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The purpose of this study is to test Davis's (1996) Social Judgment Scheme (SJS) model, which was proposed as a predictive model of group decision making with continuous alternatives. The SJS model assumes that individual group members' influence on the group decision exponentially declines with the distance from other members' judgments (i.e. majority influence process). Fifty-five 3-person groups engaged in eight group polarization tasks. First, the model fits of the SJS model and the Averaging model were compared in terms of the predictive accuracy. Results indicted that the SJS model yielded accurate predictions more often than the Averaging model. Second, a different analytical approach confirmed the model's corollary—the skewness of individual judgments distribution was negatively correlated with the direction of group polarization. These findings support the model's assumption of majority influence process in continuous alternatives tasks.

keywords group decision making, group polarization, majority influence process, social judgment scheme model

IN MODERN societies, groups are often entrusted with making decisions of consequence. Decision-making tasks in which groups engage often vary in terms of the types of alternatives. There are tasks in which groups are asked to choose one most appropriate alternative from a finite set of discrete alternatives (e.g. a criminal jury deciding whether a defendant is guilty or not guilty). On the other hand, there are tasks in which alternatives are arranged along a continuum and a group has to make a quantitative judgment by singling out a point

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that is most appropriate (e.g. a civil jury deciding the amount of damages that should be awarded).

There seems to have been a tendency for researchers to study group decision tasks with discrete alternatives more extensively than tasks with continuous alternatives (cf. Davis, 1996; Davis, Zarnoth, Hulbert, Chen, Parks et al., 1997). This tendency might be due partly to the fact that controversial cases in the US Supreme Court (e.g. *Johnson* v. *Louisiana*, 1972; *Williams* v. *Florida*, 1970), which stimulated many mock jury experiments regarding unanimity of decision and jury size, were associated with criminal cases (i.e. decision tasks with dichotomous alternatives). A well-established model of group decision-making processes, Davis's (1973) Social Decision Scheme model, which has often been applied to jury decision-making studies, is also designed to analyze the group decision process with discrete alternatives (see Stasser, Kerr, & Davis, 1989, for a review of the Social Decision Scheme model). Accordingly, an imbalance seems to exist in the literature in terms of task type: more studies have dealt with discrete alternatives tasks than continuous alternatives tasks.

This imbalance might be justifiable if the results obtained from discrete alternatives tasks could be readily generalized to continuous alternatives tasks. Whether such generalization is possible is unclear, however, and it seems premature to conclude that the task types produce no systematic differences in outcomes. For example, Miller (1989) points out that compromise among group members is possible only when alternatives are continuous: there is no compromise alternative between guilty and not guilty, whereas there are many possible compromise alternatives between two amounts, say US$10,000 and US$20,000, for a civil jury dealing with a damage awards case. The possibility of compromising may make the majority–minority influence processes more complicated.

Recently, Davis (1996) proposed a model, the Social Judgment Scheme model (SJS model), to analyze the group decision process with continuous alternatives tasks. The purpose of this study is to test the validity of the SJS model in a *group polarization* (or choice shift) context (cf. Isenberg, 1986; Kaplan & Miller, 1983; Myers & Lamm, 1976, for reviews of group polarization). The term group polarization has been used to refer to somewhat different phenomena. For example, the 'polarization' can refer to both individual level and group level shifts toward an initially dominant opinion—viz. in the former sense each group member's pre- and post-discussion judgments are compared, whereas in the latter sense the average of group members' pre-discussion judgments and the group judgment are compared (e.g. Moscovici & Zavalloni, 1969). In this paper, however, we use the term in the latter sense only. Accordingly, unlike many studies addressing underlying mechanisms of the individual attitude change via group discussion (e.g. Burnstein & Vinokur, 1973; Kaplan & Miller, 1977; Teger & Pruitt, 1967), this study focuses on the process of how individual judgments are aggregated to a group decision, and how the aggregation process presumed by the SJS model accounts for group polarization.

