

Information exchange and decision quality in groups: The boon and bane of incentives*

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ABSTRACT: In decision making settings that involve a group of people, managerial accounting systems can affect the design of incentive contracts and the distribution of information among group members, both of which are expected to affect decision quality. I use an experiment to compare the impact of flat incentive, group incentive, and individual incentive on information exchange and decision quality in groups. Participants work in groups to choose the best of multiple alternatives, with the information necessary for identifying the best alternative distributed among the individual group members. Group members make a group decision and an individual decision after discussion. I find consistent results for group and individual decision accuracy. Decision accuracy is comparable under the group and flat incentives, and better under both the group and flat incentives than under the individual incentive. The results are despite the expectations that both the group and individual incentives ought to create more economic motivation for decision accuracy than the flat incentive, and that the individual incentive ought not to contain any economic disincentive for information exchange. The results suggest that group and flat incentives may engender more cooperation and hence better judgment performance than an individual incentive in decision making tasks where the information necessary for making an optimal decision is distributed among different people.

Keywords: group decision making; flat incentive; group incentive; individual incentive; cooperation.

Data Availability: Contact the author.

I. INTRODUCTION

In organizations, people are often required to make collective group decisions or individual decisions after drawing inputs from others. Group decisions may occur in teams comprising of multiple individuals or departments within an organization, or in cross-organization collaborations such as joint ventures, strategic alliances, and integrated supply chains. Even when people are making individual decisions, they may need information from others in the organization for effective decision-making. This study focuses on decision making settings where multiple individuals possess the information necessary for making an optimal group or individual decision, and this study refers to these multiple individuals as a group.

Managerial accounting systems play two significant roles in such decision making settings. First, they influence the design of incentive contracts used to motivate group members, such as the choice of individual versus group performance measures. Second, they affect the distribution of information among group members. For example, cost information from the accounting system may not be integrated with information from other systems in an organization, such as the production system, the logistics system, the human resource system, the sales and distribution system, or the customer relationship management system, resulting in differential information across individuals or departments (Quattrone and Hopper 2005; Williams 2004). Group members may also possess different information because of inherent knowledge, experience, and expertise differences. Therefore, it is important for organizations designing managerial accounting systems to understand the implications of information distribution on decision making in groups, and how incentive structure affects the way people discuss these differentially distributed information and the resultant decision quality.

Psychological research has used “hidden profile” decision tasks to examine the effects of information distribution on group decision making (e.g., Stasser et al. 2000; Stasser and Titus 1985). In a hidden profile decision task, the total information favors one of multiple alternatives but that superior alternative is hidden from individual group members because each member has only a portion of the total information. Group decision making often suffers from the common knowledge effect, where groups tend to discuss information that is commonly held by all group members and disregard or underweight unique information that only selected group members possess (Winqvist and Larson 1998; Gigone and Hastie 1993; Stasser and Titus 1985). The common knowledge effect undermines the benefit of group decision making because unique information critical for identifying the best alternative is not adequately pooled during discussion. However, prior hidden profile research has not examined the effect of incentives. Student participants in prior studies typically receive course credit independent of decision accuracy (e.g., Stasser et al. 2000; Hollingshead 1998; Winqvist and Larson 1998).¹

Studies that examine the impact of incentives on group performance are scant and focus on effort choices (e.g., Coletti et al. 2005; Towry 2003) or production tasks (e.g., Guthrie and Hollensbe 2004; Fisher et al. 2003; Drake et al. 1999), with little attention on how incentives affect information exchange and performance in group decision making tasks. Although there is field evidence suggesting that rewarding individual rather than group performance discourages information sharing (e.g., Van Alstyne 2005), research in this area is limited.² To my knowledge, this study is the first to directly examine the effects of different incentives (i.e., flat incentive, group incentive, and individual incentive) on information exchange and performance in a

¹ The exceptions are Fraudin (2004) and Greitemeyer and Schulz-Hardt (2003) who reward participants based on the accuracy of their individual decisions, but the two studies do not examine different types of incentive.

² Van Alstyne (2005) reports a survey of 71 employees in three firms indicating that employees engage in more email exchanges under rewards for organizational performance than under rewards for individual performance.

decision making task where the information for making an optimal decision is distributed among people in a group. This study responds to the call for more managerial accounting research on incentive issues in group settings, and on how the distribution of information among group members affect decision quality (Sprinkle 2003).

This study uses a hidden profile decision task. Participants in the experiment individually read information about multiple alternatives before convening in groups of three for a group discussion. Some of the information is commonly held by all three group members whereas other information is unique to one group member. Participants make a group decision and an individual decision after the group discussion. In the flat incentive condition, participants enter into a lottery to win money regardless of their decision accuracy. The group incentive condition enters participants into the lottery if their group decision is accurate, whereas the individual incentive condition enters participants into the lottery if their individual decision is accurate.

The results are consistent for group decision accuracy and individual decision accuracy. Decision accuracy is not significantly different under the group and flat incentives, and better under both the group and flat incentives than under the individual incentive. Groups with the group incentive discuss more common and unique information items but not more implications of the information compared to groups with the flat incentive. Groups with the individual incentive do not discuss more common or unique information items and discuss less implications of the information relative to groups with the flat incentive. Comparing groups with the group incentive versus the individual incentive, the former discuss more common and unique information items and more implications of the information than the latter.

The results have several implications. In a decision making task where individual group members hold private information critical for making the optimal decision, cooperation and

effective communication of the private information are necessary. Incentives that are aligned with the nature of such a task could promote better judgment performance. In this study, the group incentive performs as well as the flat incentive, and both the group and flat incentives perform better than the individual incentive. The results are despite the expectations that the group and individual incentives ought to create greater economic motivation for decision accuracy than the flat incentive, and that the individual incentive ought not to contain any economic disincentive for information exchange. The group and flat incentives may engender greater cooperation than the individual incentive which emphasizes individual performance and encourages individualistic behavior, which could explain why the group and flat incentives outperform the individual incentive. As such, when people are making either group or individual decisions that are highly dependent on the inputs of others, using group or flat incentives rather than an individual incentive may enhance decision quality.

