; therefore, his/her voting behavior is the same in the committee search case as in the single-agent search case. The pivotal voter behaves as if he/she had engaged in the single-agent search case. Meanwhile, the other members do not have any dominant power to make a group decision and their voting results are determined by the pivotal voter's choice. This implies that they are more likely to accept the lower common value in the committee search case than in the single-agent search case. Therefore, nonpivotal voters become less picky in the committee search case. According to the AAV model, in which members were homogeneous with respect to the value of the search, all group members became less picky in a committee search activity because a pivotal voter was unspecified in each round over the search activity. In other words, no members could dominantly control the voting results. In our model, the identity of the pivotal voter is common knowledge among the group members.

Next, we conduct laboratory experiments to test the above predictions. Our identification strategy is employed by Hizen, Kawata, and Sasaki (2013). Our experiment consists of three types of games: (1) a benchmark single-agent search game; (2) a committee search game, in which three group members share the same private value; and (3) another committee search game, in which three group members have different private values. The committee search game with the members sharing the same private value (the type (2) game) is used to remove the biases caused by other unobserved heterogeneities (e.g., risk and loss attitudes, time preferences, and other factors) among the members. A difference in search behavior between a single-agent search (the type (1) game) and the committee search where the three members have different private values (the type (3) game) is attributable to both the heterogeneity of the private values among the three members and the heterogeneity of unknown factors, including risk and loss attitudes, time preferences, and other factors. The difference in search behavior between the single-agent search (the type (1) game) and another committee search where the three members share the same private value (the type (2) game) is attributable only to the heterogeneity of these unobserved factors. Therefore, the difference in search behavior between the above two differences is caused only by the artificially designed heterogeneity of private values among the three members, which is predicted in our theoretical model. This difference-in-difference approach extracts the exact effect of the variations in the private values among members on their search behaviors.

In addition, to check the effects of various voting rules, we conduct three subgames for the two different types of committee search games: [1] the one-vote rule, under which the committee search activity stops if at least one member votes to stop searching; [2] the majority rule, under which the committee search activity stops only if at least two-thirds of members vote to stop searching; and [3] the unanimity rule, under which the committee search activity is stopped only if all members vote to stop searching.

The potential contributions of this paper are threefold. First, this paper focuses attention on committee search by a group of *ex-ante* heterogeneous members under various voting rules and provides a comparison of search behavior between a pivotal voter and nonpivotal voters. This is directly comparable to the AAV model, in which members are homogeneous with respect to preferences regarding search activities, i.e., implying that no one becomes the pivotal voter. Second, we design a laboratory environment in which members in a group are *ex ante* given a different bonus, making the members artificially heterogeneous with respect to the preferences regarding search activities. Third, we suggest an identification strategy to remove the biases caused by other unobserved heterogeneity, which allows us to estimate the effects of the heterogeneity of the private values on each member's voting behavior more precisely in the search activity.

The experimental results are summarized briefly here. The single-agent search game results were consistent with the theoretical prediction; i.e., the average search duration of subjects with higher private values was shorter. However, the committee search experiments provided the unexpected result that not only nonpivotal voters but also pivotal voters became less picky. These results imply that unknown biases were not completely removed by our difference-in-difference design.

Additionally, some interesting findings of our experiments indicate gender differences in voting behavior. Our estimation showed that, as the private value increased, the acceptance threshold for the common value was higher for females than for males in the committee search in which the three group members had different private values; in contrast, females were more likely than males to vote to accept the common value in the committee search in which the three members shared the same private value. The different voting behavior according to genders can be interpreted as reflecting the difference in the extent of concern for group members. Females show more concern for other group members who have low private values than do males, in the sense that females are more likely to keep searching to obtain and share a higher common value with other group members to increase the total payoffs. [3]

The paper is organized as follows. Section 2 constructs the theoretical model and establishes its predictions. Section 3 depicts the experimental design, and Section 4 reports on the descriptive statistics for the data collected from our experiment, and then provides the results of the regression analysis. Finally, Section 5 provides some

[3] Croson and Gneezy (2009) provides a recent survey of the gender differences in social preferences.

discussions and concluding remarks.

2 Theoretical Model

To obtain the theoretical predictions, we construct a committee search model with ex-ante heterogeneous members. The model's setting is the same as the one developed by Albrecht, Anderson, and Vroman (2010), except for the payoff structure.

2.1 Model Setting

Consider an infinite-horizon sequential search model by a committee consisting of N risk-neutral members. For simplicity, we assume that time is discrete round by round in the search activity. In each round, the committee draws an option and then decides whether to accept the option by voting. The voting rule is characterized by $M \in (0, N]$, which indicates the minimum number of votes required to accept an option. If the number of votes in favor of accepting is equal to or larger than M, the option is accepted, which leads to the search activity ceasing. If the number of votes is lower than M, the option is rejected, thus implying that the search activity continues. The search activity is exogenously stopped with probability $\beta \in (0, 1)$ before the next draw is made[4]. If search activity is exogenously stopped, the payoff of each committee member is zero.

Each option is characterized by its common value, x, which is drawn from a cumulative distribution function $G(x)$. In addition to the common value, each member is *ex ante* assigned a private value, which is added as his/her own payoff if the option is accepted. Let y_i be member i's private value, which is treated as public information. Then, the sum of the common and private values, $x + y_i$, is member i's total payoff if an option with the common value x is accepted.

[4]Because agents are risk neutral, β can be interpreted as the discount rate.

We design the model in such a way that members are artificially heterogeneous with respect to private value y_i. This is an essential feature of this model because this heterogeneity is the source of conflict among members. A member with a high y_i may prefer to accept an option x earlier than other members to avoid search being exogenously stopped, whereas a member with a low y_i may prefer to accept the option later, expecting to draw options with a higher common value. It should be noted that, in the AAV model, there was no common value shared by committee members and the private value was randomly drawn by each member from an *iid* distribution.

2.2 Single-Agent Search Case

To compare with the implications obtained from the committee search model, we first characterize an individual's optimal strategy in the single-agent search model ($M = N = 1$). This case is exactly the same as the standard infinite-horizon sequential search model of Lippman and McCall (1976) and McCall (1970). Let $\bar{x}_i^S$ be an acceptance threshold for the common value of agent i; if and only if a drawn common value is equal to or higher than $\bar{x}_i^S$, the agent accepts this option, and the search activity is then stopped. The agent earns the sum of this common value plus his/her own private value, which is *ex ante* given before the search starts.

The expected value of continuing to search is given by:

$$V(y_i) = \beta \left[\int_{\bar{x}_i^S} (y_i + x)\, dG(x) + G(\bar{x}_i)\, V(y_i) \right],, \tag{1}$$

where y_i represents agent i's private value of accepting an option. The first term in the parentheses on the right-hand side represents the expected value of agent i drawing an option with a common value that is equal to or higher than $\bar{x}_i^S$, whereas the second term is the expected value of drawing an option with a common value that is lower than $\bar{x}_i^S$.

Using equation (1), the optimal threshold strategy can be easily characterized; if the payoff that the agent earns by accepting a current option, $x + y_i$, is equal to or higher than $V(y_i)$, then he/she decides to accept the option. The optimal threshold strategy is then summarized as follows:

$$\text{An agent accepts an option with } x \iff x \geq \bar{x}_i^S,$$

where:

$$\bar{x}_i^S + y_i = V(y_i),. \tag{2}$$

We examine the comparative statics analysis for the optimal threshold shown in the following proposition.