Majority influence process and group polarization

Before explaining the SJS model, let us first describe Cartwright's (1971) model of choice shift, which can be regarded as a non-mathematical and simplified version of the SJS model. Cartwright suggested that a majority influence process during group decision making would account for the reason why group judgments appear more extreme than the average of group members' pre-discussion judgments. In his analysis, Cartwright distinguished between two subtypes of majority influence processes: *pure majority process* and *coalition process*. In the data set he analyzed, there were some groups in which a pure majority faction existed (i.e. two of three group members initially made the same judgment). These groups tended to choose the majority's initial judgment as the group judgment. Even if no two members shared the same initial judgment, Cartwright proposed that two members whose initial judgments were

closer to each other might form a coalition.[1] For example, if three members' initial judgments are 1, 2, and 6, the members who made the judgments of 1 and 2 might well form a coalition against the member who made the relatively deviant judgment of 6. Cartwright maintained that such a coalition tended to dominate the group judgment process (i.e. one of the coalition members' initial judgments was likely to be chosen as the group's decision).

Both the majority and coalition processes imply that a minority (i.e. most deviant) members' initial judgment will not be incorporated into the group's final judgment. Therefore, the group's judgment is necessarily closer to the initial majority or coalition members' judgments than is the mean of all members' initial judgments. In other words, through the majority or coalition process, the initially dominant judgment at the individual level will be exaggerated at the group level.

Cartwright's (1971) two subtypes of majority influence processes can be formally subsumed into the SJS model developed by Davis (1996). The SJS model approximates the group judgment as a weighted average of the group members' initial judgments. Each members' initial judgment is weighted according to its relative closeness to the other members' judgments: the weight given to a particular member declines exponentially as the distance between his or her judgment and other members' judgments becomes greater. In other words, members central in terms of their judgmental preference are more influential in the group judgment process, whereas peripheral members (or deviant members) are less influential. Notice such an assumption is consistent with Cartwright's coalition process and pure majority process, in which most deviant member's judgment was given a weight of zero. (See appendix for more details about the SJS model.)

Purpose and hypotheses of the study

The purpose of this study is to test the validity of the SJS model in a group polarization context in two ways: (1) the SJS model is tested against a rival model, a simple averaging model (cf. Grasser, 1982), in terms of the predictive accuracy, and (2) the model's corollary regarding the group polarization is tested. Unlike the previous studies examining the SJS model (Davis, 1996; Davis, Zarnoth, et al., 1997), which applied the SJS model to group decision tasks with continuous, infinite alternatives, this study, following many past group polarization studies, employs tasks with seven or six discrete ordered alternatives. Technically speaking, the SDS model, which was designed to group decision tasks with discrete alternatives, could deal with such tasks. However, the SDS model specifies its predictions for each of initial configurations of the group members' preferences. Note that only six response categories and the group size of three yield 156 ($= 6 + 6 \times 5 + 6 \times 5 \times 4$) possible preference configurations. Therefore, so as to apply the SDS model to this particular task, there must be at least 156 groups manifesting those 156 preference configurations. It is obviously impracticable to apply the SDS model to such tasks. On the other hand, the SJS model appears to be more easily applied to the tasks with discrete ordered alternatives, although it has not yet been tested employing such tasks. Therefore, it is interesting to see whether the SJS model can be effectively applied to such tasks.

As Davis (1996) argued, one way to test the SJS model is to compare it with other models, such as the Averaging model, which predicts the group judgment by computing the average of group members' initial judgments (cf. Grasser, 1982). The first purpose of the study is to test the SJS model against the Averaging model. Although the Averaging model may not appear to be a particularly compelling model, the comparison may be justifiable given the lack of well-established rival models regarding the prediction of the group decision from individual judgments in the case of continuous alternatives.[2] This study is a first test of the SJS model against the Averaging model employing tasks with a relatively small number of ordered alternatives. It is, however, expected that the assumption of the SJS model (i.e. majority influence process) is pertinent regardless of the number of alternatives (cf. Cartwright, 1971).

