Synergy between Diversity and Similarity in Group-Idea Generation

Asako Miura and Misao Hida

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SYNERGY BETWEEN DIVERSITY AND SIMILARITY IN GROUP-IDEA GENERATION

ASAKO MIURA
Kobe Gakuin University, Japan
MISAO HIDA
Fukushima University, Japan

This article is a report of two experiments that were conducted to investigate the creative performance of groups during idea-generation sessions. The hypothesis was that groups in which higher levels of both member diversity and similarity of thought categories were combined would show greater gains in creative performance. In Study 1, the participants (n = 168) were assigned to 56 three-person groups and performed an inventive creativity task. The results supported the hypothesis. Forty-one three-person groups, which consisted solely of female participants (n = 123) performed an ameliorative creativity task in Study 2. The hypothesis was again confirmed. These results suggest that a form of synergy between diversity and similarity operates in group creativity.

Keywords: *group creativity; idea generation; diversity; similarity*

Creative activity within groups plays many important roles in our modern society. Creativity is acknowledged as an essential aspect of doing business. In his review of the field, Paulus (2000) suggested that interaction in groups can be an important source of creative ideas and innovations. The products of creativity are often sources of profit and, consequently, are major factors in the survival of an organization. Furthermore, in this information age, the

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exchange of information and knowledge and the operation of innovation (the application of ideas) within groups are becoming increasingly important components of work (Purser & Montuori, 1995). We need to empirically evaluate the creative potential (Paulus, 2000) of groups and identify the conditions under which high levels of creativity are realized by groups.

But many previous empirical studies suggest that various factors of interactive groups are responsible for the loss of productivity. First, a number of processes in groups operate to directly constrain the cognitive processes of idea generation. For example, it is not possible to share one's own ideas while others are talking within the group (production blocking; Diehl & Stroebe, 1987, 1991). This time constraint may cause participants who are waiting to share their ideas to forget them or decide that they are no longer relevant. Second, a number of social factors inhibit productivity in idea-generating groups. The potential evaluation of ideas by those within the group can also inhibit idea generation (evaluation apprehension; Diehl & Stroebe, 1987; Maginn & Harris, 1980). Although the instructions for brainstorming try to eliminate this by forbidding public criticism (cf. Osborn, 1953), participants may feel apprehensive about what the others think of their contributions. Another important social factor is the tendency of individuals to loaf or be less motivated when individual contributions are to be combined in a group product (social loafing; Diehl & Stroebe, 1987; Latané, Williams, & Harkins, 1979; Paulus, Dzindolet, Poletes, & Camacho, 1993). Similarly, one may exert less effort or take a free ride when the high performance levels of others within a group make one's contributions appear to be unnecessary (free riding; Kerr & Bruun, 1983).

How can we overcome the "loss" factors that block the generation of creative ideas in interactive groups? Which characteristics of groups lead to high levels of productivity or creativity? What factors improve the generation of creative ideas through discussion? When and how does interaction support creativity? In this article, we examine the mechanisms that affect group creativity in idea-generation tasks and attempt to answer some of the above questions. We suggest conditions that lead to enhanced perfor-

mance for idea-generating groups. We then describe two experiments that provide evidence to support the validity of these conditions.

GROUP DIVERSITY

Guilford (1967) argued that divergent production was the core of creative thinking. In one popular perspective, creativity is equated with divergent thinking or the extent to which individuals are able to generate a wide variety of ideas or responses to a particular problem situation (Baer, 1993).

The diversity of group members is one important variable and has been considered in much of the relevant prior research. In several classic studies, researchers have found that heterogeneous groups are superior to homogeneous groups in terms of the quality and creativity of solutions produced and the degree of member satisfaction with the solutions (Hoffman, 1959; Pelz, 1956; Triandis, Hall, & Ewen, 1965). Heterogeneous groups are generally seen as providing greater potential for the development of alternative directions from which to approach problems, for cross-fertilization of the members' ideas, and for the promotion of creative thinking. The findings of other research on groups have suggested that diversity among team members might affect the contexts of communication, interaction, and collaboration, in turn affecting the team's creativity (Kurtzberg & Amabile, 2000/2001).

The results of many empirical studies suggest that a greater degree of diversity or variety of perspectives on a problem is likely to lead to the emergence of a solution of higher quality. The effects of diversity have been investigated by picking out various aspects for investigation as independent variables. For example, personality type (Hoffman & Maier, 1961), level of leadership ability (Ghiselli & Lodahl, 1958), type of training (Pelz, 1956), and point of view (Hoffman, Harburg, & Maier, 1962) have all been shown to be factors in which greater diversity leads to greater creativity and more innovation than is seen in groups in which the members have more similar characteristics. Thus, we can assume that a highly diverse group membership leads to enhanced creativity.

These results have indicated that greater group diversity on various points leads to more creative and innovative performance for the group; however, the process involved has not been elucidated. One of the main benefits of sharing a variety of ideas in an interactive group is that the group members bring unique knowledge and associative structures to the interaction (Stasson & Bradshaw, 1995). This is obviously more likely when the group is heterogeneous in terms of the experience and knowledge bases of its individual members (Jackson, May, & Whitney, 1995; Moreland, Levine, & Wingert, 1996). Stroebe and Diehl (1994) cited evidence for the positive effects of cognitive diversity in idea-generating groups. On the basis of a finding that more creative scientists receive information from a wider variety of disciplinary areas, Kasperson (1978) showed that creativity appears to be related to the diversity of associative elements (e.g., information sources).