Proposition 1. *The equilibrium threshold, $\bar{x}_i^S$, decreases with the private value, y_i.*

Proof. Total differentiation of equations (1) and (2) with respect to y_i yields:

$$\begin{aligned} \frac{dV(y_i)}{dy_i} &= \beta\left(1 - G\left(\bar{x}_i^S\right)\right), \\ \text{and } \frac{d\bar{x}_i^S}{dy_i} &= \frac{dV(y_i)}{dy_i} - 1. \end{aligned}$$

Combining the above two equations shows that:

$$\frac{d\bar{x}_i^S}{dy_i} = -1 + \beta\left(1 - G\left(\bar{x}_i^S\right)\right) < 0.$$

□

Proposition 1 implies that the probability of accepting is higher when the private value is higher, which results in a shorter search duration. This prediction will be tested by lab experiments later in this paper.

2.3 Committee Search Case

Our next concern is to examine a weakly dominant strategy equilibrium in the committee search. We assume from this point forward that $y_{i+1} > y_i$ without loss of generality.

As is well known in the literature on strategic voting, to characterize the optimal voting strategy of members in a group, we need to show that a representative member in the group is a pivotal voter or, in other words, that his/her decision leads directly to the determination of the committee decision when exactly $M-1$ other members vote to accept. In this case, the option is actually accepted by the group if the pivotal voter votes to accept, whereas the option is rejected by the group if the pivotal voter votes to reject. Therefore, the equilibrium in the committee search can be defined by: (i) the expected value to a member of continuing to search $V_i^C(y_i)$; (ii) the member's threshold for voting to accept an option $\bar{x}_i^C$; and (iii) the committee threshold to (actually) accept an option $\bar{x}_C$.

First, we characterize a member's threshold for voting to accept. Given the expected value of continuing to search V_i^C, member i's threshold is obtained in the same manner as that in the single-agent search case (equation (2)). Let $\bar{x}_i^C$ and V_i^C denote member i's threshold and the expected value of continuing to search in the committee search case, respectively. Member i's threshold can be then determined by:

$$\text{Member } i \text{ votes to accept an option with } x \iff x \geq \bar{x}_i^C,$$

where

$$\bar{x}_i^C + y_i = V_i^C(y_i). \tag{3}$$

Note that, because the private value y_i varies between members in the group, the equilibrium threshold $\bar{x}_i^C$ may also differ between members.

Next, to characterize the expected value to member i of continuing to search V_i^C, we guess and check the existence of the committee threshold value $\bar{x}_C$. The value V_i^C can be then expressed by:

$$V_i^C(y_i) = \beta\left[\int_{\bar{x}_C}(y_i + x)\,dG(x) + G(\bar{x}_C)\,V_i^C(y_i)\right]. \tag{4}$$

Given the committee threshold $\bar{x}_C$, the expected value of continuing to search is exactly the same as that in the single-agent search case (see equation (1)).

Finally, we characterize the committee threshold value $\bar{x}_C$. To do so, we first state the following lemma.

Lemma 1. *For any $\bar{x}_C$, $\bar{x}_{i+1}^C < \bar{x}_i^C$.*

Proof. In a proof by contradiction, suppose that $\bar{x}_{i+1}^C \geq \bar{x}_i^C$. From equation (3), $\bar{x}_{i+1}^C \geq \bar{x}_i^C$ can be rewritten as:

$$0 \leq V_{i+1}^C(y_{i+1}) - V_i^C(y_i) - (y_{i+1} - y_i).$$

Substituting equation (4) into the above equation yields:

$$\begin{aligned} 0 &\leq \frac{\beta}{1-\beta G(\bar{x}_C)}\left[\int_{\bar{x}_C}(y_{i+1} + x)\,dG(x) - \int_{\bar{x}_C}(y_i + x)\,dG(x)\right] - (y_{i+1} - y_i) \\ &= -\frac{1-\beta}{1-\beta G(\bar{x}_C)}(y_{i+1} - y_i). \end{aligned}$$

Because $y_{i+1} - y_i > 0$, the right-hand side of the above equation must be negative, which is therefore contradictory. □

The intuition behind Lemma (1) is similar to that for Proposition (1). If his/her own private value is relatively high, a member has a strong preference to avoid the search activity being exogenously stopped. Consequently, he/she tends to vote to accept the option even if the common value of the option is relatively low.

Lemma 1 allows us to identify who the pivotal voter is in a group. Because $\bar{x}_{i+1}^C$ is lower than $\bar{x}_i^C$, if the member $i = N + 1 - M$ is willing to vote to accept the option, member $i + 1(> i)$ must also vote to accept, which implies that the total number of votes to accept must be higher than M. Similarly, if member $i = N + 1 - M$ is willing to vote to reject the option, member $i - 1(< i)$ must also vote to reject, indicating that the total number of votes to accept is lower than M. Therefore, this implies that member $i = N + 1 - M$ is the pivotal voter and that the committee threshold is the same as member i's threshold for voting to accept, $\bar{x}_C = \bar{x}_{N+1-M}^C$.

The above discussion can be summarized by the following lemma.

Lemma 2. *The equilibrium* $\left(\bar{x}_i^C, \bar{x}_C, V_i^C\right)$ *can be characterized by equations* (3), (4), *and the determination of the pivotal voter,* $\bar{x}_C = \bar{x}_{N+1-M}^C$.

It should be noted that Lemma (2) shows the characterization of the weakly dominant strategy equilibrium, in which all members choose weakly dominant strategies. As mentioned above, if member i is a pivotal voter, his/her choice, $\bar{x}_i^C$, is accepted as a group choice, resulting in the highest payoff to the pivotal voter. If member i is not a pivotal voter, his/her payoff does not depend on $\bar{x}_i^C$ because his/her voting behavior is not relevant to voting results. Therefore, the strategy that the pivotal voter i chooses $\bar{x}_i^C$ is a weakly dominant strategy. Finally, a comparison of implications from the committee search model with those of the single-agent search model yields the following testable propositions.

Proposition 2. *In the committee search case:*

1. The threshold value of a pivotal voter $(i = N + 1 - M)$ is the same as that of member i in the single-agent search case.

2. The threshold values of nonpivotal voters $(i \neq N + 1 - M)$ are lower than that of member i in the single-agent search case.

Proof. See the Appendix. □

Intuitively, Lemma 2 implies that member $i = N+1-M$ is the one and only pivotal voter and that he/she can then perfectly and dominantly control the decision-making by committee. In other words, the pivotal voter can behave as if he/she had engaged in the single-search activity. Therefore, the pivotal voter's threshold is the same as the one he/she chooses in the single-agent search activity.

In contrast, members $i \neq N+1-M$ cannot dominantly control any decisions by the committee, which implies that their values for continuing to search, V_i^C, are lower than those they would have chosen by themselves in the single-agent search activity. Consequently, their threshold values are lower in the committee search activity than in the single-agent search activity.

We emphasize that these results are closely related to the implications obtained from Albrecht, Anderson, and Vroman (2010). In their model, each member's value of an option was randomly determined after drawing options in every round and members could not observe the values drawn by other members. Therefore, the members did not know who was the pivotal voter in every round. Consequently, no one could perfectly or dominantly control the committee decision by voting in the AAV model, which implies that all members' thresholds were lower in the committee search activity than in the single-agent search activity.

It is essential for members in a group to identify who is the pivotal voter in the committee search activity. We construct the model with ex-ante heterogeneity of members with respect to the private value of accepting an option. In this model setup, committee members realize that member $i = N+1-M$ is a pivotal voter and that he/she can then perfectly control the decision by the committee. We predict that the one and only pivotal voter is not less picky in the committee search activity than in the single-agent search activity, but that other members are less picky.

3 Experimental Design and Procedure

In this section, we explain our experimental design to test the predictions derived from Propositions 1 and 2. Our experiments were conducted in the experimental laboratory of the Institute of Social and Economic Research at Osaka University, Japan, on November 13 and 18, 2014, and the total number of subjects was 135 undergraduate students (101 male and 34 female students) from various academic disciplines at Osaka University. Each subject was randomly assigned to a seat, which was separated from other seats by partitions. The subjects were not allowed to communicate with each other.

