

# Idea Generation in Groups: A Basis for Creativity in Organizations

Paul B. Paulus and Huei-Chuan Yang

*University of Texas at Arlington*

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**Knowledge or idea exchange is an important function of groups in organizations. Much research has demonstrated that idea sharing in groups involves relatively inefficient processes. Some of these processes are briefly summarized. It is proposed that there are conditions under which idea sharing in groups can be productive. One important factor is the extent to which group members carefully process the ideas exchanged in the group (*attention*). Another is the opportunity for group members to reflect on the ideas after the exchange process (*incubation*). These factors were examined by using a “brainwriting” paradigm. Evidence was obtained for enhanced performance of sharing groups in comparison to nonsharing or nominal groups both during the idea-generation session and in a second individual idea-generation session. This study suggests that, under the right conditions, the idea exchange process in groups may be an important means for enhancing creativity and innovation in organizations.** © 2000 Academic Press

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Much of the work in organizations involves knowledge work—the acquisition, sharing, and application of knowledge and information (Purser & Montuori, 1995). Idea exchange or sharing is an important part of group interaction in a variety of contexts such as meetings and intellectual work groups or teams (Antoszkiewicz, 1992; Galegher, Kraut, & Egido, 1990). In meetings, representatives from different areas or departments may wish to share knowledge and perspectives in order to develop new products, directions, or solutions (Dunbar, 1995; Sutton & Hargadon, 1996). Increasingly, decision making and idea sharing are accomplished by means of computer networks (Straus, 1996). Whether the format involves face-to-face or computer-based interactions, effective decisions and creative solutions require a full exchange of ideas by all group members (Janis & Mann, 1977). Yet corporations often encounter serious problems

Address correspondence and reprint requests to Paul B. Paulus, Department of Psychology, University of Texas at Arlington, Arlington, TX 76019. E-mail: [paulus@uta.edu](mailto:paulus@uta.edu).

in the effective sharing of knowledge among individuals or teams (Fisher & Fisher, 1998; Tobin, 1998). One problem is that groups tend to focus on information they have in common rather than on sharing their unique expertise (Stasser, 1999). Group interaction also seems to inhibit the sharing of novel ideas (Diehl & Stroebe, 1987). Given these various problems, one might question the utility of group interaction and teamwork in the organizational-innovation or idea-sharing process. However, recent theoretical and empirical developments suggest conditions under which group interaction may be quite beneficial in the generation of new ideas. We briefly summarize the relevant literature on group idea generation and the theoretical ramifications. Then we suggest conditions for enhanced productivity in idea-generating groups, and we provide some supporting evidence.

The main literature on idea generation in groups derives from the brainstorming paradigm (Osborn, 1957). In this paradigm, group members are encouraged to generate as many ideas as possible without concern for quality. They are instructed to vocalize all ideas that come to mind and not to criticize or evaluate ideas as they are presented. They are also encouraged to build on the ideas of others. Even though the brainstorming rules do enhance group idea generation (Parnes & Meadow, 1959), groups using these rules generate substantially fewer ideas than the same number of individuals brainstorming in isolation (nominal groups; Mullen, Johnson, & Salas, 1991).

There are a number of explanations for the productivity loss in brainstorming groups (Diehl & Stroebe, 1987; Paulus & Dzindolet, 1993). Participants may be unwilling to state some of their ideas because they are afraid of being negatively evaluated. Social loafing or free-riding may occur because individuals do not feel accountable or feel their efforts are not needed by the group (Karau & Williams, 1993; Kerr & Bruun, 1983). Production blocking may result because individuals cannot express their ideas when someone else is talking (Diehl & Stroebe, 1991; Lamm & Trommsdorff, 1973). Evaluation apprehension, free-riding, and production blocking insure that interactive groups start off rather slowly in the idea-generation process. By means of social comparison processes and a tendency toward downward comparison, this low level of performance may become normative and be maintained throughout the group session or in subsequent sessions even when evaluation apprehension or production blocking may no longer be a problem (Camacho & Paulus, 1995; Paulus & Dzindolet, 1993).