Many points on which diversity would be expected to stimulate creative thinking have been specified. These have included sources of information (Kasperson, 1978), specialization and area of expertise (Gerstenfeld, 1970), perspective (Hoffman, 1979), and discipline (Theirauff, 1978). Thornburg (1991) argued for *orientation* as a single term fit to cover diversity in creative contexts. As the different orientations of a group's members will be evident in the solutions found by the group, diversity of orientation inherently has a positive effect on the creative potential of a group.

GROUP SIMILARITY

However, the full range of available ideas might not be explored by a group in which the members have diverse knowledge sets (Gigone & Hastie, 1993; Stewart & Stasser, 1995). On one hand, diversity aids the creative process by providing a set of heterogeneous perspectives for consideration. On the other hand, diversity can hinder the process of group interaction by reducing the commonality of understanding and the frequency of shared experiences, or by creating such a divergence of ideas and styles that detrimental conflict is produced (Kurtzberg & Amabile, 2000/2001).

For group diversity to be maximally effective, the "distances" between the pools of ideas must not be too great. Greater distances within the group reduce the potential for commonality of understanding and the existence of shared experiences. To achieve higher levels of group creativity, we need some basis for mutual understanding of ideas from the individual members. In other words, similarity between the idea pools of members, at least to within some appropriate level, acts as a catalyst by allowing group diversity to make a positive contribution to creative performance. This catalysis, that is, restriction of the diversity within a group so that mutual comprehensibility is retained, motivates the group members to connect their ideas in effective ways and to elaborate novel ideas from the connections.

Even though group diversity provides strong possibilities, developing a consensus may become difficult when the idea pools of members are far too removed from each other. Moreover, such a situation may also lead members to feel uncomfortable with task processes or to experience conflicts during intermember communication. The above catalytic effect is then lost; the possibility of diverse ideas coming into contact with each other to produce a more novel idea is actually diminished. We can thus predict that the group's creative performance will be relatively poor. On the other hand, when there is little difference between the idea pools held by individual members, we would expect the strong similarity of the ideas to reduce the possibility of group members' becoming aware of certain novel concepts. In this case, too, we can predict relatively poor creative performance for the group. In other cases, where the idea pools are neither diverse enough for the members to produce novel ideas nor similar enough for them to communicate efficiently, we again have groups that show poor creative performance. The above discussion indicates that the degrees of diversity and similarity between the ideas held by group members have to produce a synergy for group work to make a positive contribution to creative performance.

Diversity among group members could be defined as the range of different orientations or ideas that are brought to bear on a problem and made to interact in a problem situation. However, there

have been few attempts to examine the number of ideas that are generated in group sessions as a dependent variable of diversity. Indices of group-member diversity used in previous studies have been based on attitudes on social issues (Triandis et al., 1965), occupational interests (Thornburg, 1991), and academic major (Yamaguchi, 1997a). None of these indices directly represents the variation of ideas among the members. In this study, we have attempted to measure the pools of ideas held by individuals in relation to particular tasks. We have used the indices thus produced as measures of difference and similarity in the ideas held by group members.

On the basis of the above discussion, we offer the following hypothesis on the creative performance of groups.

Hypothesis: A group made up of members who show high degrees of both diversity and similarity of thought categories will get stronger creative benefits from working as a group than will groups with other compositions.

MEASURE OF CREATIVITY

Although several different measures of performance have been applied in the many studies of brainstorming and idea generation, most of them have been based on numbers of generated ideas (Gallupe, Cooper, Grise, & Bastianutti, 1994; Szymanski & Harkins, 1992). In some of the studies in which this measure has been applied, the results have been taken to represent *productivity* (Paulus et al., 1993). This term then simply refers to the numbers of (different) task-appropriate ideas produced. Note, however, that this quantitative measure is not the only possible indicator of creativity. Although Alex Osborn, who developed the technique of brainstorming, suggested that quantity leads to quality, many studies have indicated that the quality of the ideas does not perfectly correspond to the quantity of ideas produced (e.g., Diehl & Stroebe, 1987; Graham, 1977; Vroom, Grant, & Cotton, 1969).

Because objectively assessing the quality of ideas is not possible, we have to rely on a rating system of some kind. The applicable indices of quality differ with the kind of task. In this study, we have

tried to estimate group creativity according to real-world criteria for creative performance. In discussing creativity, two elements generally come to mind: novelty and originality. Novelty indicates the quality of being new or unusual, and originality indicates freshness of aspect, perspective, or style. However, a further major element is consistently included in definitions of creativity. For an idea to be a creative solution to a problem, simply being novel or original is not enough. The solution must actually be a solution, that is, it must also be appropriate.

We build on this discussion by using three subscales to assess the creativity of ideas. In addition to novelty and originality, which are well established as subscales of creativity, we consider the utility of ideas. Utility, representing the practicability of an idea's implementation, indicates a practical perspective on creativity and is the essential aspect of creativity, particularly in applied contexts such as the development of new products by industrial organizations. This measure also has been often used in previous studies to measure quality of ideas.

When a set of independent judges assesses the creativity of a given idea, we have to avoid certain pitfalls in the treatment of assigned values. For instance, we can use the average score of all ideas generated by a group, or the average quality, as the index of creativity; with this measure, however, the creativity of a group that generates a few excellent creative ideas may be underestimated. The creativity score of a group that generates a huge number of banal ideas, the majority of which receive below-average scores, along with just a few excellent ideas, might be lower than that of another group that generates nothing but average ideas. In other words, this index could overemphasize the quantitative aspect of creativity. The highest score for creativity, or the maximum quality, provides another possible index. If we accept this index, we are likely to overestimate the relative creativity of the former group above. The score for creativity of a group that generates many moderately (not extraordinary but above average) creative ideas will be lower than that of another group that only generates a single excellent idea. In other words, this index can lead to overemphasis of the qualitative aspect of creativity.