We ran the experiments entirely on computers using the software package *Z-Tree* (Fischbacher, 2007). The instructions presented the subjects with full information about the search task. After the experiments were conducted, the subjects were required to answer a questionnaire and the payoff procedures took place afterwards. Each subject was required to play 30 games.

With regards to payoffs, we informed the subjects in advance that they would earn an appearance fee of JPY300 (USD2.8).[5] Their performance pay was determined based on the result from one of the 30 games randomly chosen by each subject.

In the committee search, we focus on cases where a group consists of three members ($i = 1, 2, or 3 and N = 3$). We have two reasons for choosing to focus on three-member groups. The first reason is that this group size is sufficiently large to analyze the decision-making of individual members in a committee search activity under the various plurality voting rules. The second reason is that this group size allows us to obtain data from a large number of groups in our laboratory with limited capacity.

In the theoretical model, as explained before, the heterogeneity of the private value is the main source of the difference in voting behaviors between the single-agent and

[5] We use the exchange rate of JPY100 to USD0.92 for April 20, 2017.

the committee search activities. In a laboratory experiment, however, there exist yet other biases that affect voting behaviors between single-agent and committee searches, including loss and risk attitudes, time preferences, and other factors. To eliminate these biases, we employ the difference-in-difference approach developed by Hizen, Kawata, and Sasaki (2013). We prepare the following three different types of games.

- **Single-agent search game:** Each subject independently decides whether to accept a common value of an option or reject it.
- **Committee search game, in which members are homogeneous in terms of the private value (referred to as the homogeneous committee search game):** Three members in a group share the same private value and collectively decide whether to accept a common value of an option or reject it by voting.
- **Committee search game, in which members are heterogeneous in terms of the private value (referred to as the heterogeneous committee search game):** Three members in a group have different private values and collectively decide whether to accept a common value of an option or reject it by voting.

The homogeneous committee search game is conducted to eliminate biases that we do not consider in the theoretical model. In the theoretical model, agents are assumed to be self-interested and homogeneous with respect to risk and loss attitudes, time preferences, and any other unobserved characteristics. Therefore, the difference in behavior between the single-agent and committee search games arises only from the heterogeneity in terms of the private values of accepting an option. However, in the real laboratory experiment, subjects may be heterogeneous with respect to various preferences and unobserved characteristics, which also causes differences in search behavior and thereby bias estimators. To eliminate these biases, we use the homogeneous committee search game as a control experiment, as described below in more detail.

Proposition 2 also predicts that a member's behavior depends largely on voting rules. To address the prediction relating to the voting rules, we conduct the following three subgames in both the homogeneous and heterogeneous committee search games:

- **One-vote rule:** A common value of an option is accepted only if at least one of the group members votes to accept ($M = 1$).
- **Majority rule:** A common value of an option is accepted only if two-thirds or more of the group members vote to accept ($M = 2$).
- **Unanimity rule:** A common value of an option is accepted only if all the group members vote to accept ($M = 3$).

In each game, before the game starts, a subject is given his/her private value, which is one of either $y_1 = -500$, $y_2 = 500$, or $y_3 = 1,500$. After observing a common value of an option in the committee search activity, the subject chooses whether to vote to accept the option or reject it. If the number of votes to accept is larger than or equal to M, the option is accepted and the search activity is then stopped. If the number of votes is lower than M, the option is rejected, which results in a new option being drawn with a probability of 0.97 and the search activity being exogenously stopped with a probability of 0.03. When the search is stopped exogenously, each subject in the group is given the fixed payoff of 500, regardless of their own private value. The experiment design is different from the theoretical model setting in which the payoff is zero when the search activity is exogenously stopped. We employed this design to encourage the subjects to keep searching. [6] Because all members in the group received

[6] We designed in this way because there is literature indicating that subjects do not search much over rounds in the laboratory experiments (Schunk and Winter 2009, Hizen et al. 2013). Brown et al. (2011) conducted the real-time-search laboratory experiment and found that subjects' reservation wages decreased over time even in the infinite-horizon sequential search case where a risk neutral agent's reservation wage remained constant over time. Zwick et al. (2003) showed in the laboratory experiment that subjects searched too much or did not search enough, depending on the set of alternatives and search cost.

the same payoff when the search activity was terminated, this design was structurally the same as the theoretical model. The same procedure is employed in the experiment for the single-agent search.

According to Proposition 2, the pivotal voter is a group member who is assigned $y_3 = 1,500$ $(N+1-M=3)$ under the one-vote rule. Because this member's acceptance threshold is lower than that of any other members, the member who holds $y_3 = 1,500$ knows, first, that if he/she rejects a draw of a common value, the other two members will also reject this draw, and second, that if he/she accepts a draw of a common value, the draw will be approved as a group decision, regardless of the other members' voting results. Under the majority rule, the pivotal voter is a group member who is assigned $y_2 = 500$ $(N+1-M=2)$. This member knows that the member who holds $y_3 = 1,500$ votes to accept a draw if the member who holds $y_2 = 500$ votes for it, and also that the member who has $y_1 = -500$ rejects a draw if the member who holds $y_2 = 500$ votes against it. Under the unanimity rule, the pivotal voter is a member who is assigned $y_1 = -500$ $(N+1-M=1)$. Because this member's acceptance threshold is higher than that of any other members, the member who has $y_1 = -500$ knows that if he/she votes to accept a draw of a common value, then the other two members will also vote for it, and that if he/she votes against a draw, it will not be approved as a group decision, regardless of the other two members' voting results.

[Table 1 around here]

We conduct between-subjects experiments consisting of seven games (the game types and voting rules in each session are shown in Table 1). By running these experiments, we can observe the search duration and voting behavior of each subject.

We explain our identification strategy for eliminating biases caused by the unobserved characteristics of subjects, following Hizen, Kawata, and Sasaki (2013). The difference in search behaviors between the single-agent and heterogeneous committee search games is attributable to the heterogeneity in terms of the different private values of accepting an option and other unobserved factors, including risk and loss attitudes, time preferences, and other factors. The difference in search behaviors between the single-agent and homogeneous committee search games is attributable only to the heterogeneity in terms of other unobserved factors because all the members share the same private value in the committee search activity. Therefore, we can conclude that the difference between these two differences arises only from the heterogeneity in terms of the different private value of accepting an option. Therefore, this method can extract the exact effect of the variation in the private values on a subject's search duration and behavior.

Given that the unobserved biases are eliminated by the difference-in-difference approach, the hypotheses derived from the theoretical implications can be summarized as follows:

Hypothesis 1: In the single-agent search, the average search duration of subjects who are given $y_3 = 1,500$ is the shortest of all members, whereas the average search duration of subjects who are given $y_1 = -500$ is the longest (Proposition 1).

Hypothesis 2: The probability of a subject voting to accept is higher in the committee search case under the one-vote rule than in the single-agent search case if the subject's private value is $y_1 = -500$ or $y_2 = 500$. The probability of the subject voting to accept is the same in the committee search case under the one-vote rule as in the single-agent search case if the private value is $y_3 = 1,500$ (Proposition 2).

Hypothesis 3: The probability of a subject voting to accept is higher in the committee search under the majority rule than in the single-agent search case if his/her private value is $y_1 = -500$ or $y_3 = 1,500$. The probability of the subject voting to accept is the same in the committee search case under the majority rule as in the single-agent search case if the private value is $y_2 = 500$ (Proposition 2).

Hypothesis 4: The probability of a subject voting to accept is higher in the committee search case under the unanimity rule than in the single-agent search case if his/her private value is $y_2 = 500$ or $y_3 = 1,500$. The probability of the subject voting to accept is the same in the committee search case under the unanimity rule as in the single-agent search case if the private value is $y_1 = -500$ (Proposition 2).