Why does the group incentive not induce better performance than the flat incentive despite greater information exchange during group discussion under the former? Performance-contingent incentives (group or individual) could increase the pressure and anxiety that people face and make it more difficult to communicate and make a decision. Effective communication is particularly important for performance in group decision making. Although the group incentive relative to the flat incentive offers the advantage of increasing information exchange, it also increases communication difficulty which may impair decision quality.

Finally, the hidden profile problem in this study compared to prior studies is less serious when participants are compensated with the group and flat incentives. The hidden profile problem is most evident when participants are rewarded with the individual incentive. As such, future psychological research that examines group decision making processes may wish to

consider the influence of different incentives. Accounting researchers should also be circumspect about applying findings from psychological research to accounting settings where decision makers work under significant monetary incentives (Ashton and Ashton 1995).

The remainder of the paper is organized as follows. Section 2 develops the hypotheses and Section 3 outlines the design of the experiment. Section 4 describes the results. Section 5 concludes with a discussion of the findings and limitations of the study.

II. HYPOTHESES DEVELOPMENT

Hidden Profile Decision Task

The hidden profile decision task is developed by Garold Stasser and his colleagues to study information exchange and decision preferences in group decision making (e.g., Stasser 1992; Stasser and Titus 1985). Group members read information about various alternatives before coming together to discuss the information and decide on the best alternative. The information comprises of common information shared by all group members as well as unique information available to only one group member. The total profile of information favors one alternative, which is hidden from individual group members prior to group discussion because information supporting that alternative is distributed among the group members. The best alternative would not be evident from the common information shared by all group members or from the information held by a single group member prior to group discussion. Group members have to pool together the common and unique information to make the optimal decision. The group, as a whole, has the potential to be more accurate than the individual group members (Winqvist and Larson 1998; Gigone and Hastie 1993).

Prior hidden profile research indicates that group members tend to focus on common information in the group discussion, which biases the group from choosing the best alternative

(Stasser et al. 2000; Hollingshead 1998; Stasser and Stewart 1992). Common information has a higher probability of being sampled during group discussion than unique information because the probability of being sampled is a function of the number of members who hold an information item prior to discussion and the probability that any one of these members would recall the information item during discussion (Hunton 2001; Stasser and Titus 1985). A recent study by Greitmeyer and Schulz-Hardt (2003) shows that individuals who receive hidden profile information items before reading a group discussion protocol that contains full information still have difficulties identifying the best alternative. Thus, even in the absence of a group process that discusses unique information insufficiently, people still do not solve the hidden profile problem easily. This is because people evaluate information during group discussion in a manner that is consistent with their pre-discussion preferences, and common information would have a greater impact on the pre-discussion preferences than unique information given that more group members have the common information prior to the group discussion (Greitmeyer and Schulz-Hardt 2003). Therefore, the hidden profile problem can be attributed to the inadequate pooling of unique information during group discussion as well as the greater impact of common information on the pre-discussion preferences of individual group members (Winqvist and Larson 1998).

Hypotheses Development

This study examines how different types of incentive affect the quality of group and individual decisions in a hidden profile decision task where decision quality is dependent on the inputs of multiple individuals. Under the flat incentive, monetary reward is not contingent on the group or individual decision quality. In contrast, a performance-contingent incentive ties the compensation to either the group or individual decision quality. Prior research does not provide direct evidence on how different incentives affect the manner in which individual group

members share and discuss information, which may in turn impact judgment performance. The process through which incentives affect decision making in groups is still largely unknown due to the paucity of research in this area (Sprinkle 2003).

In order to decide on the best of various alternatives, group members not only need to have information about the alternatives, they need to consider whether a piece of information has a positive or negative implication on the choice of an alternative. Therefore, I posit that the group accuracy and the individual accuracy after group discussion are better when individual group members share more of the information that they possess as well as discuss the implications of information more extensively. Sharing more information and discussing more implications of information can reduce the hidden profile problem by pooling more unique information during group discussion and increasing the decisional impact of unique information. The hypotheses for the effect of various incentives on the sharing and discussion of information, and the resultant group and individual decision quality are discussed next.

Group Incentive versus Flat Incentive

The flat incentive does not reward people based on the accuracy of their group or individual decision, whereas the group incentive rewards people based on the accuracy of their group decision. Relative to the flat incentive, a performance-contingent incentive increases the motivation of individuals to expend effort towards achieving performance in order to obtain the desired rewards that are linked to performance (Bonner et al. 2000; Vroom 1964). Consequently, people would have a stronger economic motivation to achieve better group accuracy if they are working under the group incentive than the flat incentive. The stronger motivation to achieve better group accuracy would, in turn, motivate group members to share more information as well as discuss the implications of information more extensively. As a result of the increased

information sharing and discussion of the implications of information, the group accuracy and the individual accuracy are expected to be better under the group incentive than the flat incentive.

Although several studies have shown that task performance is better under group than flat incentives (e.g., Guthrie and Hollensbe 2004; Hansen 1997; Kaufman 1992), they examine simpler mechanical or production tasks rather than decision making tasks which are cognitively more complex. Incentives are less likely to improve performance as the task becomes cognitively more complex (Bonner et al. 2000; Ashton 1990). This is because although incentives increase effort, effort tends to be less important than cognitive strategies for performing well in more complex tasks (Locke and Latham 1990). Further, group members may feel a stronger pressure to make the correct group decision and experience more anxiety when monetary reward is tied to group accuracy. The heightened pressure and anxiety may increase the difficulty of communicating or the adoption of more varied and riskier decision strategies, which may negatively affect decision quality (Ashton 1990; Earley et al. 1989). The ability to communicate effectively may be especially important for performing well in a decision making task where the information needed for making an optimal decision is distributed among different individuals. As such, the results from prior studies do not necessarily generalize to the group decision making task examined in this study.

