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Brainstorming and task performance in groups constrained by evidence☆

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Abstract

Group brainstorming is usually considered a task of divergent thinking, and the ideas produced in most research on brainstorming are counted and scored for creativity but put to no further use. We studied brainstorming by embedding it in a rule induction task that initially requires divergent thinking but increasingly requires convergent thinking as evidence accumulates across trials. We also tested whether brainstorming facilitated performance on the induction task itself. The experimental design was a 2 (nominal or interacting groups) $\times$ 3 (brainstorming early in the task, late in the task, or none) factorial. For brainstorming performance, nominal groups of 4 individuals outperformed face-to-face groups of 4 individuals. But as predicted from an analysis of the effects of constraining hypotheses by evidence, the advantage for nominal groups declined when brainstorming took place late in the task where there was a large amount of accumulated evidence to consider. Brainstorming did not generally affect performance on the induction task, although early group brainstorming resulted in more correct hypotheses than late group brainstorming. Group brainstorming was perceived as more effective than individual brainstorming by both interacting and nominal group members, a finding that extends the illusion of group productivity in brainstorming to tasks of convergent thinking.

The generation of plausible hypotheses based on currently available evidence is frequently a crucial step when groups are confronted with uncertainty in the course of problem-solving, decision-making, or planning tasks. The tendency to seek the opinions of others in the face of uncertainty is well-documented in the vast literature on social comparison processes (Suls & Wheeler, 2000), and everyday experience apparently suggests that interaction with others produces better ideas than does thinking in isolation (Paulus, Dzindolet, Poletes, & Camacho, 1993). Thus, group hypothesis generation is a common activity, particularly in organizations.

Much of what is known about the effect of social interaction on the process of hypothesis generation comes from the tradition of brainstorming research (Osborn, 1957; Paulus, Dugosh, Dzindolet, Coskun, & Putman, 2002) rather than research on group problem-solving. Group brainstorming research has produced a rich literature on creativity in groups and has implications for organizations (Paulus & Yang, 2000). In problem-solving, however, hypothesis generation is normally an activity that supports overall task performance and is not an end in itself. At the same time, the creative aspects of hypothesis generation have been largely ignored in research on inductive problem-solving by groups. The intersection of these two research traditions raises three questions that were the concern of our research: (1) How effective is group brainstorming in producing ideas in a problem-solving context? (2) Does group brainstorming affect task performance? (3) Does the overconfidence in the productivity of brainstorming groups (Paulus et al., 1993) extend to problem-solving groups?

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Idea generation in brainstorming

Osborn (1957) first touted group brainstorming as a means of increasing creativity. Some of the rules for brainstorming, particularly the emphasis on quantity and the prohibition of evaluation, were designed to disinhibit individuals working with each other in order to increase the raw number of ideas without particular regard for quality. Genuine creativity was supposed to arise not only from the statistical advantages of a large sample of ideas but also from the mutual stimulation of ideas and the production of new ideas by combining or changing ideas already on the table.

Despite the intuitive appeal of this line of thinking, the literature (Lamm & Trommsdorff, 1973; Mullen, Johnson, & Salas, 1991; Taylor, Berry, & Block, 1958) has consistently reported that groups produced fewer ideas than an equivalent number of individuals working alone (nominal groups). The nominal group baseline, reflecting the demands of an additive task (Steiner, 1972), is regarded as the fair comparison for a task designed simply to produce the largest number of ideas.[1] In a meta-analysis, Mullen et al. (1991) also found that interacting groups usually produced ideas of poorer quality than did nominal groups.

Thus, interacting groups perform below their potential for idea generation both quantitatively and qualitatively. Such findings are common in the general group performance literature (Hill, 1982). Less than optimal coordination (Wittenbaum, Vaughan, & Stasser, 1998) or reduced motivation (Karau & Williams, 1993) are usually sufficient to explain the process loss (Steiner, 1966, 1972). In the realm of brainstorming, coordination losses were emphasized by Diehl and Stroebe (1987) who showed that most of the reduction in productivity in interacting brainstorming groups could be attributed to production blocking. Production blocking occurs when the group process itself (e.g., waiting for a turn to speak) keeps individuals from contributing some of their ideas. Motivational losses in brainstorming groups were reported by Paulus and Dzindolet (1993) who demonstrated that group members lowered their performance goals as a result of social comparisons with the least productive group members.

When production blocking was limited by using computers (electronic brainstorming) in place of face-to-face interaction, the productivity of small groups was found to match that of nominal groups (Gallupe, Bastianutti, & Copper, 1991). Larger groups (9 or more members) even outperformed nominal groups in some studies (Dennis & Valacich, 1993; Valacich, Dennis, & Connolly, 1994).

Still, none of these studies was an unequivocal demonstration that group interaction stimulated idea production (Connolly, Routhieaux, & Schneider, 1993). More recently, Dugosh, Paulus, Roland, and Yang (2000) reframed the question in terms of cognitive mechanisms underlying the stimulation of ideas (Brown, Tumeo, Larey, & Paulus, 1998). They found that individuals who were sufficiently motivated to attend to a flow of ideas (presented by audiotape or by computer) produced more ideas than did individuals without the stimulation. Thus, consistent with an associationistic view (Anderson & Bower, 1973), attention to externally generated ideas can enhance idea generation in individuals by the process of spreading activation.

There does not appear to be anything unique to social interaction that is necessary for this process to occur (Nagasundaram & Dennis, 1993). Quite the opposite. All the evidence suggests that interaction processes block production (Diehl & Stroebe, 1987), interfere with attention (Dugosh et al., 2000), disrupt the generation process (Dugosh et al., 2000), induce norms of low production (Paulus & Dzindolet, 1993), and introduce evaluation apprehension (Camacho & Paulus, 1995), all of which introduce motivation or coordination losses that inhibit group productivity. Thus, group interaction appears to wash out the beneficial cognitive effects of exposure to different ideas.

Idea generation in rule induction

In the group performance literature, hypothesis generation has usually been treated as a task of creativity or divergent thinking (McGrath, 1984), but when the hypotheses are constrained by evidence, it also involves convergent thinking. For example, in the process of hypothesis generation in scientific research, scientists develop hypotheses based on currently available evidence and the hypotheses are evaluated by generating new evidence. The criterion of success is ultimately a pragmatic one. Scientific prizes may be awarded only for highly creative hypotheses, but the winners must also be consistent with past evidence and supported by new evidence. Creativity by itself is not the goal. Our research dealt with the role of social exchange when novel ideas are required in order to induce a general principle from a body of evidence.

In order to study hypothesis generation that occurs in the service of problem-solving, we employed a version of Laughlin's (1996) rule induction task in which individuals or groups induce a rule. The task is a deliberate analogy to the process of collective induction of laws

[1] Steiner used brainstorming as an example of a divisible task. Each idea is considered as a subtask that a group member discovers and performs (announces). However, whether the task is divisible or not, for measures of quantity, the scoring of collective performance is additive (the sum of the individual products). For measures of quality, the task can be additive (when collective performance is a sum weighted by quality), or disjunctive (if the single best idea counts for collective performance).