To test these four hypotheses, we first compare differences in average search durations by subsamples, separated by the various plurality voting rules. Additionally, to ensure robustness, we show the regression results of the linear and probit models. To test Hypothesis 1, we regress the following models using data collected in the single-agent search game:

$$E\left(vote_{jt} = 1 | y_{500j}, y_{1,500j}, \mathbf{X}_{jt}\right) = \beta_0 + \beta_1 y_{500j} + \beta_2 y_{1,500j} + \alpha \times \mathbf{X}_{jt}, \tag{5}$$

and

$$\Pr\left(vote_{jt} = 1 | y_{500j}, y_{1,500j}, \mathbf{X}_{jt}\right) = \Phi\left(\beta_0 + \beta_1 y_{500j} + \beta_2 y_{1,500j} + \alpha \times \mathbf{X}_{jt}\right), \tag{6}$$

where Φ represents the cumulative normal distribution function. $vote_{jt}$ represents the dummy variable, indicating one if subject j votes to accept in round t, y_{500j} and $y_{1,500j}$ are dummy variables indicating private values of 500 and $1,500$ assigned to subject j, respectively, and $\mathbf{X}_{jt}$ represents a vector of various control variables, including a common value drawn for subject j's group in round t, the number of rounds in a game, and game-order dummies. To test Hypotheses 2–4, we regress the following models:

$$E\left(vote_{jt}=1|\mathbf{y}_j\times\mathbf{voting\_rule}_j\times\mathbf{Homo}_j,\mathbf{X}_{jt}\right)=\beta_0+\beta\times\mathbf{y}_j\times\mathbf{voting\_rule}_j\times\mathbf{Homo}_j+\alpha\times\mathbf{X}_{jt}, \quad (7)$$

and

$$\begin{aligned}&\Pr\left(vote_{jt}=1|\mathbf{y}_j\times\mathbf{voting\_rule}_j\times\mathbf{Homo}_j,\mathbf{X}_{jt}\right)\\ =\ &\Phi\left(\beta_0+\beta\times\mathbf{y}_j\times\mathbf{voting\_rule}_j\times\mathbf{Homo}_j+\alpha\times\mathbf{X}_{jt}\right), \quad (8)\end{aligned}$$

using data collected in the heterogeneous and homogeneous committee search games. $\mathbf{y}_j\times\mathbf{voting\_rule}_j\times\mathbf{Homo}_j$ represents a vector of the cross terms between private values, voting rules, and game types (homogeneous vs. heterogeneous committee search games) faced by subject j.

4 Results

In this section, we provide the estimation results from our experiments.

4.1 Descriptive Statistics

Table 2 provides the descriptive statistics regarding the search duration in the single-agent search case, which is related to Hypothesis 1.

[Table 2 around here]

The search duration is defined as the number of rounds until a common value of an option is accepted. Table 2 shows evidence that supports Hypothesis 1; the average search duration is the longest for subjects who are given $y_i=-500$ and shortest for the subjects who are given $y_i=1,500$.

[Table 3 around here]

Table 3 provides the descriptive statistics relating to Hypotheses 2–4. In this table, the average search duration is defined as the number of rounds until a subject in a group votes to accept for the first time. Based on comparisons of the search duration between the single-agent search and the heterogeneous committee search, we can observe a significant difference for subjects who are given $y_i = -500$ under the one-vote and majority rules, those who are given $y_i = 500$ under all voting rules, and those who are given $y_i = 1,500$ under the one-vote and unanimity rules. However, as we mentioned previously, these differences may be attributable to unobserved factors, including risk and loss attitudes, time preferences, and other unobserved characteristics, as well as the heterogeneity of the private values among members in a group.

The comparisons between the heterogeneous and homogeneous committee search cases are more relevant to testing whether a subject shortens his/her own search duration in the committee search case, compared with the single-agent search. The fifth column of Table 3 exhibits these results. Recall that a member assigned $y_1 = -500$ is the pivotal voter under the unanimity rule, so we predicted that his/her search duration in the committee search under the unanimity rule would not be statistically different from the search duration in the single-agent search, but that his/her search duration under other rules in the committee search would be shorter than in the single-agent search. Looking at the upper part of Table 3, we obtain consistent results, except for the case of the one-vote rule. Similarly, the middle part of Table 3 indicates that the search duration in committee search under the majority rule is not statistically different from that in the single-agent search for a member assigned $y_2 = 500$, who is the pivotal voter under the majority rule. In addition, as we expected, the search duration is significantly shorter for this pivotal voter in the committee search under the one-vote rule than in the single-agent search, but this is not the case under the unanimity rule.

The lower part of Table 3 shows that the search duration in committee search under the one-vote rule is not statistically different from that in single-agent search for a member assigned $y_3 = 1,500$, the pivotal voter under the one-vote rule. In addition, the search duration is significantly shorter in the committee search under the unanimity rule than in the single-agent search, but this is not the case under the majority rule. These results from Table 3 imply that the pivotal voters engaged in committee search as if they had engaged in single-agent search, which is consistent with our prediction. However, we did not necessarily obtain the results for nonpivotal voters that we expected. In the next subsections, we will show the estimated results when other characteristics are controlled.

4.2 Regression: Hypothesis 1

To test Hypothesis 1, we regress equations (5) and (6), using data collected in the single-agent search experiment, and provide the estimated results in Table 4. This table indicates that both coefficients of the dummies indicating private values of 500 and $1,500$ are positive at the 1% level of significance in both the linear and the probit estimations. Moreover, the coefficient of the dummy indicating the private value of $1,500$ is significantly larger in size than that of the dummy for 500 in both estimations. Given that the reference dummy is the one indicating the private value of -500, these results imply that the probability of voting to accept increases with the private value, which is consistent with Hypothesis 1.

[Table 4 around here]

Table 4 also shows that the coefficient of the common value is positive at the 1% level of significance in both estimations, which implies that the high common value encourages subjects to vote to accept. Again, this is consistent with our theoretical predictions. However, the round has a negative effect on the probability of voting to accept at the 1% level of significance in both estimations. This result is different from our expectation, in the sense that the round has no impact on an agent's acceptance threshold in the infinite-horizon sequential search activity. One possible interpretation of this result is that more samples are observed for subjects who have preferences toward searching longer in our dataset, which causes the sample selection bias towards those with a higher threshold for accepting a drawn value. However, the opposite results were observed in the experiment by Hizen, Kawata, and Sasaki (2013). The reason why these opposite results were obtained remains one of the open questions in the sequential search experiments.

4.3 Regression: Hypotheses 2 to 4

[Table 5 around here]

Table 5 shows the estimated results of equations (7) and (8), using data from the committee search experiments. This table shows that a subject's voting behavior is affected by the cross terms of their private values, voting rules, and game types (homogeneous committee search or heterogeneous committee search).

[Table 6 around here]

Our main concern is to observe the differences in the estimated coefficients of the cross terms between heterogeneous and homogeneous committee search cases. By doing so, we find the effects of committee search under various voting rules on a subject's voting behavior, given that biases indicating an individual heterogeneity of preferences, including loss and risk attitudes, time preferences, and other factors, are controlled. The differences in these coefficients (the coefficient in the heterogeneous committee search case minus the one in the homogeneous committee search case) and their statistical significance are summarized in Table 6.