Hypothesis 1, which compares the group incentive with the flat incentive, is proposed.

H1: Groups with the group incentive

- a) have better group accuracy,
- b) have group members with better post-discussion individual accuracy,
- c) share more common information items during group discussion,
- d) share more unique information items during group discussion,

- e) discuss more implications of information during group discussion, and
 - f) experience more difficulty in communication
- than groups with the flat incentive.

Individual Incentive versus Flat Incentive

The individual incentive is a performance-contingent incentive that rewards people based on the accuracy of their individual decision. As discussed in Hypothesis 1, a performance-contingent incentive relative to the flat incentive increases the motivation of people to work towards achieving the rewarded outcome (Bonner et al. 2000; Vroom 1964). Relative to the flat incentive, the individual incentive provides greater economic motivation for people to increase their individual accuracy. If people believe that sharing more of their own information would prompt others to do the same or that discussing the implications of information with others would improve their own ability to make an accurate individual decision, the individual incentive would motivate higher levels of information sharing and discussion of the implications of information. At the very least, the individual incentive does not contain any economic disincentive for information exchange and would not discourage group members from sharing and discussing information with others because their individual compensation would not be reduced by the individual accuracy of others. Increased sharing of information and discussion of the implications of information would enhance the group accuracy and the individual accuracy under the individual incentive compared to the flat incentive.

Prior studies of individual tasks where performance is independent of the inputs of other people generally find that performance under the individual incentive is higher than that under the flat incentive (Bonner et al. 2000). However, in tasks where performance is highly dependent on the effort, skills, resources, or information of other people, the effect of a performance-

contingent incentive based on individual performance is less clear. Relative to the flat incentive, the individual incentive may not necessarily increase group and individual decision quality. Linking individual performance to compensation can make individual performance salient, and promote selfish behavior such as the hoarding of information (Van Alstyne 2005; Katz 2000). Rewarding people based on their individual performance may encourage them to behave individualistically, such that they become concerned with achieving their personal goal and ignore the goal achievement of others (Johnson et al. 1981). Although people working under the individual incentive would like others to share information so that they can make accurate individual decisions for themselves, they are not motivated to help others make accurate individual decisions. This individualistic orientation may decrease sharing of information and discussion of implications of information. In contrast, the flat incentive does not draw people's attention to their individual performance. In a group decision making task which benefits from individuals cooperating and sharing information, the flat incentive may engender more cooperation and better performance than the individual incentive.

Similar to Hypothesis 1, I expect that tying compensation to individual decision accuracy would increase the pressure and anxiety that group members experience, which would increase the difficulty in communicating under the individual incentive compared to the flat incentive.

Hypothesis 2 compares the individual incentive with the flat incentive, and is as follows.

H2: Groups with individual incentive

- a) have better group accuracy,
- b) have group members with better post-discussion individual accuracy,
- c) share more common information items during group discussion,
- d) share more unique information items during group discussion,

- e) discuss more implications of information during group discussion, and
 - f) experience more difficulty in communication
- than groups with the flat incentive.

Group Incentive versus Individual Incentive

Both the group and individual incentives are performance-contingent incentives that give people economic motivation to expend efforts towards increasing either group accuracy or individual accuracy. Under the group incentive, group members would be motivated to share information and discuss the implications of information with their fellow group members so as to improve the group accuracy. Under the individual incentive, group members need the information that others possess to make accurate individual decisions and would be motivated to share information if they believe it would encourage others to do likewise. Group members with the individual incentive would also be motivated to discuss the implications of information with others if they think it would improve their individual accuracy. Sharing more information and discussing more implications of information would improve both group accuracy and individual accuracy.

However, as discussed in Hypothesis 2, the individual incentive may encourage a more individualistic orientation than the group incentive (Johnson et al. 1981). Group members who are acting individualistically are only concerned about their individual accuracy and are not motivated to help others make accurate individual decisions, which may decrease information sharing and discussion of implications of information. Therefore, I expect the group incentive to induce higher levels of motivation to share information and discuss implications of information, and higher levels of group and individual accuracy compared to the individual incentive.

Prior literature also suggests that the group incentive would encourage greater participation and cooperation from group members compared to the individual incentive because it promotes interdependence (Wageman and Baker 1997; Hatcher and Ross 1991; Deutsch 1949, 1980), group identity (Welbourne and Cable 1995), and group cohesiveness (Shirani et al. 1998). On the other hand, group incentives may create incentives to shirk and free-ride on other group members (Gavish et al. 2000; Shirani et al. 1998; Wageman and Baker 1997; Barua et al. 1995). Group members who are not rewarded based on their individual effort may feel less individual accountability and participate less, which would lower the quality of decisions. However, Wageman and Baker (1997) argue that the benefits of cooperation outweigh the costs of free-riding associated with group-based rewards when the task is more interdependent.

Prior empirical research that directly compares group and individual incentives is limited and focuses on task performance or decision quality, and does not examine the information exchange process (e.g., Shirani et al. 1998; Wageman and Baker 1997; Hatcher and Ross 1991). This study examines group and individual decision quality as well as the information exchange process. I posit that group and individual accuracy are higher under the group incentive than the individual incentive. In an interdependent group decision making task, judgment performance is likely to benefit more from cooperation than it would suffer from free-riding under the group incentive (Wageman and Baker 1997). I do not expect differences in communication difficulty across the group and individual incentives. People working under both the group and individual incentives would experience similar levels of pressure and anxiety to make accurate decisions because their compensation is tied to decision accuracy.

Hypothesis 3, which compares the group incentive with the individual incentive, is proposed.