Hypothesis 1: *The SJS model predicts the group judgment from the individual members' initial judgments more accurately than does the Averaging model.*

A corollary of the SJS model is that group polarization will occur when the distribution of individual judgments is skewed. Imagine a situation in which three group members' initial judgments are numerically represented as 1, 3, and 5 (i.e. non-skewed). In this case, there is neither a majority faction nor a basis to form a coalition. The group will probably make a choice of 3 (cf. Crott & Zuber, 1983). On the other hand, if the initial judgments are 1, 2, and 6 (i.e. positively skewed), the first and second members might form a coalition. If either one of the coalition members' judgments (i.e. 1 or 2) is chosen as the group's judgment, it is more extreme than the mean of the initial judgments (i.e. 3) in the negative direction. Thus, if the SJS model (or at least its assumption of majority influence process) is correct, the distribution of individual judgments must be skewed for group polarization to occur (see Crott, Zuber, & Schermer, 1986; Davis & Hinsz, 1982; Davis, Kameda, & Stasson, 1992; Ono, Tindale, Hulin, & Davis, 1988; Vinokur, 1969, for similar arguments).

The direction of group polarization is related to the valence of skewness. When the distribution of individual judgments is positively skewed as in the above example (individual judgments are 1, 2, and 6), groups' judgments become numerically smaller than the mean of the initial distribution. On the other hand, the group judgments become larger when the distribution is negatively skewed. For example, if initial judgments are 1, 5, and 6, a probable group judgment of 5 is larger than their mean (i.e. 4). Thus, a negative correlation is anticipated between the direction of group polarization and the skewness of the individual distribution. Notice that the Averaging model by its definition predicts no shift from the mean of initial judgments.

Hypothesis 2: *The direction of group polarization and the skewness of the individual judgments distribution are negatively correlated.*

It is difficult, however, to test hypothesis 2 using the group as the unit of analysis. Such a group-wise test will not differ from testing the fit of the SJS model's prediction, i.e. the test of hypothesis 1. Furthermore, it might also be difficult to define adequately the skewness of the distribution with only a few data-points (e.g. three data-points in this study). Using a group-wise measure of the skewness, Vinokur (1969), for example, failed to demonstrate the relationship between the skewness of the individual judgments and group polarization. There is another way to test hypothesis 2. If the distribution of individual judgments is skewed at the population level, there will be a tendency for groups from that population also to have skewed distributions of judgments, and thus group polarization must be observed in these groups. (The population in this study is defined as all participants from whom a number of three-person groups were randomly composed.) Therefore, if groups make judgments about various issues associated with different levels of skewness of the individual judgments, the relation between the skewness of the individual judgments and group polarization can be tested with the issue as the unit of analysis.

Notice that hypothesis 2 tested in the above way is concerned primarily with the SJS model's core assumption (i.e. majority influence process). Thus, hypothesis 2 could hold even when hypothesis 1, which is concerned with more mathematical details of the SJS model, is rejected.

Method

The purpose of the experiment was to test the above two hypotheses. In the experiment, three-person ad hoc groups engaged in a series of group judgment tasks with alternatives represented on Likert-format scales. Each group member made his or her individual judgment first, and then members engaged in discussion as a group, so that whether group polarization occurred was assessed by comparing the mean of individual judgments to the group judgment.

Participants and design

Participants were 168 undergraduate students (111 males and 57 females) who were enrolled

in either an introductory psychology class at Hokkai Gakuen University or a behavioral science laboratory class at Hokkaido University. Hokkai Gakuen University is a middle-size university, and Hokkaido University is the largest university in the Hokkaido area, Japan. Participation partially fulfilled their course requirement. Each participant was randomly assigned to either an all-male or all-female three-person group according to his or her sex. Past research shows that there are several systematic gender differences, such as different participation rates, in a group decision-making setting (e.g. Klopfer & Moran, 1978; Strodtbeck & Mann, 1956). Such a gender difference might result in a nuisance factor for the SJS model (e.g. differential weights to different members based on their sex might be needed, although the SJS model allots the differential weights according solely to the relative closeness of their judgments). Thus, sex was controlled in this experiment. There were 37 male groups and 19 female groups. There is another reason for controlling for sex. Remember that hypothesis 2 will be tested with the issue as the unit of analysis. The number of the population distributions will become the degree of freedom, *df*, of the analysis. Controlling for sex, thus, will double the *df* of the analysis (i.e. the male and female judgments on a particular issue can be used as two separate populations). Thus, the *df* of the analysis was 16 (= 8 issues $\times$ 2 sexes).