Thus, in this study, we have adopted the number of generated ideas that are more creative than the average as the index of a group's creativity. Any idea receiving a score above a selected cut-off point on the scale is classified as "creative." This measure takes account of the number of creative ideas produced by a group.

TASKS USED IN THE EXPERIMENTS

Two tasks were used to estimate group creativity, and we refer to the experiments in which the respective tasks were used as Study 1 and Study 2. In the task of Study 1, participants were asked to generate unusual uses for an object. This simple heuristic task has often been used in research on brainstorming (Gallupe et al., 1994; Szymanski & Harkins, 1992). Examples of the objects used are a knife, a detached doorknob, a paper clip, a soda can, a shoelace, and a pencil (Price, 1993; Szymanski & Harkins, 1992; Thompson, Chaiken, & Hazlewood, 1993). For example, the ideas generated in response to a soda can as the target object might include "Cut off its top then use it as a vase" or "Use lots of cans to make a verge for a flower bed," and so on. The task in Study 2 is the addition of new functions to an existing object. For example, the ideas generated in response to the same target object might include "Have the can's surface change color in response to the temperature of its content" or "Attach straps to the cans so that people can wear them like necklaces," and so on. Success in both tasks requires that the groups create ideas that are novel and original. Although the two tasks resemble each other in that a certain object provides the target, the second differs from the first in that the groups are required to attach extra innovative values to the target object while retaining its original usage, whereas the first task merely requires that they change its usage.

To achieve higher levels of performance on the former task, the groups were asked to depart from their conception of the primary use of the object; in other words, they were told to break away from their fixed views of the object's function. The task thus involves the aspect of creativity, which is characterized as *inventive* creativity. In contrast to this, the groups in the latter task are asked to add func-

tions to the object or values while keeping the object itself intact and retaining its conventional function. This task involves the aspect of creativity, which is characterized as *ameliorative* creativity. Whereas inventive creativity is emphasized in aesthetic activities, such as the composition of music and the creation of fine art, ameliorative creativity plays a considerable role in practical activities, such as new-product development within businesses.

To comprehensively investigate synergy in the effects of group diversity and similarity on creative performance, we conducted experiments on both an inventive (Study 1) and an ameliorative (Study 2) task.

STUDY 1

METHOD

Experimental design. In this study, we used a 2 × 2 (Low/High Group Diversity × Low/High Group Similarity) between-group factorial design. We had four a posteriori experimental conditions, which were identified from the results of idea generation at an individual level.

The independent measures were derived from the divergence and convergence of ideas generated during the independent-work phase of the experiment. Groups were divided into two levels of diversity (low and high) according to the number of unique idea categories generated in each group with three members. Group similarity was operationally defined as the rate of duplication of idea categories in each group. We classified those groups for which high rates of idea duplication were identified as high-similarity groups, whereas the other groups were low similarity. Three dependent variables were measured: group productivity, group creativity, and individual perception of communication processes.

Participants. One hundred sixty-eight undergraduate and nursing-school students, representing all students enrolled in an introductory psychology course, participated in this study. The students

received course credits for participating. The mean age of the participants was 19.89 years; the minimum age was 18 years and the maximum was 22 years. The participants, 23% of whom were male, were randomly assigned to 56 three-person groups. Twenty-three of the groups were single gender and 33 of the groups were mixed gender. Levels of intermember familiarity were moderate and homogeneous among and within the groups; this was confirmed by a postquestionnaire survey.

Overview of the experimental task. The experimental task in this study was the "Unusual Uses Task" (UUT), in which participants were asked to generate as many unusual, interesting, and clever uses for the stimulus object as they could. The UUT has been used extensively as a creativity task (e.g., Buchanan & Lindgren, 1976; Yamaguchi, 1997b). In our case, participants were asked to generate ideas for unusual uses of a wire coat hanger, which would, of course, usually be used to hang clothes. They performed this task both as individuals and in groups. This creativity task is of the inventive type.

Procedure. The experiment consisted of three sessions: (a) individual-level idea generation, (b) group-level idea generation, and (c) postsession survey by questionnaire. First of all, participants were asked to generate no more than 10 ideas for unusual ways to use a wire coat hanger. For the individual session, subjects were instructed to work alone and without interaction and to generate ideas that were as divergent from each other as possible. They wrote the ideas on a form especially for use in the individual sessions. After finishing the individual task, each participant was randomly assigned to a particular three-person group. The group sessions were held around a rectangular table.

As an icebreaking task, each of the groups was asked to give itself a name. This took about 5 minutes. After that, the participants repeated the UUT at the group level. In the group session, the participants were told that they would brainstorm and generate as many ideas as possible within 30 minutes. They were allowed to introduce their individual-level ideas to the other members for ref-

erence. Participants were asked to enter the ideas they came up with in the individual sessions on a form especially for these sessions. The instructions were as follows: (a) Try to produce as many ideas as possible, and (b) do not directly adopt ideas that had already been generated at the individual level. The use of ideas presented by other group members as clues in the generation of further original ideas was strongly recommended.