It should be recalled that the pivotal voter is a group member who is assigned the private value $y_3 = 1,500$ under the one-vote rule. Therefore, we predict that the difference of the coefficient of the dummy indicating the private value of $y_3 = 1,500$ under the one-vote rule is statistically insignificant. Other subjects in the group assigned $y_1 = -500$ and $y_2 = 500$ become less picky in the committee search under the one-vote rule than in the single-search case, so they are more likely to vote for a randomly drawn common value. Thus, we predict that the differences of other coefficients for $y_1 = -500$ and $y_2 = 500$ under the one-vote rule are significantly positive. Similarly, because the pivotal voter is a subject who is assigned $y_2 = 500$ under the majority rule, we predict that the difference of the coefficient of the dummy indicating the private value of $y_2 = 500$ under the majority rule is statistically insignificant. However, other subjects in the group become less picky in committee search under the majority rule than in the single-agent search, which encourages them to vote for a common value in earlier rounds. Therefore, our prediction is that the differences of other coefficients for $y_1 = -500$ and $y_3 = 1,500$ under the majority rule are positively significant. Finally, the pivotal voter is a subject who is assigned $y_1 = -500$ under the unanimity rule. Therefore, we predict that the difference of the coefficient of the dummy indicating the private value of $y_1 = -500$ under the unanimity rule is statistically insignificant. By contrary, those assigned $y_2 = 500$ and $y_3 = 1,500$ are more likely to vote for a common value in the committee search under the unanimity rule than in the single-search case, which implies that the differences of other coefficients for $y_2 = 500$ and $y_3 = 1,500$ under the unanimity rule have positive significances.

Table 6 shows that, for any combinations of the private values and the voting rules, the differences of the coefficients are positive at the 1% level of significance. Even the differences that we predicted would be statistically insignificant are positive at the 1% level of significance, which is contrary to our prediction. These results show that the pivotal voter as well as nonpivotal voters lower their acceptance threshold and, therefore, become less picky in committee search than in single-agent search.

For a robustness check, we executed the same estimations, using the data only from subjects who searched for five or more rounds and for 10 or more rounds. The results remain unchanged even if these limited datasets are used, as shown in the Appendix Table. This confirms that our results in Table 6 are robust.

4.4 Gender Differences in Voting Behavior

Our experimental data allow us to examine gender differences in voting behaviors. We focus on differences in the common value accepted by a subject and search durations by gender in the committee search. Table 7 shows the average accepted value and search duration in each male and female group. The differences between the male and female groups are also shown in the table, but these differences are not statistically significant.

[Table 7 around here]

One well-known fact about gender differences is social preferences; in general, females are more risk averse, more inequality averse, and more competition averse than males, and females provide more care to people in society than men do (Croson and Gneezy 2009). This fact implies that there are likely to be gender differences in the committee search activity in which committee members have different private values.

As mentioned above, a member with a higher private value has a lower acceptance threshold for the common value because even if he/she accepts the low common value, his/her total payoff, which is equal to the sum of the common and private values, is sufficiently high. However, if the low common value is approved by voting, the total payoffs of other members with the low private values are quite low, which implies that the welfare of the other members is not given strong consideration by the member with the higher private value in the group decision. If females care more about the welfare of other members in their own group, particularly about those with low assigned private values, than do men, they will vote only for options with a high common value, even if their private values are relatively high. It should be noted that in the committee search activity in which members have the same private values, we predict that these gender differences will disappear because the committee members obtain the same payoff.

To examine the above prediction, the following population model is regressed:

$$E\left(\log commonvalue_{js}|y_{js} \times female_j\right) = \beta_0 + \beta \times y_{js} \times female_j + f_j + f_s,$$

$$E\left(\log duration_{js}|y_{js} \times female_j\right) = \beta_0 + \beta \times y_{js} \times female_j + f_j + f_s,$$

using subject-game panel data in each single-agent and committee search. $\log commonvalue_{js}$ is the log of the average accepted common value of subject j in game s, $\log duration_{js}$ is the search duration, and $y_{js} \times female_j$ is the cross term between the private value and the female dummy variable.

We employ the fixed-effect model approach and then include subject and session fixed effects (f_j and f_s) in the above regressions. It should be noted that because the subject fixed effects are included in the regressions, the female dummy is excluded in the population model. However, its cross terms with private values are included as explanatory variables.

[Table 8 around here]

Table 8 shows the estimated results. In the single-agent search case, the cross terms between the private value and the female dummy have no significant effects on both the accepted value and the search duration, which implies that there are no clear differences in voting behavior by gender. In addition, the table shows that, in the case of committee search, the effects of the cross terms are not statistically significant if group members have the same private values.

However, in the committee search case where members have different private values, the cross term with the highest private value ($y_3 = 1,500$) has a positive effect on the accepted common value at the 1% level of significance. Therefore, females with the highest private value are more likely to have a higher acceptance threshold than males with the same private value, which is consistent with the predictions obtained from theoretical models with social preferences regarding the gender differences.

5 Concluding Remarks

This paper explored an alternative theoretical model that allowed us to identify why agents become less picky in a committee search activity, as predicted by Albrecht, Anderson, and Vroman (2010). In our model, there exists one and only one pivotal voter who can perfectly and dominantly control voting results through committee search activities. Our finding is that, whereas nonpivotal voters become less picky about the acceptance threshold for essentially the same reasons found by Albrecht, Anderson, and Vroman (2010), the pivotal voter does not become less picky because he/she behaves as if he/she had engaged in the single-agent search activity.

We tested these theoretical predictions using the laboratory experiment approach. We found evidence to support many but not all of our predictions. Our estimated results showed that not only nonpivotal voters but also pivotal voters became less picky in a committee search, which was contrary to our prediction. This result implied that there still existed unobserved factors that encouraged the subject to be less picky, even though we attempted to eliminate these unobserved factors using the difference-in-difference approach. The identification of these unobserved factors will be an important direction for future research.

In addition, we found some interesting findings of our experiments regarding gender differences in voting behavior. According to the estimation, as the private value increased, the acceptance threshold for the common value was higher for females than for males in the committee search in which the three group members had different private values. However, females were more likely than males to vote to accept the common value in the committee search in which the three members shared the same private value. These gender differences in voting behavior can be explained by the difference in the extent of concern for group members. Females give more concern or care for the total payoffs of other group members who have low private values than do males. This induces females to keep searching longer to obtain and share a higher common value with other group members to increase the total payoffs.

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Appendix

Proof of Proposition 2

First, we show that $\bar{x}^C_{N+1-M} = \bar{x}^S_{N+1-M}$. Lemma 2 means that member $i = N+1-M$ is the one and only pivotal voter and that $\bar{x}_C = \bar{x}^C_{N+1-M}$. Equations (4) and (3) can be rewritten as:

$$\begin{aligned}
\bar{x}^C_{N+1-M} + y_{N+1-M} &= V^C_{N+1-M}\left(y_{N+1-M}\right). \\
V^C_{N+1-M}\left(y_{N+1-M}\right) &= \beta\left[\int_{\bar{x}_C}\left(y_{N+1-M}+x\right)dG\left(x\right) + G\left(\bar{x}_C\right)V^C_{N+1-M}\left(y_{N+1-M}\right)\right].
\end{aligned}$$

These equations are exactly the same as equations (1) and (2); therefore, $\bar{x}^C_{N+1-M}$ must be equal to $\bar{x}^S_{N+1-M}$.

Next, we show that $\bar{x}^C_{i\neq N+1-M} < \bar{x}^S_{i\neq N+1-M}$. First, Lemma 2 means that $\bar{x}^S_{i\neq N+1-M}$ is not equal to $\bar{x}_C$ because none of the members $i \neq N+1-M$ can become the pivotal voter. Because $\bar{x}^S_{i\neq N+1-M}$ is determined to maximize $V_{i\neq N+1-M}$, $V^S_{i\neq N+1-M}$ is then lower than $V^C_{i\neq N+1-M}$. Consequently, $\bar{x}^C_i$ is lower than $\bar{x}^S_i$ because equations (1) and (2) show that $\bar{x}^C_i < \bar{x}^S_i$ if $V^S_i > V^C_i$.

Instructions

Following are the instructions for one laboratory session, conducted at Osaka University. Other sessions differed from this session in terms of the type of voting rules. As an example, we provide the instructions for the session in which subjects made individual decisions and committee decisions under the majority rule.

Introduction

Welcome to our experiment! This experiment consists of three game types (Game A, Game B, and Game C). Each game is composed of 10 trials; therefore, there are 30 trials. You decide whether you accept a random draw and finish searching or reject the draw and then move on to the next round, expecting to receive a higher draw. The order of Games A to C is randomly determined. The rules of these games will be explained in detail later.