Procedure and materials

When participants arrived, they were instructed that they would engage in several decision-making tasks as members of three-person groups. Each group received four booklets: three of them were for each individual member to write down his or her own responses and one was for a group to write down the group responses. The booklets for individuals contained five stories and questions about them. Four of the five stories were adapted from Kogan and Wallach's (1964) Choice Dilemma Questionnaire (CDQ), which has been widely used in the risky shift research, and the other story was adapted from Kohlberg's (1969) Moral Dilemma (i.e. Heinz's story).[3] Each story from the CDQ was followed by a question assessing a respondent's risk preference with six response categories, each of which is associated with a certain level of risk. The Moral Dilemma story was followed by four questions asking (1) whether the protagonist's behavior was permissible, (2) whether it was good, (3) whether it was moralistically defensible, and (4) whether the respondent empathized with the protagonist. These four questions were accompanied by 7-point Likert-format scales. Therefore, each CDQ story was treated as one item, and the Moral Dilemma story was treated as four items. All participants started with the CDQ stories and ended with the Moral Dilemma story.

Participants first read a story and answered an associated question individually. After all three members completed answering the question, they were asked to close their own booklet and their seating was rearranged so that they could talk with each other. Participants were asked to indicate the group's judgment after reaching a consensus among the members. When the group achieved a consensus, the seating was rearranged again so as to prevent further interaction among the group members. Participants then repeated the same procedure (i.e. responding individually and discussing as a group) five times. For the last story, participants first answered all four questions individually, and then engaged in group discussion to answer the four questions as a group. After completing all eight group judgment tasks, participants answered a post-discussion questionnaire. Then, they were thanked and dismissed.

Results

Model fitting: the SJS model vs. the Averaging model

To test hypothesis 1, we computed the predictions from the SJS model and the Averaging model for each group. For the Averaging model, the mean of the three members' initial judgments was simply computed. For the SJS model, the initial judgments were entered in the formula given by Davis (1996; see appendix). Since both models produced predictions with decimal points whereas the response categories

were real numbers, the predicted values were rounded off for further analyses. Table 1 shows the means of observed group decision, the SJS model's prediction, and the Averaging model's prediction as a function of sex and item.

We tested hypothesis 1 in three different ways. First, for each of eight items, we conducted a series of paired-sample *t* tests to examine whether the SJS model's predictions are significantly different from the observed group decisions. The differences between SJS model's predictions and the observed decisions were significant for item 1 ($t(55) = 2.01$, $p < .05$) and marginally significant for item 2 ($t(55) = 1.96$, $p < .10$). Comparable paired-sample *t* tests were conducted for the Averaging model. The differences between the Averaging model's predictions and the observed decisions were significant for item 4 ($t(55) = 3.18$, $p < .01$), item 5 ($t(55) = 3.17$, $p < .01$), and item 8 ($t(55) = 2.01$, $p < .05$), and marginally significant for item 1 ($t(55) = 1.84$, $p < .10$) and item 2 ($t(55) = 1.90$, $p < .10$). Thus, the Averaging model yielded inaccurate prediction more frequently than did the SJS model.[4]

Second, following the analytical strategy employed by Davis (1996) and Davis, Zarnoth, et al. (1997), we employed the Kolmogorov-Smirnov goodness-of-fit test. Briefly, the Kolmogorov-Smirnov goodness-of-fit test examines the maximum difference between the two distributions in the form of cumulative relative frequency (e.g. Hays, 1994, Ch. 18 for more explanations of this test, and see Davis, 1996, for explanations in this context). A series of eight Kolmogorov-Smirnov tests were computed to test the fit between the distribution of the SJS model's predictions and the distribution of observed group decisions. The fit of the SJS model was not rejected at the .20 level for any item. The comparable eight Kolmogorov-Smirnov tests were computed for the Averaging model. The fit of the Averaging model was rejected at the .20 level for three items (items 3, 4, and 5). Thus, again, the Averaging model yielded inaccurate predictions more frequently than did the SJS model.[5]

Third, the accuracy of the two models' predictions were compared in terms of the absolute deviation from the observed group decisions.

