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The Effects of Group Size, Memory Instruction, and Session Length on the Creative Performance in Electronic Brainstorming Groups*

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Abstract

In the literature, there has been a focus on the effectiveness of larger sized electronic brainstorming groups; however, mechanisms for its effectiveness still remain open to question and some methodological concerns (e.g., the evaluation of ideas and the typing speed, and the use of different formats) continue to be important problems. To overcome such problems, a series of experiments were conducted. All subjects were exposed to the two-minute typing speed test which was overlooked in the previous studies in electronic brainstorming. In the first experiment the effect of the group size (4, 6, and 8 person groups); in the 2nd experiment that of group size (4, 6, 8, 10, and 12 person groups) with the memory instruction, and in the 3rd experiment that of group size (4 and 10 person groups) with two lengths of brainstorming session (15 and 25 minutes) were investigated on the brainstorming performance. Results showed that unique and original ideas increased as the group size increased. However, the group size did not affect the performance of one individual within these groups. Memory instruction inhibited performance in the shorter session (15 minutes) of brainstorming but enhanced it in the longer session (25 minutes) of brainstorming. Typing speed affected the total number and unique ideas but not the originality and feasibility of these ideas. In conclusion, these findings demonstrated that group size enhanced creative ideas (unique, original, and feasible ideas). Consistent with the literature, the beneficial effect of memory instruction could be evident in the longer session of brainstorming rather than the shorter one. These findings were discussed in light of the relevant brainstorming literature and their implications on educational, health and organizational settings.

Key Words

Brainstorming, Electronic Brainstorming Groups, Memory Instruction, Creative Ideas.

Since the publication of Osborn's influential book (1957), among the other creative methods, group brainstorming has been widely used in groups and teams in order to develop new programs and technologies (Parnes, 1992; Paulus, 2000, 2007; Paulus & Brown, 2003, 2007; Paulus, Dzindolet, Dugosh, Coskun, & Putman, 2002). Despite its popularity, interactive groups with the Osborn's rules (that are (1) 'do not criticize ideas; (2) say whatever comes to mind; (3) generate many ideas without concern on quality; (4) develop or combine old ideas with new ones'), were found to be less productive than the same number of individual brainstormers whose ideas are pooled (nominal groups: Mullen, Johnson, & Salas, 1991; Stroebe & Diehl, 1995; Sutton & Hargadon, 1996). Evaluation apprehension (Camacho & Paulus, 1995; Diehl & Stroebe, 1987, 1991), social loafing (Diehl & Stroebe, 1987; Karau & Williams, 1993; Kerr & Bruun, 1983; Paulus & Dzindolet, 1993), production blocking (Diehl & Stroebe, 1991; Nijstad, Stroebe, & Lodewijkx, 2003), and downward matching (Camacho & Paulus, 1995; Paulus & Dzindolet, 1993) were proposed as possible explanations for the gap between the interactive groups and the nominal groups.

Interactive groups have also found to lower their performance towards the end of the session (Coskun, Paulus, Brown, & Sherwood, 2000) and

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to convergence on a small number of categories (Brown, Tumeo, Larey, & Paulus, 1998; Connolly, Routhreaux, & Schneider, 1993; Larey & Paulus, 1999). This low performance can be due to cognitive interferences and a lack of motivation (Paulus et al., 2002). To overcome such problems, some cognitive stimulation techniques (e.g., memory instruction, incubation, task instructions that facilitate group activities, divergent thinking, exposure to high number of categories or ideas) have been suggested in the brainstorming literature (Brown et al., 1998; Coskun, 2005a, 2005b, 2005c; Coskun et al., 2000; Coşkun & Yılmaz, 2009; Dugosh, Paulus, Roland, &Yang, 2000; Paulus et al., 2002; Paulus, Larey, Putman, Laggett, & Roland, 1996).

In the literature there has been a focus on the effectiveness of larger sized electronic brainstorming groups (Valacich, Wheeler, Mennecke, & Wachter, 1995). Despite the fact that the first studies (Gallupe et al., 1992) have shown that electronic brainstorming groups were reported to be more productive than oral brainstorming groups, the latter studies (Pinsonneault & Barki, 1999; Pinsonneault, Barki, Gallupe, & Hoppen, 1999) have provided contrary evidence. However, mechanisms for its effectiveness still remains open to question and some methodological concerns (e.g., evaluation of ideas and typing speed, and using different formats) continue to be important problems (Dennis & Valacich, 1999; Dennis & Williams, 2003; Paulus, 2000; Paulus & Brown, 2007). To overcome such problems, a series of experiments were conducted by evaluating not only the number of unique ideas but also the number of good ideas (original and feasible ideas). All subjects were exposed to the two minute typing speed test which was overlooked in the previous studies in electronic brainstorming. In the first experiment the effect of the group size (4, 6, and 8 person groups) was investigated.