H3: Groups with the group incentive

- a) have better group accuracy,
 - b) have group members with better post-discussion individual accuracy,
 - c) share more common information items during group discussion,
 - d) share more unique information items during group discussion,
 - e) discuss more implications of information during group discussion, and
 - f) do not experience more difficulty in communication
- than groups with the individual incentive.

III. DESIGN OF EXPERIMENT

Participants

220 second and third year undergraduate students from a university in Singapore participate in the experiment. The students are accounting ($n = 108$) and business ($n = 112$) majors who have taken at least one financial accounting course and one management accounting course so that they have a basic understanding of the information items presented to them for the task, which involve making an investment decision. The average age of the participants is 21.15 and 67.27% are females. The participants work in groups of three, forming 68 groups. Of the 68 groups, four are dropped from the analyses because of computer software problems or because participants reveal their names during the discussion. There are 16 extra participants who remain after forming groups in the experimental sessions, and they complete an individual decision making task instead of the group decision making task.

Experimental Procedure

The experiment adopts the experimental procedure in hidden profile research and takes place at computers. Each experimental session has between 6 to 18 participants. Participants

arrive at the computer lab and are seated at computers with an empty space between each person. They are instructed not to talk to each other during the experimental session.

Participants are then randomly assigned to groups of three and they do not know who their fellow group members are. Group members are instructed to refer to each other only by their group member identification number and to remain anonymous throughout the study. The experiment uses anonymity and computer-mediated discussion so that the study can focus on the effects of information distribution and incentives on the group decision making process. Anonymity removes effects related to social context cues such as gender, race, physical appearance, and social norms. The group decision support system literature shows that anonymity results in more open discussion (Gavish et al. 2000; Jessup et al. 1990). Computer-mediated discussion eliminates effects related to face-to-face, verbal, and non-verbal communication cues such as facial expression, voice inflexion, and body language. Prior research on face-to-face versus computer-mediated discussions indicates that computer-mediated discussions have the advantage of social equalization such that group members participate more equally (Kiesler and Sproull 1992; Siegal et al. 1986), and that the process of group decision making in face-to-face discussions and computer-mediated discussions is similar (Weisband 1992). However, computer-mediated discussions can result in lower social presence which makes it more difficult to create a cooperative environment (Barkhi et al. 2004).

Participants are told that the task is to decide which company out of three companies (Alpha, Beta, and Gamma) is the best medium- to long-term (5 to 10 years) financial investment. The groups are then randomly assigned to one of the four experimental conditions and a description of the incentive condition is given. Next, participants answer three questions on their understanding of the incentive condition, which must be answered correctly before they can

proceed with the experiment.³ Then, participants are given ten minutes to individually review information items given to them.⁴ They are told that within a group, some group members may have information that other group members do not have and that one company is the best choice when all information is considered. Participants indicate their individual decision before entering a virtual chat room to discuss with the other two members of their group. Groups are given a maximum of 30 minutes for the group discussion and to reach a group decision.⁵ Groups may end their group discussion earlier if they reach a group decision before the allotted 30 minutes is up. After the group discussion, a pre-assigned group member indicates the group decision. Group members indicate their individual decision again and are told that their individual decision need not agree with the group decision. Finally, participants answer a post-experimental questionnaire.

The 16 extra participants complete an individual decision making task. They review all the information items that are given to participants in the group decision making task, make an individual decision, and then rate each information item on two aspects. The first aspect concerns the importance of an information item in the participant's decision, on a scale of 0 (Not important at all) to 10 (Extremely important). The second aspect concerns whether an information item suggests a positive effect or a negative effect on the company's prospects as a medium- to long-term financial investment.

Experimental Design

There are four experimental conditions. Condition 1 is a control condition where all information items are shared by all three group members (i.e., no hidden profile), and where

³ Participants are asked whether: (1) the accuracy of their individual decision after the group discussion, (2) the accuracy of the other two group members' individual decisions after the group discussion, and (3) the accuracy of their group decision increase, decrease, or do not affect their chance of winning the lottery.

⁴ The pilot study indicated that ten minutes was sufficient for participants to review the information items.

⁵ The pilot study indicated that 30 minutes was sufficient for the group discussion. The mean time taken by groups to complete their discussion in the study is 20.77 minutes (std dev = 7.06 minutes).

participants receive the flat incentive. Conditions 2, 3 and 4 are hidden profile conditions where the three group members share certain common information items but individually possess unique information items, and where participants receive the flat incentive, the group incentive, and the individual incentive respectively.

Operationalization of Variables

Hidden Profile and Information Items

The experimental materials in this study are newly developed but adopt similar information distribution patterns in prior hidden profile studies. There are 12 information items per company, with a total 36 information items for all three companies (Alpha, Beta, and Gamma). Table 1 shows the distribution of information items across the three companies and the three group members. Each company has 4 financial information items (earnings per share, gross margin, dividend per share, and current ratio) and 8 non-financial information items (e.g., litigation information, product information, marketing information, management information). The total information favors Beta (9 positive items and 3 negative items) over Alpha (5 positive items and 7 negative items) and Gamma (5 positive items and 7 negative items).

In the hidden profile conditions, each group member has 6 information items per company prior to the discussion, of which 3 items are commonly held by all three group members and 3 items are uniquely held by only that group member. The 6 pre-discussion information items per company are balanced with 3 positive items and 3 negative items. The 3 common information items per company are such that there are 2 positive items and 1 negative item for both Alpha and Gamma, and 3 negative items for Beta. Since the pre-discussion information items that each member holds do not favor any company and the common

information items favor Alpha and Gamma over Beta, the superior alternative Beta is hidden from the group members before group discussion.