After finishing the group sessions, a questionnaire was used to assess how individual participants had perceived the communication process and intermember familiarity within the respective groups. Participants were asked to indicate how they perceived their communication process from (a) the listeners' and (b) the speakers' point of view. Responses to all of these questions were on a 5-point scale. After the participants had completed all of the experimental sessions, they were debriefed on the experiment and asked not to discuss it with anyone. Participants were then given their credit points and thanked for participating.

RESULTS

Coding of individual-level ideas/Group categorization. The data on individual-level idea generation was aggregated, and the authors examined each idea to assess whether or not it was redundant. Ideas that were regarded as redundant or identical with the conventional usage of a wire coat hanger were excluded from the subsequent analysis. A total of 1,168 ideas (6.95 per person) survived this process. Two trained raters, who were graduate students (psychology major) and not aware of the experimental conditions from which the ideas had been derived, categorized each of the ideas on the basis of its usage. Ideas that were regarded as much the same (e.g., "a slipper rack" and "a shoe rack") were included in a single category. The ideas from each group were thus categorized and then compiled on a per-group basis.

Group diversity was defined as the number of categories needed to classify the items produced by each group. All groups were assigned one of two levels of group diversity (high or low) on the basis of the average number of categories ([M] = 18.21). Group

similarity was defined as the extent of category duplication within each group. This score for duplication indicates the degree to which multiple ideas from a given group fell into single categories. For example, a group that generated 10 ideas, 3 of which were in the same category, would receive a group-similarity score of 30.0%. All groups were assigned one of two levels of group similarity (high or low) on the basis of the average rate of duplication ([*M*] = 20.01%).

Results of the assignment of these two independent variables are summarized in Table 1. No significant difference between the sexes was found in any of the dependent variables.

The coding of group-level ideas. The group-level ideas were handled in much the same way as the individual-level ideas. The results for group-level idea generation were coded and the authors assessed the ideas to determine the numbers of nonredundant ideas and ideas regarded as original. Ideas that had been adopted without modification from products of the UUT at the individual level were excluded from the subsequent analysis. The total number of appropriate ideas was 849, and the numbers generated by individual groups ranged from 3 to 34 (M = 15.79; SD = 7.51).

Two raters assessed each of the ideas for creativity on three scales: novelty, originality, and utility. Novelty was defined as the degree to which the suggested usage differed from the hanger's conventional usage. Originality was defined as the degree to which the usage was unique. Utility was defined as the degree of practical applicability. The raters were again blind to the experimental conditions. The scale for each of the indices of creativity ran from 1 (*lowest*) to 5 (*highest*). Because the degree of agreement between the two coders was acceptable (r = .87-.90, ps < .01), we took the average of the scores of both coders for each idea as the result of this stage. Average scores on the three scales of creativity were 2.46 (SD = 1.12), 2.06 (SD = 0.97), and 2.35 (SD = 1.08), respectively. Values for Pearson's correlation coefficient rs between these scales were originality-novelty, r = .82; originality-utility, r = .42; and novelty-utility, r = .38 (ps < .05). Table 2 presents the scale means

TABLE 1: Idea Generation by the Individual Members of Groups (Study 1)

	Similarity			
	Low		*High*	
Measure	*Low Diversity*	*High Diversity*	*Low Diversity*	*High Diversity*
No. of groups	13	15	15	13
No. of categories per group	13.77	23.53	12.80	12.77
Rate of duplication of categories per group	0.05	0.11	0.36	0.28

and the standard deviations of all group and individual dependent variables for each of the four experimental conditions.

Group productivity. Group productivity was determined by counting the number of unique ideas generated by each group. A two-way ANOVA of group productivity revealed significant main effects of both group diversity, $F(1, 52) = 7.93$, $p < .01$, and group similarity, $F(1, 52) = 4.80$, $p < .05$. For both diversity and similarity, groups rated as high produced more ideas than groups rated as low. There was no significant interaction, $F(1, 52) = 0.15$, *ns*.

Group creativity. In this study, we regarded ideas of "above-average creativity" as creative. More precisely, we used the following procedure in constructing each index of group creativity: (a) Calculate the mean score for each of the three dimensions of idea creativity, based on all generated ideas, and (b) count, for each group, the number of ideas with a score higher than the calculated mean in any of the three dimensions. As was noted earlier, the mean scores in the three dimensions, novelty, originality, and utility, were 2.46, 2.06, and 2.35, respectively. A two-way ANOVA of group creativity revealed significant main effects for both group diversity, $F(1, 52) = 4.77$, $p < .05$, and group similarity, $F(1, 52) = 7.30$, $p < .01$. In Table 2, we see that the mean score for group creativity exhibits the same pattern as that for group productivity. On both diversity and similarity, groups rated as high produced more creative ideas than did groups rated as low. Interaction between diver-

TABLE 2: Values for Mean and Standard Deviation of Dependent Variables (Study 1)

	Similarity							
	Low				*High*			
	Low Diversity		*High Diversity*		*Low Diversity*		*High Diversity*	
Variable	M	SD	M	SD	M	SD	M	SD
Productivity[a]	11.00	5.31	14.27	7.46	15.40	8.35	20.08	4.91
Creativity[b]	9.00	3.76	11.80	6.24	12.53	6.28	15.92	3.95
Perception of communication (as listener)[c]	11.56	2.47	11.07	2.97	12.16	2.95	12.72	2.04
Perception of communication (as speaker)[c]	13.36	2.02	12.44	2.11	12.24	2.73	14.00	1.24

a. Number of ideas generated by the group.
b. Number of ideas for which the creativity score was higher than average.
c. Assessed on three 5-point items to produce a scale ranging from 3 to 15.

sity and similarity was not significant, $F(1, 52) = 0.04$, *ns*). However, in those cases where the high-similarity condition held, groups that also had high levels of diversity were significantly more creative than groups that did not ($p < .05$). This result indicates that groups achieved the best creative performance when they had high degrees of both diversity and similarity.

