EFFECT OF NUMBER OF IDEAS AND FOLDERS ON

IDEA GENERATION IN GROUPS

by

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ABSTRACT

EFFECT OF NUMBER OF IDEAS AND FOLDERS ON

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Electronic brainstorming is a method developed to take advantage of the positive effects of collective ideation, such as cognitive stimulation, while decreasing production blocking and social loafing. Research indicates that as group size increases so does the total number of ideas generated. Yet, as groups get larger, brainstormers may succumb to cognitive overload and no longer benefit from the cognitive stimulation of other group members. To counter this potential source of production loss, the use of folders has been developed. Folders are a means of collecting ideas and distributing them among group members in smaller more manageable sets. However, studies demonstrating the effect of group size have also increased the number of folders as group size increases. The present study was designed to determine the differential effects of exposure to varied numbers of ideas (as in groups of varied sizes) and the number of folders. Participants generated ideas for 15 minutes while being exposed to 28 or 112 ideas. Additionally, ideas were distributed among 1, 4 or 8 folders. A control group with no idea exposure was used for comparison. The 112 idea condition produced significantly more ideas than the nominal and the 28 idea and nominal conditions, but there was no effect of folders. This suggests that the effect of group size in electronic brainstorming is due to exposure to a large number of ideas and is not affected by the increased number of folders.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Brainstorming has come a long ways since research in the area first began with Osborn in the 1950s. Brainstorming was a technique developed to enhance creativity, problem solving, decision making, and ideation. Group collaboration is a way to bring varying backgrounds, cultures, knowledge, and opinions together, creating a dynamic flow of combinations and thought processes to produce novel ideas. Originally, brainstorming was done through verbal communication or by having members physically write their ideas. Nowadays, many of the obstacles encountered in the old way of doing things have been overcome through the use of technology and what is now termed as "electronic brainstorming." Advances in technology enable large groups to come together to collaborate and allow for group work to take place all over the world.

Osborn (1957) proposed that by applying his brainstorming technique in groups, using his four rules to enhance the process, interacting groups would be able to generate considerably more ideas than groups of individuals. Bringing together a diverse group of people with various backgrounds, ethnicities, careers, and experiences should increase the pool of creativity. Idea combinations may be created by one member that another might not have been able to generate without being triggered from an outside source. To experimentally test whether group brainstorming is beneficial, researchers typically compare interactive group brainstorming with nominal group brainstorming. Nominal groups consist of the same number of people as those working in interacting groups, except nominal group members work individually on a task without exchanging any input or having communication with partners. When brainstormers work in nominal groups, their ideas are collectively pooled after a brainstorming session and redundant ideas are eliminated to create a fair comparison against interactive groups of the same size.

When real groups interact face to face with the other members in their group, as the group size increases, so too does the total number of ideas generated (Bouchard and Hare, 1970; Mullen, Johnson,

1

& Salas, 1991). Larger groups also produce more high quality ideas which are ideas that are rated as being both novel and useful (Diehl & Stroebe, 1987; Taylor et al., 1958). What is particularly interesting is the comparison of nominal to real groups. Persons working as individuals in nominal groups are able to perform better while brainstorming than groups of similar size who work together face to face (Diehl &Stroebe, 1987; Mullen et al., 1991; Taylor, Berry, & Block, 1958). Bouchard and Hare (1970) found a significant interaction between group size and group type indicating that as group size increases, the difference between nominal and real groups increase as well. When electronic brainstorming (EBS) is compared to its face to face counterpart, EBS has been found to significantly outperform face to face brainstorming on quantity, quality and reported satisfaction of the group ideation process (Derosa, Smith, and Hantula, 2007). However, nominal groups are able to outperform small EBS groups, but large EBS groups are able to outperform nominal groups of equal size (Dennis & Gallupe, 1993; Valacich, Dennis, Connolly, 1994). Eight or more members appear to be the critical size beyond which real interacting EBS groups are able to brainstorm more productively than nominal EBS groups (Pinsonneault, Barki, Gallupe & Hoppen, 1999; Dennis & Valacich, 1999).