---- insert Table 1 here ----

The experimental materials were piloted with four accounting professors. Two accounting professors read all the 36 information items and both chose Beta as their best choice. Two accounting professors read the 3 common information items per company, and one chose Alpha while the other chose Gamma. Data from the 16 extra participants who read all the 36 information items are analyzed. 12 of the 16 extra participants (75%) choose Beta, which is higher than a random chance of 33% ($\chi^2 = 12.53, p < 0.001$). Each information item has an importance rating (scale of 0 to 10) and a direction rating (positive versus negative effect on investment prospects). I multiply the importance rating and the direction rating to get a score for each information item, and sum up the scores for all the 12 information items per company to get the total score for a company. Alpha has a mean score of -10.25, Beta a mean score of 43.33, and Gamma a mean score of -14.88. Paired t-tests show that Beta has a higher score than Alpha (paired $t = 11.28, p < 0.001$) and Gamma (paired $t = 10.55, p < 0.001$), whereas Alpha and Gamma do not have significantly different scores (paired $t = 1.135, p = 0.274$). The total profile of information is successfully manipulated since it supports Beta as the best company and does not differentiate between Alpha and Gamma.

In the hidden profile conditions, the three group members each have 6 information items per company prior to the discussion. I multiply the importance rating and the direction rating given by the 16 extra participants to get a score for each information item; and aggregate the scores for the 6 information items per company that each group member holds. Paired t-tests indicate that Alpha, Beta, and Gamma do not have significantly different scores for all three

group members (all p -values ≥ 0.189). The 6 pre-discussion information items that each group member holds are successfully manipulated since that they do not favor any company.

Independent Variable: Incentive Type

All participants are paid \$10 for participating in the study. In addition, participants may be entered into a lottery to win additional money. In the flat incentive condition, all participants are entered into a lottery with a one in three chance of winning \$20 regardless of their decision accuracy. In the group incentive condition, groups with the correct group decision are entered into a lottery with a one in three chance of winning \$60 that is split evenly among the three group members. In the individual incentive condition, participants with the correct post-discussion individual decision are entered into a lottery with a one in three chance of winning \$20. The expected value of the total payment receivable by a participant (\$16.67) is equal across the three incentive conditions if the correct group decision or post-discussion individual decision is made.

Dependent Variables

Group and Individual Judgment Performance. Group and individual judgment performance are assessed by whether groups and individuals correctly choose Beta after the group discussion. An accurate decision is coded as “1” whereas an inaccurate decision is coded as “0”.

Discussion Content. The 64 group discussion transcripts are coded by either one of two coders who are blind to the experimental conditions and the hypotheses. 22 of the 64 discussion transcripts are randomly selected to be coded by both coders so that inter-rater reliabilities can be computed. The inter-rater reliabilities are reported in parentheses as follows. The discussion transcripts are coded for three variables: the number of common information items discussed out

of a total of 9 common items ($r = 0.97$), the number of unique information items discussed out of a total of 27 unique items ($r = 0.97$), and the number of inference statements made ($r = 0.87$). Inference statements represent the discussion of implications of information, which include statements that draw conclusions about a company, make assertions about the consequences arising from the given information, and expand or elaborate on the given information.

Communication Difficulty and Confidence. In the post-experimental questionnaire, participants rate on a scale of 0-10 the level of difficulty their group experiences in reaching a group decision and the level of difficulty they experience in communicating with their group members, and the mean of the two ratings is used as the measure of communication difficulty. Participants also rate on a scale of 0-10 their level of confidence that they have made the right individual choice once before the group discussion and once after the group discussion.

IV. RESULTS

Manipulation Check

Participants choose the superior alternative before group discussion more often (i.e., they have better pre-discussion individual accuracy) in the control Condition 1 where they have all the information items than in the hidden profile Conditions 2, 3, and 4 (Wald $\chi^2 = 20.95$, $p < 0.001$). The pre-discussion individual accuracy is not significantly different across the hidden profile Conditions 2, 3, and 4 (Wald $\chi^2 = 2.53$, $p = 0.283$). Therefore, the manipulation of the hidden profile is successful.

Table 2 shows the pre-discussion individual accuracy, the group accuracy, and the post-discussion individual accuracy in the four experimental conditions. Hollingshead (1996) uses a similar hidden profile task involving an investment choice with the same number of information items per company as this study, and her study finds that about 70% of groups in the all shared

information condition made the correct choice compared to between 10-40% in the hidden profile conditions. In this study, 71% of groups in the all shared information condition made the correct choice, 61% in the flat incentive condition and 50% in the group incentive condition, and 19% in the individual incentive condition. Group accuracy under the flat incentive condition (Wald $\chi^2 = 0.37$, $p = 0.543$) and the group incentive condition (Wald $\chi^2 = 1.40$, $p = 0.237$) are not significantly different from that in the all shared information condition. Group accuracy in the individual incentive condition (Wald $\chi^2 = 7.47$, $p = 0.006$) is worse than that in the all shared information condition. In comparison with prior hidden profile studies, groups with the flat and group incentives in this study may solve the hidden profile problem better because participants in prior hidden profile studies are rewarded with course credit that is independent of decision accuracy or are rewarded based on individual accuracy. When participants are rewarded with cash and the type of incentive matches the nature of the task (i.e., group or flat incentives rather than an individual incentive), the hidden profile problem may not be so serious.

--- insert Table 2 here ---

Tests of Hypotheses

Group and Individual Judgment Performance

Logistic regression indicates that both the incentive type (Wald $\chi^2 = 7.25$, $p = 0.027$) and the mean pre-discussion individual accuracy of group members (Wald $\chi^2 = 12.28$, $p < 0.001$) affect group accuracy.⁶ Groups do not have better group accuracy under the group incentive compared to the flat incentive (Wald $\chi^2 = 0.39$, one-tailed $p = 0.267$), even though the group

⁶ Prior research suggests that the pre-discussion preferences of group members affect the post-discussion decision accuracy (Greitmeyer and Schulz-Hardt 2003; Winkvist and Larson 1998). Therefore, I control for the pre-discussion accuracy of group members when testing the effects of incentives on group accuracy and post-discussion individual accuracy. The results are similar without controlling for the pre-discussion accuracy of group members.

incentive ought to create more economic motivation for decision accuracy than the flat incentive. H1a is not supported. Contrary to H2a, groups have better group accuracy under the flat incentive than the individual incentive (Wald $\chi^2 = 5.62$, one-tailed $p = 0.009$) although the individual incentive should provide stronger economic motivation for decision accuracy than the flat incentive. Group accuracy is higher under the group incentive than the individual incentive (Wald $\chi^2 = 6.34$, one-tailed $p = 0.006$), consistent with H3a.