Perception of communication processes. The responses to the items on the postsession questionnaire were used to assess how members of groups under the four conditions perceived the processes of communication. Two variables, for perception as a listener and as a speaker, were assessed on 5-point scales with verbal anchors. Scores for each variable were determined by responses to three items. Perception of the process of communication from the listener's viewpoint was assessed in terms of agreement or disagreement with items such as "During the task session, I listened attentively to the comments of other members" (Cronbach's $\alpha = .73$), whereas perception from the speaker's viewpoint was assessed with such items as "I tried to clarify my statements during our discussion" (Cronbach's $\alpha = .77$). In view of the high alpha values, we obtained the scores for each dimension of perception of

communication by simply summing the scores of each participant on the three corresponding items. The scales thus ran from 3 to 15. The mean scores of the participants on all scales are summarized in Table 2.

In the case of perception as a speaker, Diversity × Similarity interaction was significant, $F(1, 161) = 16.23$, $p < .001$; however, in no case was there a reliable main effect. To interpret this interaction, we examined the simple main effect of group diversity under conditions of both high and low similarity through a test for honestly significant difference. Group diversity made a significant difference in the results for both high- and low-similarity groups, but the respective trends were in opposite directions. When the level of group similarity was high, the members of high-diversity groups felt more positive about how they had stated their own opinions during the group task process. The opposite result held for low-similarity groups.

A significant main effect of group similarity was seen in the perception of communication as a listener, $F(1, 161) = 7.30$, $p < .01$. Self-rating for attentiveness in listening to the statements of others during the brainstorming session was higher for members of high-similarity groups than for members of low-similarity groups.

DISCUSSION

Study 1 was intended to investigate the prediction that a certain amount of similarity between the idea pools of group members is a prerequisite to obtaining benefits from diversity when the group engages in creative activity. The hypothesis we tested was that groups with high levels of both member diversity and similarity of thought categories would gain greater benefits from working in a group and that this would be demonstrated in stronger creative performance. The results of the experiment supported the hypothesis; that is, we confirmed the operation of synergy in the effects of diversity and similarity on group creativity. Furthermore, groups in which the membership showed some degree of both diversity and similarity generated more ideas than groups for which any other conditions held.

With regard to perception by members of the group-communication process, that is, the other point we were investigating, the effect of similarity appeared in the self-perception of group members of their performance as listeners. This may indicate that communication within a group proceeds more smoothly when the ideas being generated by its members have a certain similarity.

In summary, the results of Study 1 have confirmed that, at least in the context of inventive creativity, either diversity or similarity among the group members only contributes to creative performance in brainstorming when both are present to some degree, that is, the effects of the two factors are synergistic. In Study 2, we explore the possibility of the general applicability of this effect through a task that requires ameliorative creativity, which more closely approximates the practical demands of typical organizations.

STUDY 2

The purpose of this study was to broaden our investigation by examining a rather different creativity task and thus consider the possibility of generalizing the results obtained in Study 1.

Study 2 differs from Study 1 on the following three points: (a) we controlled for potential differences in communication process between the sexes by having all groups consist solely of females; (b) to assess consistency across task, subjects were assigned a different creative task; and (c) to simplify the index of creativity, the creativity of the ideas was rated on a 10-point scale against a single criterion: How creative is this idea?

METHOD

Experimental design. Like the previous study, this experiment was arranged with a 2×2 (Low/High Group Diversity $\times$ Low/High Group Similarity) between-group factorial design.

Participants. One hundred twenty-three undergraduate students, representing all students enrolled in an introductory psychology

course, participated in the study. The students received course credit for doing so. The participants were all female and their mean age was 19.52 years, within a minimum age of 19 years and maximum age of 24 years. They were randomly assigned to 41 three-person groups. Intermember familiarity was moderate and at homogeneous levels between and within the groups; this was confirmed by a postquestionnaire survey.

Overview of experimental task. The experimental task used in this study is rather different from that of Study 1. The task is of the general type where participants are asked to generate ideas for changes that improve a particular implement by making it more convenient, and so on, without changing or removing its original function. This is an ameliorative creativity task. Such a task still requires divergent thinking for good performance. In this experiment, participants were asked to generate as many ideas for improvements to an umbrella as possible, with the ideas being as creative as possible.

Procedure. The procedure in this experiment was very similar to that of Study 1. The experiment consisted of three sessions: (a) individual-level idea generation, (b) group-level idea generation, and (c) a postsession survey by questionnaire.

RESULTS

Coding of individual-level ideas/Group categorization. All ideas generated in the individual-level trials were coded by the authors; as with Study 1, the authors also assessed whether or not ideas were redundant. Ideas regarded as redundant or not differentiable from the conventional usage of umbrellas were excluded from the subsequent analysis. The remaining 677 ideas (5.50 per person) were taken into the data-categorization stage. On the basis of the same procedure and criterion as had been used in Study 1, two trained raters categorized the ideas, after which the experimental groups were divided into the same four conditions (High/Low Group Diversity × High/Low Group Similarity). The results of the assign-

ment of these two independent variables in this case are summarized in Table 3.