Contrary to this rather negative perspective on the group idea-sharing process, Paulus and his colleagues (Brown, Tumeo, Larey, & Paulus, 1998; Paulus, 2000; Paulus, Larey, & Dzindolet, 2000) have developed a cognitive theory of group creativity which suggests conditions under which cognitive stimulation effects can be observed in groups. They suggest that sharing of ideas in groups should stimulate additional associations or ideas. In groups, idea-sharing individuals are exposed to more ideas during their session than solitary idea generators. Thus, there is much potential for cognitive stimulation in groups, as long as group members attend carefully to the shared ideas. However, the competing demands of generating one's own ideas and processing the ideas of others may

divide attention (Mulligan & Hartman, 1996) and limit the beneficial effects of idea sharing (Nagasundaram & Dennis, 1993). If individuals were provided an opportunity to generate additional ideas on their own afterward, the impact of the cognitive stimulation experienced during the sharing process may become evident (incubation, Smith, 1995).

Several procedural techniques have been developed to overcome the limitations of interactive brainstorming and to demonstrate potential productivity gains from idea sharing. These techniques have focused on limiting verbal interaction and exchanging ideas by writing or typing on computers (e.g., Nunnaker, Briggs, & Mittleman, 1995). "Brainwriting" is the term used by some who have promoted various techniques for sharing written ideas in groups as a means of enhancing creativity (Geschka, Schaudé, & Schlicksupp, 1976–1977; Greene, 1987; Johanson, 1978; Van Gundy, 1981). Writing ideas instead of speaking them in groups eliminates the problem of production blocking since individuals do not have to wait their turn to generate ideas. It may also reduce evaluation apprehension since the written format eliminates the need for public speaking and is typically more anonymous than oral brainstorming.

Several studies have examined the effectiveness of written idea exchange in groups. For example, Van de Ven and Delbecq (1974) proposed a *Nominal Group Technique* that involves an initial session of independent writing of ideas. These ideas are subsequently shared by the group in a round-robin fashion and summarized on a blackboard. Then the group discusses the ideas for clarification and evaluation. Finally, there is an individual voting process to rank order the ideas. This procedure was compared with an interacting group process in which ideas were generated using an unstructured group discussion. In a comparison using groups of size seven, nominal groups were found to perform better than interacting groups. This finding is, of course, similar to that obtained in the group-brainstorming literature. In another study, Madsen and Finger (1978) used a written-feedback procedure in which group members exchanged copies of written ideas halfway through independent-writing sessions. The effectiveness of this procedure was compared with an independent-writing group that did not exchange ideas and a typical oral brainstorming group. Each condition involved groups of size four which were given instructions in the basic rules of brainstorming and sessions with two different problems—effects of an extra thumb and brand names for toothpaste. There was no difference among the conditions for the thumbs problem, but both the independent-writing and written-feedback conditions performed better than the oral-brainstorming groups in generating ideas on brand names for toothpaste. However, the written-feedback condition did not enhance performance relative to the independent-writing condition. In sum, studies of written exchange of ideas in groups find that this procedure can lead to better performance than oral-brainstorming groups but not individual writing.

The fact that written exchange of ideas is not associated with production loss relative to nominal controls suggests that the former procedure might be an effective alternative to oral brainstorming. This effectiveness could be attributed to the lower level of production blocking, evaluation apprehension,

or downward comparison experienced when the writing procedure is employed. Yet, it is surprising that the writing paradigm has not provided any clear evidence of production gains relative to nominal controls. These studies suggest that the participants do not benefit from cognitive stimulation of the idea-exchange process. Similarly, Diehl and Stroebe (1987) found that hearing others generate ideas does not enhance the performance of individual brainstormers. The lack of cognitive stimulation effects in brainstorming studies is inconsistent with an information-processing perspective which presumes that group members can attend, encode, store, and retrieve information that is encountered in group interaction (Hinsz, Tindale, & Vollrath, 1997; Nagasundaram & Dennis, 1993). Moreover, several theorists have argued that group idea sharing should in fact be the source of significant cognitive stimulation (Osborn, 1957; Paulus et al., 2000). Ideas from others should lead to novel associations or prime related concepts.