A number of factors have been hypothesized as contributors to production loss in face to face brainstorming groups.   Production blocking, social loafing, and evaluation apprehension may all contribute to inhibit group collaboration.   Production blocking has been found to be an important contributor to production loss in face to face brainstorming groups (Lamm & Trommsdorf, 1973). This occurs when there is a need to take turns during verbal collaboration (Diehl & Stroebe, 1987). Members cannot simultaneously communicate their ideas as they are generated or they run the risk of not hearing others or causing confusion. It is a detrimental player in verbal brainstorming and naturally this effect increases as group size increases (Mullen et al., 1991). Attentively listening to others may cause participants to forget their own ideas or train of thought; on the other hand, if group members are focused on remembering their own ideas, they may decrease their chances of cognitive stimulation because they are less likely to be processing the input of others. Blocking also reduces the amount of time each member has to input their respective ideas because they are forced to wait till there is an opportunity to speak (Nijstad, Stroebe, Lodewijkx, 2003).

Evaluation apprehension is another potential source of production loss. It occurs when members of a brainstorming group feel that they will be associated with the input they provide to the group. Therefore, brainstormers may participate in self monitoring and censoring of their ideation (Diehl & Stroebe, 1987; Lamm & Trommsdorf, 1973). Evaluation apprehension is reduced when participants feel that they are anonymous because they are no longer directly linked to the ideas that they share. Again, as in production blocking, evaluation apprehension increases with group size because with each additional group member there is increased chances of criticism and judgment (Gallupe et al., 1992).

Another factor that may play a role in the loss of productivity while brainstorming is social loafing. Social loafing happens when participants in a group setting do not put in the effort that they would if they were performing the task on their own (Karau & Williams, 1993). This may be because a diffusion of responsibility or a feeling that one's own ideas will not aid in group discussion. Just as with production blocking and evaluation apprehension, social loafing increases with group size (Karau & Williams, 1993). When there are more members who are contributing ideas there is less of a feeling that one's input is essential and therefore less of a feeling that one must contribute for the group to succeed.

A major benefit of conducting brainstorming via an electronic medium is that it reduces many of the productivity losses that occur during face to face brainstorming. Production blocking is dramatically reduced because group members no longer need to wait their turn to contribute ideas. Idea generation and input from all interacting members can essentially occur simultaneously because they can all be typing and submitting their ideas at the same time (Dennis & Valacich, 1993; Pinsonneault & Barki, 1999; Valacich et al., 1994). This allows for an increased rate of idea input and sharing between group members. Evaluation apprehension can also be reduced because electronic programs can be set up to allow participants to exchange ideas anonymously. Although anonymity has shown little effect in laboratory settings, it has been shown to affect criticalness and play a role in real world field settings (Dennis & Williams, 2005; Nunamaker, Dennis, Valacich, Vogel, & George, 1991). Of course if individuals are anonymous, they may tend to loaf in groups (Karau & Williams, 1993). So benefits of anonymity may be outweighed by the effects of loafing. Thus it is not surprising that a review of the literature does not indicate a clear effect of anonymity in electronic brainstorming (Derosa et al., 2005).