1st Experiment

Subjects: A total number of 52 students enrolled in psychology courses participated in this experiment for an experimental credit and were randomly assigned to various group size conditions (4, 6, and 8 person groups).

Instruments

Brainstorming Rules: (1) do not criticize; (2) say whatever comes to mind; (3) try to produce many ideas without being concerned about their quality; (4) combine ideas and make new ideas.

Brainstorming Problem: They were given an extra thumb problem ("Suppose each child was born with an extra thumb on each hand after the year of 2006. This extra thumb has the same amount of flexibility and pressure like the other thumb. Think about the difficulties or benefits of having an extra thumb and generate as many ideas as possible about it.")

Typing Speed Test: All subjects were instructed to write as many sentences as they can from the 10 independent sentences appeared on the top of computer screen within the two minutes.

Procedure

After all subjects signed the informed consent forms, they were tested in a lab setting that had separate computers at which each subject was stationed depending on the experiment conditions. Then they were exposed to the two minutes typing speed test. After that, the experimenter handed out the brainstorming rules and read aloud to them. All subjects were randomly assigned to 4, 6, or 8 person groups and brainstormed on the extra thumb problem for fifteen minutes.

Findings

Coding and Performance Analysis

The inter-rater reliability coefficients for rating the total, unique, and original ideas were 0.99, 0.98, and 0.89, respectively. One way ANOVA showed that group size had significant effects on the total ($F(2, 9) = 13.13$, $p < .002$, $\eta^2 = .75$) and unique ideas ($F(2, 9) = 9.48$, $p < .006$, $\eta^2 = .68$). Tukey test indicated that 8-person groups (M=135.75 total, M = 108 unique) generated more ideas than 6-person groups (M = 93 total, M = 78.5 unique) and 4-person groups (M = 62 total, M = 52 unique), the last two being not significantly different from each other. Typing speed had also significant effect on the number of total and unique ideas, ($F(1, 8) = 9.19$, $p < .02$, $\eta^2 = .53$ and $F(1, 8) = 9.08$, $p < .02$, $\eta^2 = .53$, respectively). However, group size did not have any significant effect on one individual's performance within the groups ($F(2, 9) = .04$, $p > .96$, $\eta^2 = .009$).

2nd Experiment

Experiment 2 included bigger sized groups (4, 6, 8, 10, and 12 person groups) and investigated the

effects of memory on performance in the shorter session. There has been inconsistent evidence for the effect of memory instruction. One research has not found evidence for the beneficial effect of memory instruction in the shorter brainstorming session (Paulus &Yang, 2000), while another one has shown the beneficial effect of it in the longer brainstorming session with a confounding paradigm (Dugosh et al., 2000).

Subjects: A total number of 176 students, enrolled in the classes in the Faculty of Science and Arts participated in this experiment for an experimental credit and were randomly assigned to both various group size (4, 6, 8, 10, and 12 person groups) and memory conditions (memory and no-memory).

Instruments and Procedure

The instruments in Experiment 2 were analogous to those in Experiment 1 except for the brainstorming problem, namely the university problem (generating ideas to improve the university). The procedure in Experiment 2 was identical to the one in Experiment 1 except for the provision of memory instruction. In the memory condition of the test, all subjects were instructed that there would be a memory test at the end of the session and they had to memorize the ideas they generated. In the no-memory condition, they were given no such information.

Findings

Coding and Performance Analysis

The inter-rater reliability coefficients for rating the total, unique, and original ideas were 0.99, 0.99, and 0.92, respectively. The two way ANOVA showed that group size had significant effects on the number of total ($F(4, 30) = 36.27$, $p < .0001$, $\eta^2 = .83$) and unique ideas ($F(4, 30) = 31.07$, $p < .0001$, $\eta^2 = .81$). Tukey test showed that, 12-person groups had significantly more total and unique ideas than 8, 6 and 4-person groups. No difference was detected for closely sized groups (e.g., 4 and 6, 6 and 8, 8 and 10, 10 and 12 person groups). Memory instruction had also significant effects on total ($F(1, 30) = 13.98$, $p < .001$, $\eta^2 = .32$) and unique ($F(1, 30) = 4.87$, $p < .04$, $\eta^2 = .14$) ideas, with the fact that memory groups had fewer ideas than no-memory groups. Typing speed had a significant effect on the number of unique ideas, $F(1, 29) = 9.11$, $p < .005$, $\eta^2 = .23$).