Table 1. Means of the observed group judgments, the SJS model's predictions, and the Averaging model's predictions as a function of sex and item

		Item							
Sex	Observed / model	1	2	3	4	5	6	7	8
Male	Observed	4.30 (.91)	2.97 (1.19)	3.03 (1.12)	1.81 (1.13)	5.57 (1.37)	3.49 (1.28)	3.76 (1.39)	6.35 (.82)
	SJS	4.54 (.87)	3.27 (1.04)	3.03 (1.07)	1.73 (1.39)	5.65 (1.32)	3.51 (1.04)	3.76 (1.21)	6.30 (.78)
	Averaging	4.46 (.77)	3.14 (1.00)	2.95 (.88)	2.14 (.86)	4.97 (1.07)	3.35 (.85)	3.57 (1.07)	6.11 (.81)
Female	Observed	3.95 (1.13)	3.26 (.93)	2.42 (1.07)	2.53 (1.39)	5.37 (1.32)	3.26 (1.04)	3.63 (1.01)	6.11 (.81)
	SJS	4.00 (1.05)	3.26 (.73)	2.63 (.90)	3.00 (1.25)	5.42 (1.30)	3.42 (.84)	3.68 (.67)	6.21 (.79)
	Averaging	4.11 (.81)	3.53 (.77)	2.79 (.63)	2.95 (1.03)	5.16 (1.08)	3.42 (.77)	3.79 (.63)	6.05 (.71)

Notes: Numbers in parentheses are standard deviations. *N*s are 37 for the male cells and 19 for the female cells. Items 1 through 4 correspond to the CDQ items, and items 5 through 8 correspond to items associated with the Moral Dilemma scenario.

Table 2. Mean absolute deviation score as a function of predictive model, sex, and item

		Item							
Sex	Model	1	2	3	4	5	6	7	8
Male	SJS	.41	.57	.43	.41	.78	.51	.59	.38
		(.60)	(.60)	(.65)	(.93)	(1.06)	(.65)	(.76)	(.55)
	Averaging	.49	.65	.46	.59	.94	.57	.51	.46
		(.51)	(.54)	(.61)	(.73)	(.73)	(.66)	(.65)	(.56)
Female	SJS	.26	.31	.21	.58	.37	.16	.37	.21
		(.56)	(.58)	(.71)	(.77)	(.60)	(.37)	(.60)	(.42)
	Averaging	.26	.37	.47	.52	.72	.26	.37	.37
		(.56)	(.60)	(.61)	(.70)	(.61)	(.45)	(.60)	(.50)

Notes: Numbers in parentheses are standard deviations. *N*s are 37 for the male cells and 19 for the female cells. Items 1 through 4 correspond to the CDQ items, and items 5 through 8 correspond to items associated with the Moral Dilemma scenario.

This test is not redundant because some patterns of inaccurate predictions cannot be detected by the above analyses: given the observed group decisions of 1, 2, and 3, if a model yielded predictions of 3, 2, and 1, which are inaccurate, the model's predictions are, however, judged accurate in terms of the mean and the cumulative relative frequency. For each group and each item, the absolute difference between the SJS model's prediction and the observed group decision was computed. Similarly, the absolute difference between the Averaging model's prediction and the observed group decision was computed. The mean absolute deviation scores are shown in Table 2 as a function of the model, item, and sex. As consistent with the previous analyses, the absolute deviation scores are generally smaller for the SJS model than for the Averaging model. A $2 \times 2 \times 8$ analysis of variance (ANOVA) with sex, models (SJS vs. Averaging), and items as independent variables was computed.[6] The last two factors involved repeated measures. The significant main effect of the model ($F(1, 54) = 4.08, p < .05$), confirmed hypothesis 1. An unexpected main effect of sex was also significant ($F(1, 54) = 7.02$, $p < .05$). As seen in Table 2, the absolute deviation scores are generally smaller for females than males.