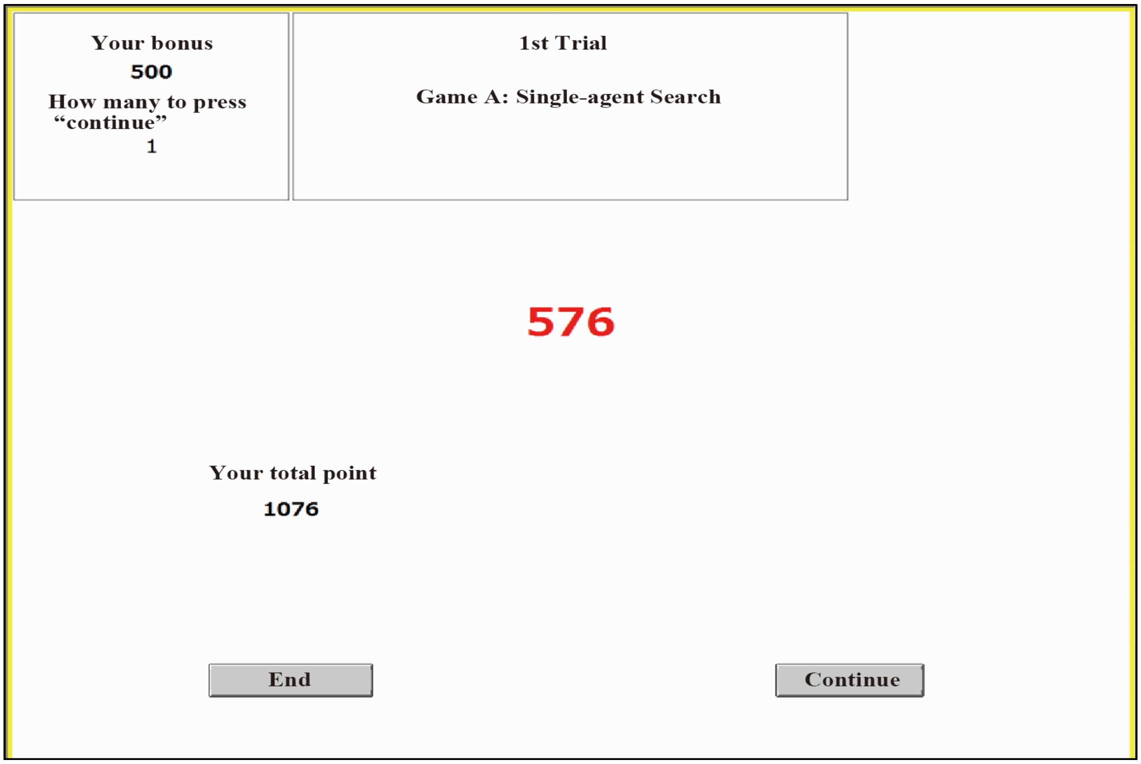
The reward for this experiment

In this experiment, we pay JPY 300 (USD 2.8) as a show-up fee, plus the performance pay, which is based on your points from all the trials. At the end of experiment, one of the experimenters draws a lottery and chooses one trial from 30 trials. We will pay you the performance pay based on the points obtained in the trial chosen by the lottery. The conversion rate between points and JPY is: 1 point = JPY1.

Game A

When Game A begins, the PC monitor displays the screen below.

Either -500, 500, or 1,500 points are randomly assigned as your bonus. The bonus points are displayed at the upper left of the screen (in this case, your bonus is 500). Note that your bonus is different in each trial. The drawn points are displayed at the center of the screen (in this case, the points are 578). The points are drawn randomly from between zero and 1,000. Note that the probability of drawing each point is the same. You decide whether to continue or end the game with the drawn points. If you press the lower left "End" button, then the trial ends, and you obtain the drawn points that you possess at that time, plus your bonus that is displayed at the upper left of the



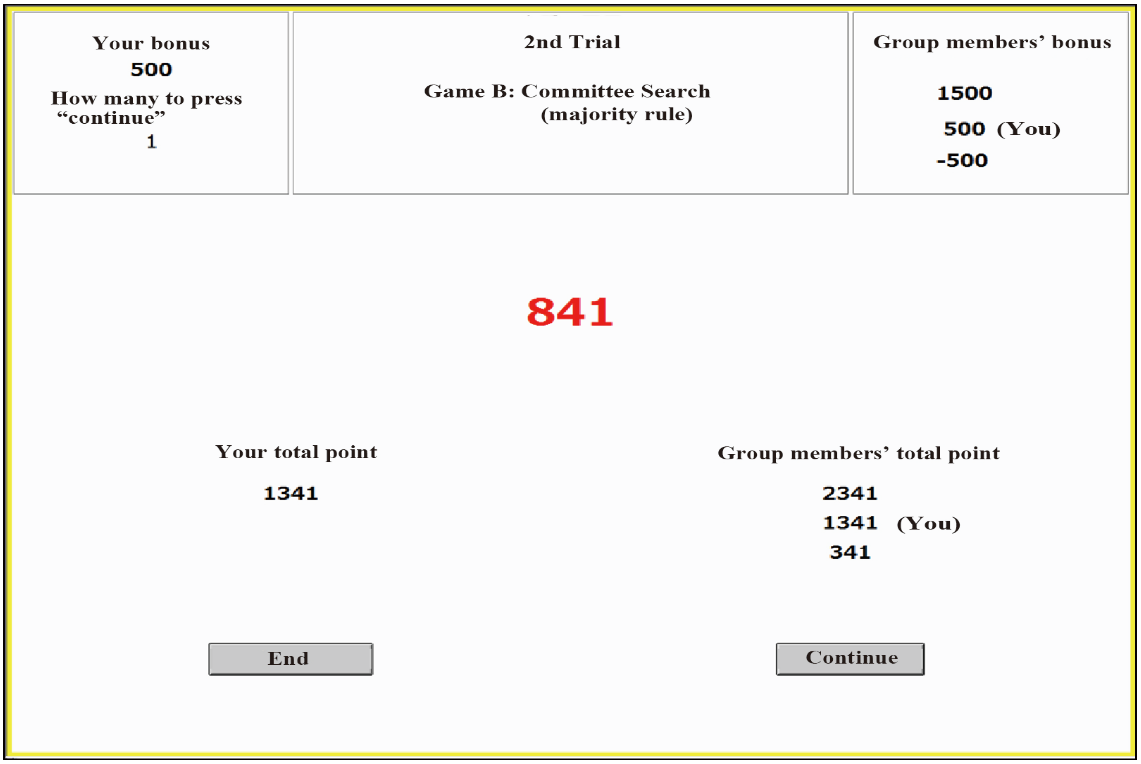
screen.

In this case, the drawn points equal 578 and your bonus is 500, so your total points are 1,076. The number at the lower left of the screen indicates the total points if you end the game (in this case, your total points are 1,076). If you press the lower right "Continue" button, there is a 97% probability that you will be allowed to move to the next round, and the newly drawn points are then displayed at the center of the screen. Thus, there is a 3% probability that the trial will be forcibly terminated, and your points in the trial will be 500, regardless of your bonus.

Game B

When Game B begins, the screen below is displayed on the PC monitor.

You play Game B in a group of three. Either -500, 500, or 1,500 points is allocated to each group member as their own bonus. Your bonus points are displayed at the



upper left of the screen (in this case, your bonus is 500). In Game B, each of the group members is allocated a different number of bonus points. Note that the bonus points change by trial. In addition, the upper right of the screen displays the bonus points of the group members, including yours. The drawn points are displayed at the center of the screen (in this case, the points equal 841). The points are drawn randomly from between zero and 1,000. Note that the probability of drawing each point is the same. The group members share the same drawn points. You vote whether to continue or end the game with the drawn points.