What then accounts for the lack of stimulating impact of group idea sharing? We believe there are several relatively simple explanations. First, group members may not be very attentive to the ideas expressed in the group (attention hypothesis). The group-brainstorming paradigm requires individuals to generate their own ideas, listen to the ideas of other group members, and combine or build on the shared ideas. Individuals in groups must also attend to the interaction process to determine the timing of their contributions. It may be a rather difficult task for individuals to effectively introspect or tap their own ideas, to attend carefully to the ideas of other group members, and to regulate the interaction process (Nunamaker et al., 1995; Straus, 1996). To simplify this process, individuals may focus primarily on the self-generation component.

An alternative perspective is that individuals do carefully process the shared information but may lack a sufficient opportunity to demonstrate the stimulation value of this information during the sharing session (Paulus et al., 2000). It may take some time to reflect on the shared information and to integrate this with one's own ideas (incubation hypothesis). This may not be feasible while one is dealing with the simultaneous demands of listening to the ideas of others and generating one's own ideas. If participants are provided with a subsequent session in which they can reflect on the shared ideas and continue to generate new ideas, the benefits of group information processing may become evident.

The present experiment was designed to examine whether procedures intended to enhance attention and potential for incubation in group brainstorming would lead to production gains in idea generating. This experiment employed a "brainwriting" procedure in which four individuals exchanged ideas on pieces of paper in a round-robin fashion. The writing procedure eliminated production blocking by allowing group members to generate ideas continuously and reduced social loafing by having each person write with a different-color pen. Since each person was asked to read (silently) the ideas on the slips as they were passed along, it was presumed that processing of the shared ideas would take place (group condition). In a second group-exchange condition, the group members were instructed that they would be tested for their memory of

the exchanged ideas after the group session (memory group condition). This manipulation was designed to increase attention to the ideas exchanged. However, it is also possible that this manipulation might reduce the number of ideas generated because of the competing demands of memorization and generation. In a control condition (nominal condition), ideas were generated without exchanging them with other group members. After the initial session, participants in all three conditions continued to write ideas individually (without sharing them) to assess for potentially positive aftereffects of the group exchange process (incubation).

The writing procedures were designed to eliminate production blocking, reduce social loafing, and encourage careful processing of shared ideas. Therefore it was predicted that the group writing procedure would enhance the idea-generation process in comparison to the individual performance (nominal) condition. It was also predicted that the memory manipulation would further enhance the generation of additional ideas if it increased attention to shared ideas without slowing down the generation process. The stimulating effects of group idea exchange process were expected to either increase or persist in the second individual writing session because of group-induced cognitive priming. If attentional demands of the sharing procedure in the first session limit the cognitive-integration process, the benefits of the shared experience will be evident only in the second solitary generation session. If the brainwriting procedure facilitates both attention to others' ideas and subsequent incubation, positive effects of the exchange process should be evident in both sessions.

## METHOD

### *Participants*

One hundred twenty students from introductory psychology classes participated to fulfill a course requirement. They were randomly assigned to one of the three conditions (group, memory group, and nominal). Participants were recruited in groups of four. When fewer than four participants reported, they were assigned to the nominal condition. Twelve groups of four were constructed from these individual participants in a random fashion. There were 10 groups in the group condition and 8 in the memory group condition.

### *Materials*

Each participant used a different-color pen (red, blue, black, or green) so that we could later identify the source of the ideas. The colors also aided participants in distinguishing ideas generated by others from their own. This should increase accountability and reduce the tendency to loaf. In the two group conditions, every participant was given 25 slips of paper. For the individual writing condition (nominal), each participant was given a letter-size sheet.

### *Procedure*

When students arrived for the experiment, the experimenter explained the four brainstorming rules and brainstorming procedures. In the first session participants were given 15 min to generate possible uses for a paper clip. Participants in the nominal condition were asked to sit in separate chairs placed in the four corners of the room and to write down the ideas on a letter-size sheet. This arrangement was designed to prevent the participants from seeing each other's work and to make it difficult to monitor each other's overall activity rate. Participants in the interactive conditions were seated around a table. They were asked to write their idea on a slip of paper and pass it on to the next person. As they received a slip from other group members, they were asked to read the ideas on the slip and then add their own. If participants could not come up with an idea in a reasonable period of time, they were allowed to pass the slip on. When they received a completed slip with four ideas on it, they were to read those ideas and place the sheet in the center of the table. In this way we hoped to induce the participants to attend carefully to the ideas being generated by other group members. This procedure was continued for 15 min.