Coding of group-level ideas. In this stage, too, ideas regarded as redundant or the same as conventional uses of umbrellas (e.g., as shades for protection against the sun) were excluded, as were ideas that had been adopted without modification from the individual sessions. The total number of appropriate ideas was 243, and the range of numbers of accepted ideas produced by the groups was from 2 to 14 ($m = 5.93$; $SD = 2.91$).

Group productivity. Group productivity was determined by counting the number of unique ideas generated by each group. Table 4 presents the scale means and standard deviations of all group/individual dependent variables for each of the four experimental conditions. A two-way ANOVA on group productivity revealed significant main effects of both group diversity, $F(1, 37) = 611.21$, $p < .01$, and group similarity, $F(1, 37) = 6.12$, $p < .05$, and significant interaction between the two, $F(1, 37) = 4.19$, $p < .05$. As had been the case in Study 1, the high-diversity groups produced more ideas than did the low-diversity groups, and the high-similarity groups produced more ideas than did the low-similarity groups. In the case of the high-similarity condition, the groups that showed high levels of diversity were significantly more creative than were the other groups ($p < .05$); however, group diversity made no significant difference in the low-similarity condition. This clearly suggests that diversity in the idea pools of group members has a stronger positive effect on group productivity when the group members also share more similar ideas.

Group creativity. The two raters assessed the creativity of each idea against a single criterion: "How creative is the idea?" The raters were blind to the experimental conditions. A rating of 10 was the highest score for creativity, and a rating of 1 the lowest (i.e., on a 10-point scale). The fundamental point to be considered in judging the creativity of an idea was whether its focus was on extending an existing feature of umbrellas or represented a truly new usage. As

TABLE 3: Idea Generation by the Individual Members of Groups (Study 2)

	Similarity			
	Low		*High*	
Measure	*Low Diversity*	*High Diversity*	*Low Diversity*	*High Diversity*
No. of groups	9	13	9	10
No. of categories per group	11.22	10.67	16.85	17.00
Rate of duplication of categories per group	0.08	0.23	0.06	0.21

TABLE 4: Values for Mean and Standard Deviation of Dependent Variables (Study 2)

	Similarity							
	Low				*High*			
	Low Diversity		*High Diversity*		*Low Diversity*		*High Diversity*	
Variable	M	SD	M	SD	M	SD	M	SD
Productivity[a]	4.44	1.33	5.46	2.76	4.78	1.39	8.90	3.25
Creativity[b]	1.78	0.97	2.54	1.56	2.89	1.76	4.20	3.12
Perception of communication (as listener)[c]	13.48	2.12	13.23	1.77	13.64	1.41	13.47	2.26
Perception of communication (as speaker)[c]	12.04	2.30	11.77	2.72	12.63	2.39	12.30	2.23

a. Number of ideas generated by the group.
b. Number of ideas for which the creativity score was higher than average.
c. Assessed on three 5-point items to produce a scale ranging from 3 to 15.

this single criterion replaced the three subscales of Study 1, the raters were told to take into consideration the utility, originality, and novelty of the ideas. Those ideas which were not redundant but were not considered worthy of a score on any of these qualities were assigned a score of 0. As the interrater correlation had a high level of significance ($r = .73$), the average of the scores assigned by the two coders was calculated as the score for each idea. The average score for idea creativity was 3.15 ($SD = 1.31$), and the distribution of scores was approximately normal. Those ideas which were given above-average scores for creativity were regarded as cre-

ative. The number of generated ideas receiving scores above the mean was again used as the index of group creativity.

A two-way ANOVA of group creativity revealed a significant main effect of group similarity, $F(1, 37) = 4.77$, $p < .05$. Groups identified as high-similarity performed more strongly on idea creativity than did those of low-similarity. On the other hand, group diversity did not produce a significant main effect $F(1, 37) = 2.67$, *ns*. Although the Diversity × Similarity interaction was not significant, $F(1, 37) = 0.19$, *ns*, of the groups for which the high-similarity condition held, those that were also high diversity were marginally more creative than those that were low diversity ($p < .06$). In line with the results of Study 1, this result indicated that those groups identified as having high levels of both diversity and similarity demonstrated the strongest creative performance.

Perception of communication processes. The two variables that reflect how group members perceived their roles in the group processes, that is, perception of communication as a listener and a speaker, were assessed in the same way as in Study 1. The mean scores of participants on each scale are summarized in Table 4. A two-way ANOVA indicated that neither independent variable had a significant effect. The results suggest that most participants tended to perceive their roles in the process of communication as relatively positive.

DISCUSSION

In Study 2, the synergistic effect of diversity and similarity on group creativity in idea generation that was suggested by Study 1 was investigated in a slightly more precise condition (all group members were female) and with another creativity task. Our empirical analysis indicated similar results on group performance to those of the first study. Our hypothesis on group creative performance had thus received further support. Accordingly, we can regard the possibilities of generality for this effect as strong.

At the same time, most participants in all four experimental conditions saw their processes of communication with the group as

fairly smooth. Although this might indicate the operation of some form of ceiling effect, we cannot make any assumption on this point based purely on the data gathered in this experiment.