The results for the post-discussion individual accuracy are consistent with the results for the group accuracy. Logistic regression shows that both the incentive type (Wald $\chi^2 = 17.69$, $p < 0.001$) and the pre-discussion individual accuracy (Wald $\chi^2 = 23.75$, $p < 0.001$) affect post-discussion individual accuracy. Group members do not have better post-discussion individual accuracy under the group incentive compared to the flat incentive (Wald $\chi^2 = 0.04$, one-tailed $p = 0.422$), providing no support for H1b. Group members have better post-discussion individual accuracy under the flat incentive than the individual incentive (Wald $\chi^2 = 15.30$, one-tailed $p < 0.001$), contrary to H2b. Group members achieve higher post-discussion individual accuracy under the group incentive than the individual incentive (Wald $\chi^2 = 15.26$, one-tailed $p < 0.001$). H3b is supported.

Discussion Content

Table 4 reports the number of common information items discussed, the number of unique information items discussed, and the number of inference statements made in Conditions 2, 3, and 4. I perform ANOVAs using the preceding variables as the dependent variables, and the incentive type as the independent variable.

Groups discuss more common information items ($t = 1.68$, one-tailed $p = 0.050$) and unique information items ($t = 1.75$, one-tailed $p = 0.043$) under the group incentive than the flat

incentive, consistent with H1c and H1d. However, groups do not make more inference statements under the group incentive than the flat incentive ($t = -0.01$, one-tailed $p = 0.495$). H1e is not supported.

Groups do not discuss more common information items ($t = -0.69$, one-tailed $p = 0.248$) nor more unique information items ($t = -0.78$, one-tailed $p = 0.220$) under the individual incentive compared to the flat incentive, providing no support for H2c and H2d. Groups make less inference statements under the individual incentive than the flat incentive ($t = -1.80$, one-tailed $p = 0.039$), contrary to H2e.

Consistent with H3c and H3d, groups discuss more common information items ($t = 2.30$, one-tailed $p = 0.013$) and unique information items ($t = 2.46$, one-tailed $p = 0.009$) under the group incentive than the individual incentive. Groups also make more inference statements under the group incentive than the individual incentive ($t = 1.74$, one-tailed $p = 0.044$), supporting H3e.

--- insert Table 3 here ---

Communication Difficulty and Confidence

Table 4 shows the communication difficulty, the confidence in the accuracy of the individual decision before and after group discussion, and the change in confidence after group discussion. ANOVAs are performed using the communication difficulty and the change in confidence as the dependent variables and the incentive type as the independent variable.

As hypothesized in H1f, participants experience more communication difficulty under the group incentive than the flat incentive ($t = 1.92$, one-tailed $p = 0.028$). The level of communication difficulty in the individual incentive condition is also marginally higher than that in the flat incentive condition ($t = 1.41$, one-tailed $p = 0.080$), providing marginal support for H2f. Participants do not experience significantly different levels of communication difficulty

under the group incentive and the individual incentive ($t = 0.49$, one-tailed $p = 0.311$), supporting H3f. These results support the proposition that performance-contingent incentives (group or individual) relative to the flat incentive increase communication difficulty. Consistent with the results for communication difficulty, participants increase their confidence that they have made the right individual decision less under the group incentive ($t = -3.16$, two-tailed $p = 0.002$) and the individual incentive ($t = -1.80$, two-tailed $p = 0.075$) than under the flat incentive, and not any differently under the group incentive and the individual incentive ($t = -1.33$, two-tailed $p = 0.187$). The higher level of communication difficulty under performance-contingent incentives may partially explain why the flat incentive perform comparably with the group incentive and better than the individual incentive, even though the group and individual incentives ought to increase economic motivation to achieve decision accuracy more than the flat incentive.

--- insert Table 4 here ----

Summary of Results

The results for the group accuracy, the post-discussion individual accuracy, the number of common and unique information items discussed, and the number of inference statements made can be summarized as such. First, groups with the group incentive do not outperform groups with the flat incentive for both group and individual accuracy, despite the former discussing more common and unique information items than the latter. Groups make as many inference statements under the group incentive and the flat incentive, which may help groups under both types of incentive to achieve similar decision accuracy. In addition, groups may feel greater pressure and anxiety to make the correct group choice under the group incentive, which may explain the greater communication difficulty that participants experience under the group incentive. Increased communication difficulty may negate the benefits of discussing more

common and unique information items under the group incentive. Greater pressure to perform may also encourage groups to adopt more varied and riskier decision strategies that can impair judgment performance.

Second, groups perform better under the flat incentive than the individual incentive in terms of both group and individual accuracy although the former do not discuss more common and unique information items than the latter. This may be because groups make more inference statements and discuss more implications of the information under the flat incentive than the individual incentive. The performance-contingent nature of the individual incentive can also increase pressure and anxiety, which may explain the increased level of communication difficulty under the individual incentive compared to the flat incentive.

Third, groups perform better under the group incentive than the individual incentive with respect to both group and individual accuracy. Groups also discuss more common and unique information items and make more inference statements under the group incentive than the individual incentive.