At the end of the first 15-min session, each participant received a recall sheet on which to list as many ideas as possible from the brainstorming session. For the group and memory group conditions, participants were instructed to include their own ideas and those of others in the group.

In the second session, participants in all conditions were seated on separate chairs which were arranged in the corners of the same room. They were asked to continue generating ideas individually (without sharing) on the paper clip problem for an additional 15 min using a large sheet of paper. The experimenter then debriefed the participants and answered any questions regarding the study.

The instructions about procedures for Session 1 included the following:

*Nominal Condition:* Please do not talk during the session. You will need to write down your ideas. You do not need to make complete sentences when representing the ideas. Just use simple phrases. Don't worry about spelling or grammar.

*Group and Memory Group Conditions:* You will write your ideas on slips of paper and share these with one another. Do not talk to each other while you are doing this. You will each use a different color pen to write down one idea on the slip of paper and pass it to the person on your immediate right. You will then receive the slip of the paper from the person on your left. Read the idea(s) on the slip of paper, add your own idea, and pass it on. If you finish before receiving your next slip, you may use a blank slip until it is passed to you. When you receive your original slips, simply put them in the center of the table. This process will continue until the session is over. You do not need to make complete sentences when representing the ideas. Just use simple phrases. Don't worry about spelling or grammar.

In the Memory Group Condition the following instructions were added: "While you are sharing your ideas, we would like you to examine all of the ideas carefully. We will ask to you to recall all the ideas generated at the end of this session."

### *Dependent Variables*

Performance was determined by counting the number of unique ideas. Each participant's transcript of ideas was coded by a rater for the total number of ideas generated in each of the two brainstorming sessions. A raw group total was obtained by adding the four members individual totals. The raters then checked the four transcripts for repetitive ideas and calculated a new group total excluding repetitive ideas for Session 1 (unique ideas). For Session 2, the raters repeated the same procedures for the nonrepetitive group total. In addition, the ideas repeated from Session 1 were eliminated from the totals of Session 2. One rater coded all the transcripts for the 30 four-person groups. A second rater coded the transcripts of 10 groups to determine interrater reliability. For number of ideas recalled by the group, the rater first counted the total number of ideas each participant recalled by comparing the recall sheets with the transcripts of the ideas generated. The memory scores of the four participants in each session were summed to obtain group memory scores. All analyses reported below involve group totals.

At the end of the first brainstorming session, participants were given a questionnaire to tap perception of their performance and their feelings during the brainstorming session on 9-point scales.

## **RESULTS**

The interrater reliabilities (Cronbach  $\alpha$ ) for the raw group total for Sessions 1 and 2 were .99 and .99, respectively. The interrater reliabilities for nonrepetitive group total for Sessions 1 and 2 were .98 and .90, respectively. Because the nonrepetitive group total reflects the number of unique ideas produced by the group, only this measure is discussed in the comparison of group performance across conditions.

For the number of unique ideas in Session 1, there was a significant difference among the three conditions,  $F(2, 27) = 6.01, p < .01$ . Since the sample sizes and variances were somewhat unequal in the three conditions, the Games–Howell procedure was used for post hoc comparisons. These tests revealed that the group condition yielded significantly more ideas than the memory group and nominal conditions, which did not differ significantly from one another. There was also a significant difference among the three conditions in the number of unique ideas generated in Session 2,  $F(2, 27) = 12.42, p < .01$ . Games–Howell comparisons indicated that participants were significantly more productive in the group and memory group conditions than in the nominal condition. There was no significant difference between the group and memory-group conditions (see Table 1).