To explore the cause of this unexpected main effect of sex, we counted the frequency of minority influence process that is contradictory with the majority influence process assumed by the SJS model. The instance of minority influence was operationally defined as instances in which the group judgments deviate from the majority members' judgments to a minority members' initial judgment. Suppose, for example, that group members' initial judgments were 1, 2, and 5. If this group made a judgment of 3, 4, or 5, this group was counted as an instance of the minority influence. As consistent with the previous analyses, even when such a relaxed definition of the minority influence was employed, the frequency of the minority influence process was low (utmost 30.4 percent for items 5 and 7). There was a small but consistent gender difference: the minority influence process was more likely to occur among the male groups than among the female groups (i.e. this pattern was observed in all items except item 4). However, partly because of the low frequency of the minority influence process, this gender difference was not significant by the chi-square tests (the largest observed difference in the frequency of minority influence was 37.8 percent for the male groups vs. 15.8 percent for the female groups in item 7). We shall discuss some implications of this finding in the discussion section.

Skewness of the individual judgments and group polarization

Hypothesis 2 predicts that group polarization occurs when the distribution of the individual judgments on a given issue is skewed. As stated in the method section, the unit of this analysis is the issue, and the male and female samples are separated. Thus the *df* is 16 (= 8 issues × 2 sexes).[7] First, for each issue, the skewness score was computed based on either male or female participants' individual judgments. Second, group polarization scores were computed by subtracting mean group judgment from mean individual judgment, separately for the male and female samples. Thus, when the mean group judgment is larger than the mean individual judgment, the group polarization score is positive, whereas when the mean group judgment is smaller than the mean individual judgment, the group polarization score is negative—viz. the valence of the group polarization score corresponds to the direction of group polarization. Notice that both skewness scores and group polarization scores were computed in the issue-by-issue, but not group-by-group, manner. Hypothesis 2 predicts negative correlation between skewness and the direction of group polarization. As shown in Figure 1, a scatterplot of the group polarization score as a function of the skewness score clearly shows the negative correlation ($r = -.61$, $p < .05$). This result supports hypothesis 2.

Discussion

In this study, the validity of the SJS model was examined in the context of group polarization. First, the SJS model was tested against the

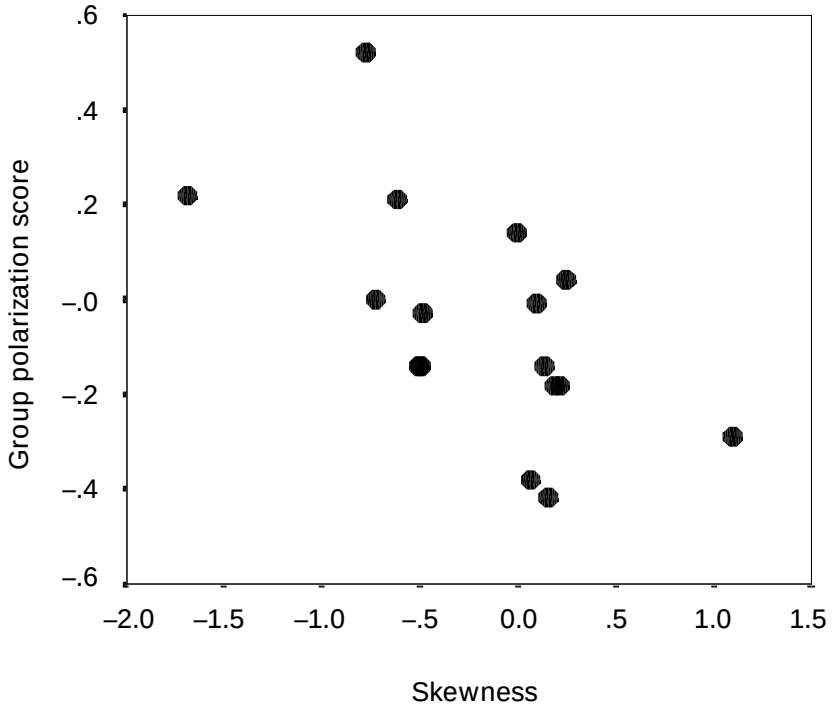

Figure 1. Scatterplot of the group polarization score as a function of the skewness of the individual judgment distribution.

Averaging model. The results showed that the SJS model predicted observed group judgments more accurately than did the Averaging model. The Averaging model's predictions differed significantly from observed decisions more frequently than did the SJS model's predictions. The Averaging model's fit to the observed decision in terms of the cumulative relative frequency was more frequently rejected than was the SJS model's fit. The absolute deviation from the observed decision was larger for the Averaging model than the SJS model. The general trend of this series of analyses indicates that the SJS model produces more accurate predictions than does the Averaging model.