Group size had a significant effect on the number of original ideas, $F(4, 30) = 21.06$, $p < .0001$, $\eta^2 = .74$ with the fact that the superior performance of 12-person groups (M = 24.62) over 4 (M = 9.38), 6 (M = 12.63), and 8-person groups (M = 15.75). No effect was found for memory and interaction between the two variables. Group size also had a significant effect on the number of feasible ideas, $F(4, 30) = 13.18$, $p < .0001$, $\eta^2 = .64$ with the fact that the 12-person groups (M = 27.37) had a superior performance over the 4 (M = 12.13), 6 (M = 14.25) person groups. However, group size did not have any significant effect on one's individual performance within the groups ($F(4, 30) = .51$, $p > .72$, $\eta^2 = .03$). Memory instructed individuals (M = 10.88) had fewer unique ideas than those ones with no-memory instruction (M = 12.85), $F(1, 30) = 7.19$, $p < .01$, $\eta^2 = .19$.

3rd Experiment

Experiment 3 was conducted to examine the length of the brainstorming session (15 and 25 minutes) with memory instruction in small (4 person groups) and large groups (12 person groups) in order to clear the inconsistent findings in the literature (Dugosh et al., 2000; Paulus & Yang, 2000).

Subjects: A total of 216 students enrolled in the classes in the Faculty of Science and Arts, participated in this experiment for an experimental credit and they were randomly assigned to various group size conditions (4 and 10 person groups), memory conditions (memory and no-memory), and the length of the brainstorming sessions (15 and 25 minutes).

Instruments and Procedure

Both the procedure and the instruments were analogous to those used in Experiment 1 and 2.

Findings

Coding and Performance Analysis

The inter-rater reliability coefficients for rating the total, unique, and original ideas were 0.99, 0.99, and 0.92, respectively. Three way ANOVA showed that group size had significant effect on the number of total ($F(1, 22) = 134.85$, $p < .0001$, $\eta^2 = .86$) and unique ideas ($F(1, 22) = 122.13$, $p < .0001$, $\eta^2 = .85$), with evidence for the superior performance of the 10-person groups over the 4-person ones. Also, an interaction effect between memory and session length in total($F(1, 22) = 7.87$, $p < .01$, $\eta^2 = .26$) and unique ideas($F(1, 22) = 122.13$, $p < .0001$, $\eta^2 = .85$)

showed that no-memory groups generated more ideas than the memory groups in the 15 session but memory groups generated more ideas than the no-memory groups in the 25 minute session. Typing speed had also significant effects on total ($F(1, 21) = 12.06$, $p < .02$, $\eta^2 = .37$) and unique ideas($F(1, 21) = 5.08$, $p < .04$, $\eta^2 = .20$).

Group size did not have a significant effect on one's performance, ($F(1, 22) = .08$, $p > .77$, $\eta^2 = .00$). However, session length $F(1, 22) = 7.18$, $p < .01$, $\eta^2 = .25$ and the interaction effect between memory and session ($F(1, 22) = 6.32$, $p < .02$, $\eta^2 = .22$) had significant effects, in line with the group size effects. In addition, analysis revealed that group size had significant effects on the number of original ($F(1, 22) = 114.59$, $p < .0001$, $\eta^2 = .84$) and feasible ideas ($F(1, 22) = 56.32$, $p < .0001$, $\eta^2 = .72$) with the superior performance of the10-person groups over the 4-person ones in these measures.

General Discussion

The findings of all three experiments have consistently demonstrated that unique and original ideas increased as the group size increased. However, group size did not affect the performance of one individual within these groups. Memory instruction inhibited performance in the shorter session (15 minutes) of brainstorming but enhanced it in the longer session (25 minutes) of brainstorming. Typing speed affected total and unique ideas but not the originality and feasibility of ideas.

In conclusion, these findings demonstrated that group size enhanced creative ideas (unique, original, and feasible ideas). Consistent with the literature (Dugosh et al. 2000; Paulus & Yang, 2000), the beneficial effect of memory instruction could be evident in the longer session of brainstorming rather than the shorter one. These findings may also have important implications for educational, industrial, and health settings. Individuals in these settings can be invited to an electronic brainstorming session in a synchronized or asynchronized (or desynchronized) fashion and be allowed to brainstorm in larger groups with memory instruction (Easton, Easton & Belch, 2003; Kerr & Murthy, 2004; Michinov & Primois, 2005; Paulus et al., 1996). Leaders can play important roles in the construction and the management of such groups (Palmon & Illies, 2004). Then it will be appropriate to hold a subsequent session where all the participants can select and rate in the original and feasible ideas.

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