Three significant differences on questionnaire items were found among the three conditions (see Table 1). First, participants in the group condition were most positive about verbal brainstorming and nominal participants the least positive,  $F(2, 117) = 5.91, p < .01$ . Second, participants in the two group conditions enjoyed doing the task more than did those in the nominal condition,

**TABLE 1**  
**Performance and Perceptual Measures for Brainstorming Task**

	Group	Memory group	Nominal
Total number of unique ideas			
Session 1	$M = 85.50$ $SD = 24.10$	$M = 61.13$ $SD = 15.53$	$M = 60.83$ $SD = 13.87$
Session 2	$M = 81.40$ $SD = 22.87$	$M = 66.50$ $SD = 17.56$	$M = 43.08$ $SD = 13.72$
Do better using brainwriting <sup>a</sup>	$M = 6.5$ $SD = 2.46$	$M = 5.22$ $SD = 2.99$	$M = 4.60$ $SD = 2.46$
Enjoy doing the task <sup>b</sup>	$M = 5.95$ $SD = 2.16$	$M = 6.09$ $SD = 1.40$	$M = 4.79$ $SD = 1.71$
Number of ideas remembered <sup>c</sup>	$M = 5.42$ $SD = 2.10$	$M = 6.44$ $SD = 1.98$	$M = 6.81$ $SD = 2.17$

<sup>a</sup> Scale scoring range: 1-writing exchange process; 9-verbal brainstorming.

<sup>b</sup> Scale scoring range: 1-enjoy it very little; 9-enjoy it very much.

<sup>c</sup> Scale scoring range: 1-very few; 9-very many.

$F(2, 117) = 6.67, p < .01$ . Finally, participants in the nominal condition felt that they remembered more ideas than those in the two group conditions,  $F(2, 117) = 4.85, p < .01$ .

It seems likely that the effect of group performance in Session 1 on group performance in Session 2 is mediated by recall of ideas from Session 1. Such mediation would be evidence for a stimulating effect of exposure to others' ideas during the group-writing sessions. To explore this issue, a series of multiple-regression analyses were performed (Baron & Kenny, 1986). These analyses tested whether (a) group performance in Session 1 ( $F$ ) significantly affected group performance in Session 2 ( $T$ ), (b) group performance in Session 1 significantly affected recall ( $R$ ), and (c) if the effects of group performance in Session 1 on Session 2 were significantly reduced when recall was included as an additional predictor of group performance.

All three findings are necessary to confirm mediation and were obtained in the regression analyses. The regression equation predicting performance in Session 2 from performance in Session 1,  $T = .77F + 9.01$ , was significant,  $F(1, 28) = 22.79, p < .01$ , and accounted for 45% of the variance. The regression equation predicting recall from Session 1 performance was  $R = .71F - 21.07$ , accounted for 40% of the variance, and was significant,  $F(1, 28) = 18.70, p < .01$ . The regression equation which assessed the combined effects of recall and Session 1 performance on the performance in Session 2 was  $T = .30F + .66R - 4.95$ . This was significant,  $F(2, 27) = 31.22, p < .01$ , and accounted for 49% of the variance. The coefficient for recall was significant,  $t(28) = 4.72, p < .01$ , but the coefficient for Session 1 performance was not,  $t(28) = 1.91, p < .07$ . This finding suggests that recall mediated the effects of performance in Session one on that in Session 2. When recall was included in the equation, the effect of Session 1 performance was no longer significant.



## DISCUSSION

The findings indicate that the group-writing technique results in greater productivity than individual writing (nominal groups). During the first session, those who shared ideas without memorization instructions outperformed the nominal group in number of unique ideas generated. In the second session, both the group and the memory-group conditions facilitated performance relative to the nominal condition. This is the first evidence that interactive group brainstorming can actually enhance performance relative to individual brainstorming in small groups.

The results obtained are generally consistent with both the attention and incubation hypotheses. The group-writing procedure may have enhanced group members' attention to others' ideas. Since participants read slips that contained only two to four ideas, participants may have been able to process these ideas effectively (Nagasundaram & Dennis, 1993). The enhanced attention to others' ideas may have resulted in additional cognitive stimulation of ideas. Interestingly, asking participants to memorize the ideas being generated inhibited the idea-exchange process in comparison to the regular writing group in Session 1. The focus on memorization may make it cognitively more difficult to generate new ideas at the same time.