In this game, the voting rule is as follows:

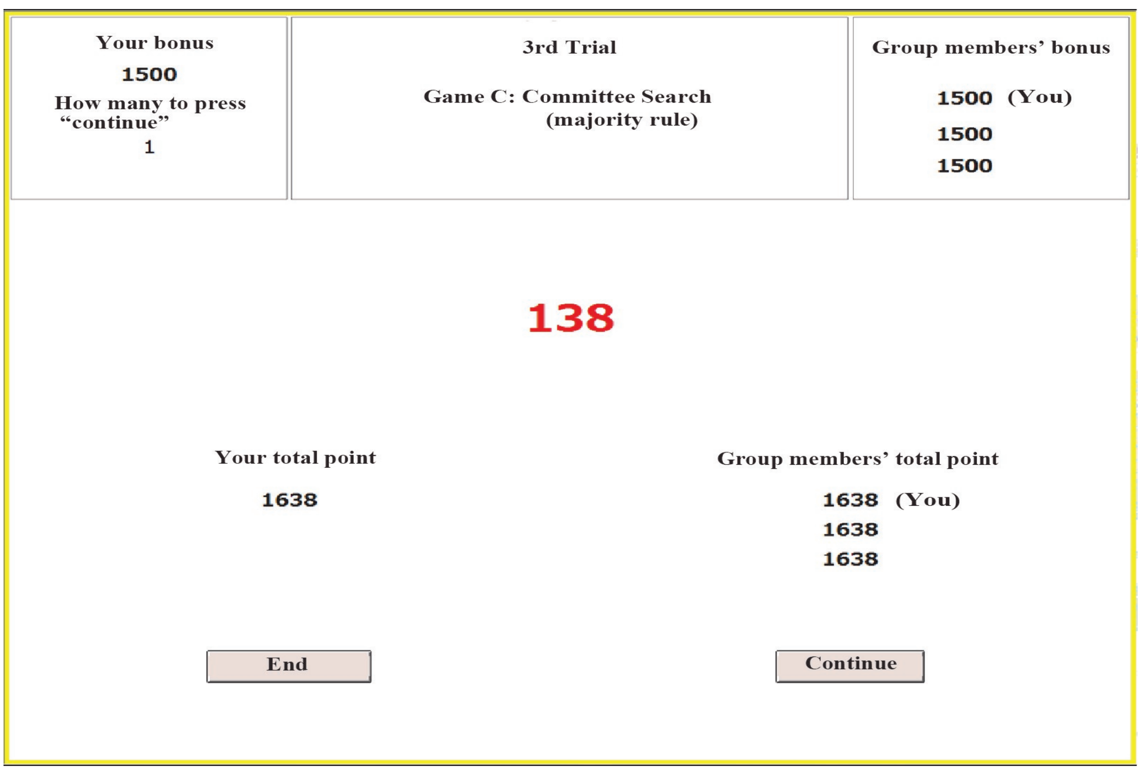
"If at least two members vote to 'end,' then the game is ended."

If more than two of three members voted to "end," the game ends and the profit is then determined. Note that the points at the center of the screen are the same for each member in the group but the bonus points differ between members, so the profits also vary between the group members. If your group decides to end the game, your profit is displayed at the lower left of the screen. In this case, your profit is 500 + 841 = 1,341, and the other group members' profits are 1,500 + 841 = 2,341 and –500 + 841 = 341.

If more than two of three voted to "continue," there is 97% probability that your group will then move to the next stage, at the start of which the newly drawn points that are shared with the other group members are displayed and you can vote again. However, there is a 3% probability that the game will be forcibly terminated, and you and your group members will receive 500 points only, regardless of bonuses.

Game C

When Game C begins, the screen below is displayed on the PC monitor.



As noted above, Game B is played in a group of three, with either -500, 500, or 1,500 points being allocated to each group member as their own bonus. Your bonus points are displayed at the upper left of the screen (in this case, your bonus is 1,500). In Game C, all of the group members are allocated the same bonus points. Note that the bonus points do not change by trial. In addition, the upper right of the screen displays the group members' bonus (The group members' bonus points are the same in Game C). The drawn points are displayed at the center of the screen (In this case, the points are 138). The points are drawn randomly from between zero and 1,000. Note that the probability of drawing each point is the same. The group members share the same number of drawn points. You vote whether to continue or end the game given the drawn points.

In this game, the voting rule is as follows:

"If at least two members vote to 'end," then the game is ended."

If more than two of the three members vote to "end," the game is ended and the profits are determined. Note that the points at the center of the screen and the bonus points are the same for each member within the group and, therefore, the profits are the same for each member of the group. If your group decides to end the game, your profit is displayed at the lower left of the screen. In this case, your profit and other group members' profits are 1,500 + 841 = 1,638.

If more than two of the three members voted to "continue," there is a 97% probability that your group will move to the next stage, during which the newly drawn points that are shared with the other group members are displayed, and you can vote again. However, there is a 3% probability that the game will be forcibly terminated, in which case you and your group members will receive only 500 points, regardless of bonuses.

	Session 1	**Session 2**	**Session 3**
	Single-agent Heterogeneous + Unaminity Homogeneous + Unaminity	Single-agent Heterogeneous + Majority Homogeneous + Majority	Single-agent Heterogeneous + One vote Homogeneous + One vote
Participants	21	18	21
	Session 4	**Session 5**	**Session 6**
	Single-agent Heterogeneous + One vote Homogeneous + One vote	Single-agent Heterogeneous + Majority Homogeneous + Majority	Single-agent Heterogeneous + Unaminity Homogeneous + Unaminity
Participants	24	27	24

Table 1: Session structure

	-500	500	1500	-500 vs. 500		500 vs. 1500	
Average	5.165	3.779	2.677	1.386	***	1.103	***
S.D.	(0.305)	(0.204)	(0.141)	(0.357)		(0.255)	
Observations	375	453	399				

Table 2: Search duration in the single-agent search

*** 1% ** 5% * 10% significant. Standard deviations are in parentheses.

Voting rule		Single	Heterogeneous committee	Homogenous committee	Signle VS Heterogenous committeee		Heterogenous committee VS Homogenous committee	
		Private value: -500						
Majority	Average	5.165	3.298	4.768	1.867	***	-1.470	***
	S.D.	0.305	0.281	0.454	0.598		0.543	
	Observations	375	104	112				
One vote	Average	5.165	2.185	2.898	2.980	***	-0.713	
	S.D.	0.305	0.288	0.334	0.812		0.483	
	Observations	375	54	88				
Unanimity	Average	5.165	5.286	4.185	-0.120		1.101	
	S.D.	0.305	0.737	0.325	0.672		0.761	
	Observations	375	140	168				
		Private value: 500						
Voting rule		Single	Heterogeneous committee	Homogenous committee	Signle vs. Heterogenous committeee		Heterogenous committee vs. Homogenous	
Majority	Average	3.779	2.949	3.508	0.830	**	-0.559	
	S.D.	0.204	0.242	0.294	0.393		0.378	
	Observations	453	138	118				
One vote	Average	3.779	2.247	3.011	1.532	***	-0.765	**
	S.D.	0.204	0.256	0.285	0.506		0.387	
	Observations	453	77	87				
Unanimity	Average	3.779	2.493	2.667	1.286	***	-0.174	
	S.D.	0.204	0.175	0.244	0.379		0.293	
	Observations	453	140	111				
		Private value: 1500						
Voting rule		Single	Heterogeneous committee	Homogenous committee	Signle vs. Heterogenous committeee		Heterogenous committee vs. Homogenous committee	
Majority	Average	2.677	2.510	2.559	0.166		-0.048	
	S.D.	0.141	0.191	0.253	0.263		0.318	
	Observations	399	143	145				
One vote	Average	2.677	2.048	1.880	0.629	**	0.168	
	S.D.	0.141	0.177	0.158	0.271		0.244	
	Observations	399	126	100				
Unanimity	Average	2.677	1.757	2.340	0.920	***	-0.583	**
	S.D.	0.141	0.168	0.157	0.259		0.230	
	Observations	399	140	147				

Table 3: Search duration in committee search

*** 1% ** 5% * 10% significant. Standard deviations are in parentheses.

VARIABLES	Linear		Probit	
Private value 500	0.071	***	0.547	***
	(0.012)		(0.077)	
Private value 1500	0.171	***	1.224	***
	(0.017)		(0.1000)	
common value	0.001	***	0.007	***
	(0.00003)		(0.0004)	
round	-0.006	***	-0.057	***
	(0.001)		(0.006)	
Period	YES		YES	
Constant	-0.238	***	-5.094	***
	(0.012)		(0.295)	
Observations	5,400		5,400	
R2	0.430		0.558	
F test	0.000		0.000	

Table 4: Regression related to Prediction 1

Note: Only samples in the single agent search game are used. *** 1%, ** 5% * 10% significant. Standard errors are in parentheses.