V. DISCUSSION AND CONCLUSION

This study examines how different types of incentive affect information exchange and judgment performance in a decision making task that involves a group of people. The results show that both group and individual accuracy are comparable under the group and flat incentives, and are better under the group and flat incentives than under the individual incentive. Although groups discuss more common and unique information items in the group incentive condition than in the flat incentive condition, groups in both conditions do not differ in the number of inference statements made. Groups make more inference statements even though they do not discuss more common and unique information items under the flat incentive than the individual incentive.

Finally, groups discuss more common and unique information items and also make more inference statements under the group incentive than the individual incentive. When groups make more inference statements, it would help participants assess the implications of information better and result in higher decision accuracy. This may explain why decision accuracy is equally good under the group and flat incentives, and better under the group and flat incentives than the individual incentive.

The results have several implications. Organizations should be aware that information for effective decision making is often distributed among different people and departments, either because of the inherent differences in knowledge, experience, and expertise or as a result of the accounting information system. Prior research indicates that a hidden profile problem may arise under such a scenario, wherein decision makers do not pool together unique information to make an optimal decision but focus their attention on commonly held information. However, the results in this study suggest that the hidden profile problem documented in prior studies may not be so serious when there are proper incentives. Groups with hidden profile information acting under the group and flat incentives in this study do not differ significantly in their decision accuracy compared to groups with full information. In contrast, groups with hidden profile information acting under the individual incentive make less accurate decisions compared to groups with full information.

This study also highlights the importance of considering the nature of the work and the costs and benefits of different incentive systems when adopting performance-contingent pay. The Towers Perrin 2005-2006 Worldwide Total Remuneration Survey shows that companies worldwide are increasingly relying on performance-contingent incentives to reward their employees, and lower-level employees are also included in this trend. This study shows that in a

decision making task where information for optimal decision making is distributed among different individuals and information sharing is essential, a flat incentive can match the performance of a group-based incentive and both the flat and group-based incentives can outperform an individual-based incentive. Although the flat incentive and the group incentive have similar levels of performance, the group incentive has the benefit of increasing knowledge exchange among employees compared to the flat incentive. The individual incentive which highlights individual performance reduces information exchange and cooperation among employees relative to the flat and group incentives, even when there is no explicit economic disincentive for information exchange under the individual incentive. Performance-contingent pay, whether it is based on group or individual performance, may also increase the pressure and anxiety faced by employees compared to a flat incentive. This increased pressure and anxiety may result in greater difficulty in communicating as well as riskier decision strategies, which may harm judgment performance in complex decision making tasks that require the inputs of multiple individuals.

This study has several limitations. First, this study uses anonymous and computer-mediated discussions. In reality, people working in groups are not anonymous, often interact face-to-face, and may have established relationships from prior interactions. Many other variables such as social context cues, verbal and non-verbal communication cues, and prevailing relationships may influence the group decision making process and moderate the effect of incentives. Second, this study examines only a group decision making task where group members are highly interdependent in the task. The results may not generalize to other group tasks with varying degrees of task interdependencies among group members.

TABLE 1

Distribution of Information Items in the Decision Task

Panel A: Distribution of information items across the three companies*

Alpha Company	5 positive items - 2 common - 3 unique	7 negative items - 1 common - 6 unique
Beta Company	9 positive items - 9 unique	3 negative items - 3 common
Gamma Company	5 positive items - 2 common - 3 unique	7 negative items - 1 common - 6 unique

Panel B: Distribution of information items across the three group members in the hidden profile conditions[†]

Group Member 1					
Alpha Company		Beta Company		Gamma Company	
3 positive items - 2 common - 1 unique	3 negative items - 1 common - 2 unique	3 positive items - 3 unique	3 negative items - 3 common	3 positive items - 2 common - 1 unique	3 negative items - 1 common - 2 unique
Group Member 2					
Alpha Company		Beta Company		Gamma Company	
3 positive items - 2 common - 1 unique	3 negative items - 1 common - 2 unique	3 positive items - 3 unique	3 negative items - 3 common	3 positive items - 2 common - 1 unique	3 negative items - 1 common - 2 unique
Group Member 3					
Alpha Company		Beta Company		Gamma Company	
3 positive items - 2 common - 1 unique	3 negative items - 1 common - 2 unique	3 positive items - 3 unique	3 negative items - 3 common	3 positive items - 2 common - 1 unique	3 negative items - 1 common - 2 unique

Notes:

* There are a total of 12 information items per company. 3 out of the 12 information items per company are common items held by all three group members. 9 out of the 12 information items per company are unique items held by only one group member, with 3 unique items distributed to each group member. The total information favors Beta (9 positive items and 3 negative items) over Alpha (5 positive items and 7 negative items) and Gamma (5 positive items and 7 negative items). The common information items favor Alpha (2 positive items and 1 negative item) and Gamma (2 positive items and 1 negative item) over Beta (3 negative items).

[†] Each group member holds 6 information items per company, of which 3 are common items and 3 are unique items. The 6 information items per company that each group member holds are balanced with 3 positive items and 3 negative items such that no company is favored.

TABLE 2

Pre-discussion Individual Accuracy, Group Accuracy, and Post-discussion Individual Accuracy*

Panel A: Descriptive Statistics

Condition [†]	Pre-discussion individual accuracy			Group accuracy			Post-discussion individual accuracy		
	n	Mean	Std dev	n	Mean	Std dev	n	Mean	Std dev
1 (All shared information)	42	0.69	0.47	14	0.71	0.47	42	0.74	0.45
2 (Flat incentive)	54	0.35	0.48	18	0.61	0.50	54	0.56	0.50
3 (Group incentive)	48	0.21	0.41	16	0.50	0.52	48	0.50	0.51
4 (Individual incentive)	48	0.29	0.46	16	0.19	0.40	48	0.17	0.38

Panel B: Hypotheses Tests of Group Accuracy and Post-Discussion Individual Accuracy

Planned Contrasts	Group accuracy, controlling for mean pre-discussion individual accuracy of group members H1a-H3a			Post-discussion individual accuracy, controlling for pre-discussion individual accuracy H1b-H3b		
	Results	Wald χ^2	one-tailed p	Results	Wald χ^2	one-tailed p
H1: Group versus Flat	Group = Flat	0.39	0.267	Group = Flat	0.04	0.422
H2: Individual versus Flat	Individual < Flat	5.62	0.009	Individual < Flat	15.30	<0.001
H3: Group versus Individual	Group > Individual	6.34	0.006	Group > Individual	15.26	<0.001

Notes:

* Participants make an individual decision before discussion, followed by a group decision and another individual decision after discussion, as to which company out of three companies is the best financial investment. An accurate decision is coded as “1” and an inaccurate decision is coded as “0”.