GENERAL DISCUSSION

The naive expectation that the productivity of a group will be greater than that of its members or that the behavior of a group reflects the group's emergence has been discounted by a number of empirically based studies (Mullen, Johnson, & Salas, 1991). The results of these studies indicate that a group is not automatically more productive than the simple additive productivity of its members. Such studies indicate that trying to confirm the superiority of group productivity by comparing interactive group performance with the performance of individuals in "nominal groups" is futile. It would also be presumptuous to expect certain properties to emerge automatically as the group becomes increasingly cohesive, because various kinds of serious loss factors, including production blocking, evaluation apprehension, and social loafing, are inherent in the very process of the formation of a group. However, even given that this is the case, we cannot infer that there is no significance in creative activity by groups simply on the basis of findings that groups have no productive advantage over individuals. That is what makes it rather a challenge to explore those properties of groups that do in fact lead to relatively superior creativity. Clarifying the mechanisms of group emergence and exploring those factors and methods that make groups operate effectively and maximize their creative potential are socially useful tasks.

Consequently, in our two studies, we have tried to clarify what makes a group relatively creative, with a focus on the mechanisms through which creativity emerges. In particular, we focused on finding out what kind of composition helps a group to resist the forces that drive convergence of thought and thus draw divergent thought from its members.

We now briefly summarize our model of how synergy between diversity and similarity operates in group creativity. With the inten-

tion of identifying the mechanism that leads to creativity, we observed groups in terms of the effects of the idea pools of their members and the relevance of the pools to the given tasks. The results have indicated that diversity of ideas among the members leads to the sharing of numerous unique and varied ideas and thus to an enhanced creative potential for the group (Paulus, 2000). At the same time, this creative potential is only realized in more creative performance when there is also a certain level of similarity among the ideas, so that the members are able to share idea-evaluation criteria or to communicate smoothly enough that they reach a group consensus.

CONCLUSION

This study represents a step toward a better understanding of how member traits affect group-emergence properties. The results suggest that degrees of diversity and similarity among group members operate synergistically to produce a significant effect on creative performance. Given the rapid pace of contemporary corporate life, organizations need to keep abreast of change (Isaksen & Murdock, 1993) and be adaptable (Basadur, 1993). To achieve these goals, they need a certain readiness to respond to unexpected changes. Organizational/group creativity is thus acknowledged as an important part of doing business. Because creative products are usually a visible and tangible outcome of a creative process, the processes in this situation have been of particular interest (Slabbert, 1994). A creative product is often a source of profit and, consequently, a major survival goal of an enterprise. However, it is also true that the nature of a group often includes traits that inhibit its creativity in various ways. We need to build on this fact and continue to accumulate empirical results that help us identify effective forms of intervention that draw the fullest possible creativity from groups. In further research into group emergence, we need to supplement the controlled-experimental approach with methods such as field practice, with observation of the processes and results, and research into the activities of real organizations.

REFERENCES

Baer, J. (1993). *Creativity and divergent thinking: A task-specific approach*. Hillsdale, NJ: Lawrence Erlbaum.

Basadur (1993). Impacts and outcomes of creativity in organizational settings. In S. G. Isaksen, M. C. Murdock, R. L. Firestien, & D. J. Treffinger (Eds.), *Nurturing and developing creativity: The emergence of a discipline* (pp. 278-313). Norwood, NJ: Ablex.

Buchanan, L. J., Jr., & Lindgren, H. C. (1973). Brainstorming in large groups as a facilitator of children's creative responses. *Journal of Psychology*, *83*, 117-122.

Diehl, M., & Stroebe, W. (1987). Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of Personality and Social Psychology*, *53*, 497-509.

Diehl, M., & Stroebe, W. (1991). Productivity loss in idea-generating groups: Tracking down the blocking effect. *Journal of Personality and Social Psychology*, *61*, 392-403.

Gallupe, R. B., Cooper, W. H., Grise, M. L., & Bastianutti, L. M. (1994). Blocking electronic brainstorms. *Journal of Applied Psychology*, *79*, 77-86.

Gerstenfeld, A. (1970). Organizational climate for creativity. In A. Gerstenfeld (Ed.), *Effective management of research and development* (pp. 55-67). Reading, MA: Addison-Wesley.

Ghiselli, E., & Lodahl, T. (1958). Patterns of managerial traits and group effectiveness. *Journal of Abnormal and Social Psychology*, *57*, 61-66.

Gigone, D., & Hastie, R. (1993). The common knowledge effect: Information sharing and group judgment. *Journal of Personality and Social Psychology*, *65*, 959-974.

Graham, W. K. (1977). Acceptance of ideas generated through individual and group brainstorming. *Journal of Social Psychology*, *101*, 231-234.

Guilford, J. P. (1967). *The nature of human intelligence*. New York: McGraw-Hill.

Hoffman, L. R. (1959). Homogeneity of member personality and its effects on group problem-solving. *Journal of Abnormal and Social Psychology*, *58*, 27-32.

Hoffman, L. R. (1979). Applying experimental research on group problem solving to organizations. *Journal of Applied Behavior*, *15*, 375-391.

Hoffman, L. R., Harburg, E., & Maier, N. R. F. (1962). Differences and disagreement as factors in creative group problem solving. *Journal of Abnormal and Social Psychology*, *64*, 206-214.

Hoffman, L., & Maier, N. (1961). Quality and acceptance of problem solutions by members of homogeneous and heterogeneous groups. *Journal of Abnormal and Social Psychology*, *62*, 401-407.

Isaksen S. G. & Murdock, M. C. (1993). The emergence of a discipline: Issues and approaches to the study of creativity. In S. G. Isaksen, M. C. Murdock, R. L. Firestien, & D. J. Treffinger (Eds.), *Nurturing and developing creativity: The emergence of a discipline* (pp. 145-168). Norwood, NJ: Ablex.