A corollary of the SJS model was also tested—namely, that the skewness of the individual judgments distribution should be negatively correlated with the direction of group polarization. If the distribution is negatively skewed, group polarization should occur in the positive direction; if the distribution is positively skewed, group polarization should occur in the negative direction. The correlation analysis confirmed this prediction. In sum, the general pattern of the results was supportive to the SJS model.

Gender difference in the degree of model fit

An unexpected finding was that the fit of the SJS model was better for the female groups than for the male groups. As reported in the result section, this pattern is perhaps due to the relatively high frequency of the minority influence process among the male groups than the female groups. This implies that females in the minority position complied with the majority faction more easily than males. On the contrary, Eagly and Carli (1981) refuted the commonly held belief that females are more easily influenced than are males. Maccoby (1998), however, recently pointed out that various gender differences might exist in different interaction styles of males and females. According to Maccoby's perspective, for example, individual females are not necessarily more easily influenced by others than are individual males, but female–female interactions might involve more conflict-avoidance (i.e. apparently submissive) style than male–male interactions. Therefore, some gender differences might be masked unless males and females are observed in group settings that allow them to show their natural interaction styles. Note that this experiment employed a group decision-making setting in which participants actually interacted with each other. Accordingly, this study might have been more suitable to detect some difference between the male–male interaction style and the female–female interaction style. Admittedly, the data size is too small and the design is not appropriate for deriving any strong conclusion. This finding, however, suggests that small group research might be suitable to study gender differences.

Limitations of the study and conclusion

This study employed the group decision tasks with a relatively smaller number of alternatives than tasks employed in the previous research of the SJS model (Davis, 1996; Davis, Zarnoth, et al., 1997), which posed several limitations. First, it could be said that our study tested the SJS model with easier tasks than the previous studies. For example, as Davis (1996) has noted, when there are infinite response categories, people might find particular points more salient and be more likely to choose them (e.g. for a civil jury deciding a damage award, US$1000.00 is probably more salient than US$1015.23 and the like). If group judgments tend to be rounded off to such psychologically salient points, it becomes more difficult to make accurate predictions. Given a 7-point Likert–format scale, on the other hand, it seems less likely that some particular response category becomes more salient (albeit the neutral point might be such a salient point).

Second, employing the Likert-type alternatives, this study sacrificed the sensitivity in model testing (e.g. the SJS model and the Median model were not distinguishable, see Note 2). The SJS model assumes that a member's social influence declines exponentially with the distance from other members' judgmental positions. However, the linear decay or other more complicated weighting schemes are conceivable. The relatively narrow range of the response categories prevented us from testing the exponential function against other functions.

Our study, however, focused on the SJS model's core assumption (i.e. majority influence process) more thoroughly than did the previous studies. For example, this study not only assessed the model fit but also tested a corollary derived from the assumption. Given the fact that the development of the SJS model is still at a beginning stage, thorough tests of the model's core assumption might have been needed. This study confirmed that group decision-making process with continuous alternatives tasks can be approximated by a majority influence process. Combined with the robust finding of the majority process in group decision-making process with discrete (mostly dichotomous) alternatives tasks (Stasser et al., 1989), it can be said that majority influence process is pervasive in the group decision-making process, albeit the meanings of 'majority' are slightly different from context to context.

Given the confirmation of the core assumption of the SJS model, further research should be needed to specify an accurate mathematical model of group decision process with continuous alternatives tasks. It is possible that different mathematical models provide best fit for different tasks and in different contexts. Miller (1989), for example, suggested that a minority member might be able to induce more compromise from the majority faction under unanimity rule, which endows him or her with a veto power, than majority rule (see Miller, 1985; Ohtsubo et al., 2002, for supportive evidence; see also Davis, Au, Hulbert, Chen, & Zarnoth, 1997, for a contradictory finding). Kaplan and Miller (1987) suggested that intellective vs. judgmental distinction might be relevant to the continuous alternatives tasks, as to the discrete alternatives tasks. Notice that such model × task, and model × procedure interactions have long been studied in the context of the SDS model. So as to refine and improve the SJS model, it seems that further studies are needed to test it in various settings.