[†] Condition 1 is the control condition where a group member has all the 12 information items per company and is entered into a lottery with a 1 in 3 chance of winning \$20 regardless of decision accuracy. Conditions 2, 3, and 4 are hidden profile conditions where a group member has 6 information items per company, of which 3 are common items held by all three group members and 3 are unique items held by only one group member. In Condition 2 with the flat incentive, a group member is entered into a lottery with a 1 in 3 chance of winning \$20 regardless of decision accuracy. In Condition 3 with the group incentive, a group is entered into a lottery with a 1 in 3 chance of winning \$60 to be divided equally among the three group members if the group decision is accurate. In Condition 4 with the individual incentive, a group member is entered into a lottery with a 1 in 3 chance of winning \$20 if the post-discussion individual decision is accurate.

TABLE 3

Information Exchange and Inferences*

Panel A: Descriptive Statistics

Condition [†]	n	Number of common information items discussed (maximum = 9)		Number of unique information items discussed (maximum = 27)		Number of inference statements	
		Mean	Std dev	Mean	Std dev	Mean	Std dev
2 (Flat incentive)	18	5.94	1.73	9.72	3.80	25.17	8.51
3 (Group incentive)	16	7.19	2.46	12.75	5.77	25.13	10.95
4 (Individual incentive)	16	5.44	2.25	8.38	5.43	19.25	9.13

Panel B: Hypotheses Tests of Information Discussed

	Number of common information items discussed H1c-H3c		Number of unique information items discussed H1d-H3d		Number of inference statements (i.e., implications of information) H1e-H3e	
Planned Contrasts	<i>t</i>	<i>one-tailed p</i>	<i>t</i>	<i>one-tailed p</i>	<i>t</i>	<i>one-tailed p</i>
H1: Group versus Flat	1.68	0.050	1.75	0.043	-0.01	0.495
H2: Individual versus Flat	-0.69	0.248	-0.78	0.220	-1.80	0.039
H3: Group versus Individual	2.30	0.013	2.46	0.009	1.74	0.044

Notes:

* There are a total of 12 information items per company, of which 3 are common items held by all three group members and 9 are unique items held by only one group member. The group discussion transcripts are coded for the following: (1) number of common information items discussed; (2) number of unique information items discussed; and (3) number of inference statements made (i.e., implications of information), which include statements that draw conclusions about a company, make assertions about the consequences arising from the given information, and expand or elaborate on the given information.

[†] Conditions 2, 3, and 4 are hidden profile conditions where a group member has 6 information items per company, of which 3 are common items held by all three group members and 3 are unique items held by only one group member. In Condition 2 with the flat incentive, a group member is entered into a lottery with a 1 in 3 chance of winning \$20 regardless of decision accuracy. In Condition 3 with the group incentive, a group is entered into a lottery with a 1 in 3 chance of winning \$60 to be divided equally among the three group members if the group decision is accurate. In Condition 4 with the individual incentive, a group member is entered into a lottery with a 1 in 3 chance of winning \$20 if the post-discussion individual decision is accurate.

TABLE 4

Communication Difficulty and Confidence*

Panel A: Descriptive Statistics

Condition [†]	n	Communication difficulty (0-10)		Confidence before group discussion (0-10)		Confidence after group discussion (0-10)		Change in confidence after group discussion	
		Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev
2 (Flat incentive)	54	3.17	2.20	6.59	1.61	7.87	1.17	1.28	1.75
3 (Group incentive)	48	4.07	2.50	7.00	1.35	7.31	1.42	0.31	1.55
4 (Individual incentive)	48	3.83	2.45	6.90	1.49	7.63	1.63	0.73	1.25

Panel B: Additional Contrast Analyses

Contrasts	Communication difficulty H1f-H3f		Change in confidence after group discussion	
	<i>t</i>	<i>one-tailed p</i>	<i>t</i>	<i>two-tailed p</i>
H1: Group versus Flat	1.92	0.028	-3.16	0.002
H2: Individual versus Flat	1.41	0.080	-1.80	0.075
H3: Group versus Individual	0.49	0.311	-1.33	0.187

Notes:

* In a post-experimental questionnaire, participants rate on a scale of 0-10 the level of difficulty their group experiences in reaching a group decision and the level of difficulty they experience in communicating with their group members, and the mean of the two ratings is used as the measure of communication difficulty. Participants also rate on a scale of 0-10 their level of confidence that they have made the right individual choice once before the group discussion and once after the group discussion.

[†] Conditions 2, 3, and 4 are hidden profile conditions where a group member has 6 information items per company, of which 3 are common items held by all three group members and 3 are unique items held by only one group member. In Condition 2 with the flat incentive, a group member is entered into a lottery with a 1 in 3 chance of winning \$20 regardless of decision accuracy. In Condition 3 with the group incentive, a group is entered into a lottery with a 1 in 3 chance of winning \$60 to be divided equally among the three group members if the group decision is accurate. In Condition 4 with the individual incentive, a group member is entered into a lottery with a 1 in 3 chance of winning \$20 if the post-discussion individual decision is accurate.

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