VARIABLES	Linear		Probit	
Heterogenous committee search				
One vote				
Private value: 500	0.077	**	0.477	***
	(0.032)		(0.176)	
Private value: 1500	0.242	***	1.246	***
	(0.043)		(0.208)	
Majority vote				
Private value: -500	0.047		0.208	
	(0.030)		(0.169)	
Private value: 500	0.201	***	1.063	***
	(0.044)		(0.226)	
Private value: 1500	0.317	***	1.609	***
	(0.052)		(0.243)	
Unaminity vote				
Private value: -500	-0.002		-0.051	
	(0.044)		(0.244)	
Private value: 500	0.387	***	1.892	***
	(0.057)		(0.240)	
Private value: 1500	0.528	***	2.549	***
	(0.055)		(0.263)	
Homogenous committee search				
One vote				
Private value: -500	-0.175	***	-0.892	***
	(0.049)		(0.225)	
Private value: 500	-0.097	*	-0.436	*
	(0.052)		(0.252)	
Private value: 1500	-0.014		0.078	
	(0.052)		(0.246)	
Majority vote				
Private value: -500	-0.145	***	-0.743	***
	(0.051)		(0.246)	
Private value: 500	-0.012		-0.005	
	(0.052)		(0.259)	
Private value: 1500	0.034		0.250	
	(0.063)		(0.295)	
Unaminity vote				
Private value: -500	-0.077		-0.375	
	(0.052)		(0.245)	
Private value: 500	0.053		0.325	
	(0.068)		(0.311)	
Private value: 1500	0.234	***	1.199	***
	(0.067)		(0.302)	
common value	0.001	***	0.004	***
	(0.00003)		(0.0002)	
round	-0.001		-0.003	
	(0.002)		(0.008)	
Period dummy	YES		YES	
Constant	-0.193	***	-3.296	***
	(0.042)		(0.256)	
Observations	9,780		9,780	
R2	0.463		0.467	
F test	0.000		0.000	

Table 5: Regression related to Predictions 2 to 4

Reference category is the cross term between private value as -500, one-vote rule, and heterogenous committee search game. *** 1%, ** 5% * 10% significant. Standard errors are in parentheses.

	Linear		Probit	
One vote				
-500	0.175	***	0.892	***
	(0.049)		(0.225)	
500	0.174	***	0.912	***
	(0.050)		(0.225)	
1500	0.256	***	1.169	***
	(0.055)		(0.242)	
Majority				
-500	0.192	***	0.951	***
	(0.047)		(0.205)	
500	0.213	***	1.068	***
	(0.057)		(0.267)	
1500	0.283	***	1.360	***
	(0.054)		(0.229)	
Unaminity				
-500	0.075		0.324	
	(0.058)		(0.269)	
500	0.334	***	1.567	***
	(0.077)		(0.307)	
1500	0.293	***	1.351	***
	(0.056)		(0.262)	

Table 6: Comparison of coefficients

*** 1%, ** 5% * 10% significant. Standard errors are in parentheses.

	Male	Female	Difference	
log of average accepted value	6.655	6.676	-0.021	*
			(0.013)	
log of search duration	0.791	0.831	-0.040	
			(0.032)	
observations	2,552	841		

Table 7: Average differences between male and female
*** 1%, ** 5% * 10% significant. Standard errors are in parentheses.

VARIABLES	Sigle agent search				Committee search with different private value				Committee search with same private values			
	log accepted value		**log search duration**		**log accepted common value**		**log search duration**		**log accepted common value**		**log search duration**	
Private value 500	-0.091	***	-0.230	***	-0.156	***	-0.264	***	-0.089	***	-0.233	***
	(0.023)		(0.075)		(0.043)		(0.077)		(0.020)		(0.073)	
Private value 1500	-0.166	***	-0.527	***	-0.391	***	-0.483	***	-0.271	***	-0.479	***
	(0.018)		(0.070)		(0.067)		(0.080)		(0.037)		(0.070)	
(Private value 500) ×(Female)	0.038		-0.076		0.056		-0.092		-0.037		-0.048	
	(0.033)		(0.149)		(0.054)		(0.165)		(0.051)		(0.147)	
(Private value 1500) ×(Female)	-0.071		-0.101		0.246	***	0.040		0.021		-0.078	
	(0.056)		(0.177)		(0.076)		(0.193)		(0.056)		(0.156)	
Game	YES		YES		YES		YES		YES		YES	
constant	6.740	***	1.016	***	6.649	***	0.854	***	6.762	***	0.976	***
	(0.029)		(0.084)		(0.056)		(0.080)		(0.033)		(0.073)	
Observations	1,227		1,227		1,079		1,079		1,087		1,087	

Table 8: Regression related to gender differences in voting behaviors

*** 1%, ** 5% * 10% significance. Standard errors are in parentheses.

	Linear		Probit		Linear with more than 5 rounds of search		Probit with more than 5 rounds of search		Linear with more than 10 rounds of search		Probit with more than 10 rounds of search	
One vote												
-500	0.175	***	0.892	***	0.273	***	1.465	***	0.756	***	7.133	***
	(0.049)		(0.225)		(0.098)		(0.528)		(0.149)		(0.757)	
500	0.174	***	0.912	***	0.238	**	1.293	***	1.219	***	13.60	***
	(0.050)		(0.225)		(0.095)		(0.467)		(0.164)		(0.887)	
1500	0.256	***	1.169	***	0.253	**	1.078	**	0.792	**	8.012	***
	(0.055)		(0.242)		(0.101)		(0.501)		(0.318)		(1.097)	
Majority												
-500	0.192	***	0.951	***	0.240	***	1.126	***	0.190		0.802	
	(0.047)		(0.205)		(0.080)		(0.385)		(0.121)		(0.605)	
500	0.213	***	1.068	***	0.343	***	1.712	***	0.383	**	1.858	***
	(0.057)		(0.267)		(0.121)		(0.540)		(0.161)		(0.677)	
1500	0.283	***	1.360	***	0.427	***	2.009	***	0.547	***	2.628	***
	(0.054)		(0.229)		(0.122)		(0.525)		(0.203)		(0.887)	
Unaminity												
-500	0.0753		0.324		0.079		0.310		0.005		-0.225	
	(0.058)		(0.269)		(0.107)		(0.519)		(0.094)		(0.580)	
500	0.334	***	1.567	***	0.474	***	2.162	***	0.628	***	2.911	***
	(0.077)		(0.307)		(0.096)		(0.425)		(0.106)		(0.393)	
1500	0.293	***	1.351	***	0.338	***	1.611	***	0.481	***	-3.178	***
	(0.056)		(0.262)		(0.099)		(0.510)		(0.136)		(0.654)	

Appendix Table: Comparison of coefficients

*** 1%, ** 5% * 10% significanct. Standard errors are in parentheses.