Notes

1. Cartwright (1971) defined the coalition process in a slightly different way. However, so as to make Cartwright's analysis more comparable to the SJS model, we decided to present the coalition process as described in the text.
2. Another plausible rival model is the Median model whereby the median of group members' initial judgments is taken to predict the group decision (Crott & Zuber, 1983). In this particular study, however, given the rather small number of alternatives and group size of three, both the SJS model and the Median model yield almost equivalent predictions. Therefore, the two models are in fact indistinguishable. There is a reason for preferring the SJS model to the Median model other than the relative predictive accuracy, however. As Ohtsubo, Miller, Hayashi, and Masuchi (2002) have noted, the predictive accuracy of the Median model might fluctuate with group size. When a group is composed of an odd number of members, the Median model chooses the most central member's initial judgment. On the other hand, when a group is composed of an even number of members, the median tends to be located between two most central members' judgments, and thus no member may endorse that particular point. Accordingly, the Median model might produce more accurate prediction when applied to groups with an odd number of members. This undermines the generalizability of the Median model.
3. The four CDQ items were about (i) whether a president of a corporation should build a new plant in the United States or in a riskier but potentially more beneficial foreign country, (ii) whether a college senior should go to medical school, which assures his career as a medical doctor, or a conservatory of music, (iii) whether a college senior should pursue his graduate study at a more prestigious but competitive university or a less prestigious university, and (iv) whether a captain of a college football team should try riskier play to win or play conservatively to assure a tie. These items are accompanied with a question asking what is the lowest probability of success that makes the riskier choice worthwhile taking. Alternatives are given in a form of '1 in 10' or '3 in 10'. The Heinz story describes that Heinz stole expensive medicine, which he could not afford, to save his wife's life. All scenarios, which were originally written in English, were translated into Japanese by the first author.
4. The similar pattern was found when the comparable paired-sample *t* tests were conducted for males and females separately. However, partly because of the small sample size, the relative

superiority of the SJS model was not as clear as when the male and female samples were combined.

5. The similar pattern was found when the Kolmogorov-Smirnov tests were computed for males and females separately. However, the superiority of the SJS model was not clear for the female sample. Because of the small sample size (i.e. 19), the model fits were not rejected for both models except a few exceptions.
6. One might find the CDQ items and the Moral Dilemma items should be analyzed separately because of the differences in the procedure and the scales associated with them. Such separate analyses were conducted. The results were basically consistent with the results reported in the text. The result of the $2 \times 2 \times 8$ ANOVA is reported primarily for the sake of simplicity.
7. In order to treat the four items associated with the Moral Dilemma story as separate items, we computed the coefficient α of those items. Coefficient α's were .51 for the male sample and .32 for the female sample. These low levels of α's suggest a lack of internal coherence of the four items. Moreover, the skewness scores associated with those items varied substantially. For the male sample, for example, two items were associated with positive skewness and the other two with negative skewness. Thus, we decided to treat these four items separately to test hypothesis 2.

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Appendix

The SJS model posits that the group judgment, G, can be approximated by a weighted average (or weighted sum) of every group member's individual judgment, x_i.

$$G = c_1x_1 + c_2x_2 + \ldots + c_rx_r \qquad (1)$$

where $c_1 + c_2 + \ldots + c_r = 1$; r = group size

The weight, c_i is defined as below.

$$c_i = \frac{\sum_{j=1}^{r} f\left(\left|x_i - x_j\right|\right)}{\sum_{i=1}^{r}\sum_{j=1}^{r} f\left(\left|x_i - x_j\right|\right)}, i \neq j \qquad (2)$$

Formula (2) implies that each member's judgment is weighted according to some function of the distance between his or her judgmental position and other members' judgmental positions. As stated in the text, the SJS model assumes that each member's influence exponentially declines with the distance from other members' judgments. This assumption is more precisely expressed by the formula below.

$$f\left(\left|x_i - x_j\right|\right) = e^{-\theta\left(\left|x_i - x_j\right|\right)}, i \neq j \qquad (3)$$

Following Davis's (1996) suggestion, parametric value of $\theta = 1.00$ was used in this study. Our data also indicated that $\theta = 1.00$ fits better than do the other more extreme values of θ.