The demonstration of production gains with the group-writing procedure indicates that this procedure may have effectively overcome the potential problems of production blocking, evaluation apprehension, and social loafing. Of course, eliminating these problems only provides a basis for a comparable performance of group brainstorming and individual brainstorming. The enhanced performance of group exchange in comparison to solitary generation in both Sessions 1 and 2 suggests that other factors such as cognitive stimulation had a facilitative effect. This study clearly demonstrates that group exchange processes can be beneficial and provides support for those who have argued for synergistic effects in group brainstorming (Offner, Kramer, & Winter, 1996; Paulus et al., 2000). These results are generally consistent with our cognitive model of group creativity (Paulus et al., 2000). The mediational analyses, which indicated that recall accounts for a large portion of the relationship between Sessions 1 and 2, is also consistent with this perspective. The type of cognitive-stimulation effects reported in our studies is also consistent with observations of work groups by other scholars (Csikszentmihalyi & Sawyer, 1995; Dunbar, 1997).

Although our results are compatible with a cognitive-stimulation perspective, other processes could have played a role in the production gains obtained. The elevated performance for groups in Session 1 could be due to social competition engendered by the group exchange procedure. For example, in the writing procedure there is a constant monitoring of performance and an implicit pressure to keep generating ideas as slips are passed on from one group member to another. The group-writing paradigm may therefore produce an upward rather than a downward comparison process (cf., Paulus, Larey, Putman, Leggett, & Roland, 1996). The positive effects of group exchange on Session 2

performance may reflect an entrainment process. Performance rates from one session may become entrained in the group and carried over to a subsequent session (Kelly & Karau, 1993; Paulus & Dzindolet, 1993). Even though individuals were performing individually in the second session, the high rate of performance "set" in the group-interaction situation may have carried over to the "distributed group" situation. However, such a carryover effect should be most evident when individuals continue to function as a group (Kelly, 1988; Paulus & Dzindolet, 1993). Alternatively, if a sense of competition develops with the use of the group-exchange technique, this sense of competition may carry over to the second session. Since activity level in groups and number of ideas are totally confounded in the idea-generation paradigm, it is difficult to disentangle the relative influence of the various processes discussed. Studies which vary the quality (e.g., uniqueness or diversity) as well as quantity of the ideas exchanged may be able to demonstrate more clearly the unique influence of cognitive factors on the synergy experienced by brainwriting and electronic brainstorming groups.

The findings for brainwriting suggest that similar results might be obtained in electronic brainstorming. Electronic brainstorming also involves the exchange of ideas in a structured fashion but eliminates the production blocking features of conventional oral brainstorming (Nunamaker et al., 1995). Our theoretical analyses suggest a number of factors that may be responsible for the failure of past studies to find group stimulation effects for electronic-brainstorming groups smaller than nine (Valacich, Dennis, & Connolly, 1994). Participants may not pay much attention to the ideas generated by others since they may be focused on the primary task of generating their own ideas. Even if individuals do attend to the ideas of other participants, they may not demonstrate the full benefit of this exposure during the typical brief brainstorming sessions since the time taken for processing ideas from others takes away time required for generating one's own ideas. If electronic brainstormers are provided a subsequent session to continue generating ideas without having to attend to additional ideas of the group, they may be able to demonstrate some benefit of exposure to ideas from others in the prior session.

The participants in our study involved groups of unacquainted students who worked on the problem for only a short period of time. This situation may not appropriately simulate processes that may occur for organizational groups or teams that are involved in information exchange or idea sharing over extended periods of time. However, we have found that acquainted groups in organizations demonstrate production loss of group brainstorming similar to that obtained with students in laboratory studies (Paulus, Larey, & Ortega, 1995). Furthermore, in the present study we simulated the types of interactions that are common in organizations. These involve exchange of information and ideas followed by opportunities to reflect on this information individually at a later time, whether this be in face-to-face meetings or by means of written or computer messages (Galegher et al., 1990). Thus the paradigm used in this study is more characteristic of regular organizational practice than that used in previous studies of face-to-face and electronic brainstorming. It will be of

interest to examine some of our hypotheses about group-creativity processes in organizational settings, especially in light of the increase in knowledge work done by groups or teams (Purser & Montuori, 1995). The findings of this study and others on idea-generating groups may provide a basis for enhancing the effectiveness of information exchange and intellectual teamwork in organizations.

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