Jackson, S. E., May, K. E., & Whitney, K. (1995). Understanding the dynamics of diversity in decision-making teams. In R.A. Guzzo, E. Salas, et al. (Eds.), *Team effectiveness and decision-making in organizations* (pp. 204-261). San Francisco: Jossey-Bass.

Kasperson, K. J. (1978). Scientific creativity: A relationship with information channels. *Psychological Reports*, *42*, 691-694.

Kerr, N. L., & Bruun, S. (1983). The dispensability of member effort and group motivation losses: Free rider effects. *Journal of Personality and Social Psychology*, *44*, 78-94.

Kurtzberg, T. R., & Amabile, T. M. (2000/2001). From Guilford to creative synergy: Opening the black box of team-level creativity. *Creativity Research Journal*, *13*, 285-294.

Latané, B., Williams, K., & Harkins, S. (1979). Many hands make light the work: The causes and consequences of social loafing. *Journal of Personality and Social Psychology*, *37*, 822-832.

Maginn, B. K., & Harris, R. J. (1980). Effects of anticipated evaluation on individual brainstorming performance. *Journal of Applied Psychology*, *63*, 120-123.

Moreland, R. L., Levine, J. M., & Wingert, M. L. (1996). Creating the ideal group: Composition effects at work. In E. Witte & J. H. Davis (Eds.), *Understanding group behavior: Vol. 2. Small group processes and interpersonal relations* (pp. 11-35). Mahwah, NJ: Erlbaum.

Mullen, B., Johnson, C., & Salas, E. (1991). Process loss in brainstorming groups: A meta-analytic integration. *Basic and Applied Social Psychology*, *12*, 3-23.

Osborn, A. F. (1953). *Applied Imagination*. New York: Charles Scribner's Sons.

Paulus, P. B. (2000). Groups, teams, and creativity: The creative potential of idea-generating groups. *Applied Psychology: An International Review*, *49*, 237-262.

Paulus, P. B., Dzindolet, M. T., Poletes, G., & Camacho, L. M. (1993). Perception of performance in group brainstorming: The illusion of group productivity. *Personality and Social Psychology Bulletin*, *19*, 78-89.

Pelz (1956). Some social factors related to performance in a research organization. *Administrative Science Quarterly*, *1*, 310-325.

Price, K. H. (1993). Working hard to get people to loaf. *Basic and Applied Social Psychology*, *14*, 329-344.

Purser, R. E., & Montuori, A. (1995). Varieties of knowledge work experience: A critical systems inquiry into epistemologies and mindscapes of knowledge production. In M. Beyerlein & D. Johnson (Eds.), *Advances in interdisciplinary studies of work teams: Vol. 1. Knowledge teams: The creative edge* (pp. 117-162). Greenwich, CT: JAI.

Slabbert, J. A. (1994). Creativity in education revisited: Reflection in aid progression. *Journal of Creative Behavior*, *27*, 60-69.

Stasson, M. F., & Bradshaw, S. D. (1995). Explanation of individual-group performance differences: What sort of "bonus" can be gained through group interaction? *Small Group Research*, *26*, 296-308.

Stewart, D., & Stasser, G. (1995). Expert role assignment and information sampling during collective recall and decision making. *Journal of Personality and Social Psychology*, *69*, 619-628.

Stroebe, W., & Diehl, M. (1994). Why groups are less effective than their members: On productivity losses in idea-generating groups. *European Review of Social Psychology*, *5*, 271-304.

Szymanski, K., & Harkins, S. (1992). Self-evaluation and creativity. *Personality and Social Psychology Bulletin*, *18*, 259-265.

Theirauff (1978). *An introductory approach to operations research*. New York: John Wiley.

Thompson, E. P., Chaiken, S., & Hazlewood, J. D. (1993). Need for cognition and desire for control as moderators of extrinsic reward effects: A person × situation approach to the study of intrinsic motivation. *Journal of Personality and Social Psychology*, *64*, 987-999.

Thornburg, T. H. (1991). Group size and member diversity influence on creative performance. *Journal of Creative Behavior*, *25*, 324-333.

Triandis, H. C., Hall, E. R., & Ewen, R. B. (1965). Member heterogeneity and dyadic creativity. *Human Relations*, *18*, 33-55.

Vroom, V. H., Grant, L. D., & Cotton, T. S. (1969). The consequences of social interaction in group problem solving. *Organizational Behavior and Human Performance*, *4*, 77-95.
Yamaguchi, H. (1997a). Size effects on creative idea production by means of group discussion. *Journal of the Faculty of Letters, Okayama University*, *27*, 87-98.
Yamaguchi, H. (1997b). The influences of member diversity upon group creativity. *Research Bulletin of Educational Psychology, Faculty of Education, Kyusyu University*, *42*, 9-19.

Asako Miura is an associate professor in the Faculty of Humanities and Sciences at Kobe Gakuin University, Japan. Before joining Kobe Gakuin University, she served in the Graduate School of Human Sciences at Osaka University as an assistant professor. She graduated in social psychology from Osaka University in 1992 and received her Ph.D. from that university in 2002. Her research interests include group creativity, emergence from group processes, electronic brainstorming, and computer-mediated communication.

Misao Hida received his M.A. from Gakushuin University, Japan. His research interests include group creativity, group decision making, and interpersonal relations. He is currently employed as a professor of the Faculty of Education at Fukushima University, Japan.