3

Thus by having groups brainstorm electronically many of the harmful effects of verbal face to face brainstorming are reduced and the positive effects of idea exchange can be obtained. With an increase of idea contribution from increased group size and decreased process losses, participants are able to work and build off each other at a much higher rate. When a group of people come together and collaborate and exchange thoughts, ideas, and opinions with each other they create cognitive stimulation (Paulus & Brown, 2007). Thus, when one member contributes an idea to a collaborative group this then should trigger new ideas to be produced by other members of the group (Dennis and Valacich, 1993; Lamm & Trommsdorff, 1973). Originally, Osborn (1957) termed this "piggybacking" in that brainstormers were building upon others' ideas, consistent with his rule instructing participants to combine and improve. Incoming ideas from other group members can potentially stimulate further idea generation from the rest of the group. This interplay can guide further ideation down the same line or provide alternative pathways that might not have been otherwise accessed (Paulus, 2000). Attention to others ideas obviously plays an enormous role in group cognitive stimulation (Dugosh, Paulus, Roland, & Yang, 2000; Paulus & Yang, 2000). If group members do not attend to others input, they are in essence working alone. By doing this they are missing potential triggers of new ideas or categories. As group size increases, so should the effects of cognitive stimulation (Dennis and Valacich, 1993; Gallupe et al., 1992; Valacich et al., 1994). However when groups are small (typically 4 or less members), EBS interactive groups are typically outperformed by nominal groups (Derosa et al., 2005). This could be due to the slight distraction of trying to keep up with the flow of idea exchange occurring in interactive EBS groups. However, as group size increases, the difference in performance between real and nominal groups decreases to a point at which interactive groups perform better than nominals (Dennis & Williams, 2005; Derosa et al., 2005). As group size increases, the stimulating effects of the high exchange of ideas may be enough to overcome any potential distracting effects (Paulus & Brown, 2007). However, it is also possible that when large quantities of ideas are generated in a short period of time, as occurs in large electronic brainstorming groups, an information overload may arise (Dennis & Valacich, 1993; Gallupe et al., 1999; Santanen, Briggs, & de Vreede, 2004; Valacich et al., 1994). That is, participants may become overwhelmed with the high flow rate of ideas and begin "tuning out" or completely ignoring the shared ideas.

One way to potentially reduce the effects of overload during brainstorming would be to divide the ideas that each members is presented with into smaller, more manageable subsets. Using the technology created to facilitate brainstorming, ideas can be distributed into folders that hold varying quantities of ideas. This allows for brainstormers to review smaller groupings of ideas that are contributed by others. The quantity of ideas is related to group size, so as the number of group members increase so do the number of ideas generated. Similarly, the number of folders used in EBS usually corresponds to the number of members in the group (R.O. Briggs, personal communication, October 21, 2009; Grise, 1997). By distributing presented ideas among rotating folders participants are continuously being re-exposed to sets of ideas as they submit new ideas. This process limits overload because participants do not become overwhelmed with the high quantity of input that occurs in large group brainstorming (Grise & Gallupe, 2000). Chin, Hayne, and Licker (1992) used folders as a means of categorizing ideas for users for further processing. They suggested an advantage of "parallel entry of clusters rather than serial discussion." Other studies propose the idea of "chunking" ideas into smaller sets or presenting them in different windows (Dennis, 1994; Nagasundaram & Dennis, 1993). It is likely that increasing the number of folders with an increasing group size is a critical factor in facilitating the high performance of large interactive EBS groups. However, no studies have evaluated the role of folders in the group size effect.

Since there has been confounding between the number of shared ideas and the number of folders as group size increased in EBS studies, the proposed study will attempt to assess the effects of the number of shared ideas and the number of folders into which these ideas are distributed. If the number of ideas to which a person is exposed to increases without increasing the number of folders, participants may experience cognitive overload. Under such a condition, the positive effect of an increased number of shared ideas may not occur. However, when ideas are distributed in a large number of folders, overload should diminish and the positive benefit of a high number of ideas should be observed. Since increased size of group in EBS is also related to increased novelty of ideas, a positive effect on novelty is expected as well. In addition, typically when more ideas are generated, there is also

an increase in the number of good ideas (ideas that are both novel and useful). Therefore the following hypotheses are proposed:

H1: Quantity of ideas generated will be greatest when there are a high number of ideas presented and these ideas are distributed among a large number of folders.

H2: Novelty of ideas generated will be greatest when there are a high number of ideas presented and these ideas are distributed among a large number of folders.

H3: The number of good ideas (that are high in both novelty and utility) will be greatest when there are a high number of ideas presented and these ideas are distributed among a large number of folders.

In summary, all three hypotheses predict that there will be a significant interaction between number of ideas participants are exposed to and the number of folders used. For each, it is expected that those who are exposed to the most ideas which are also distributed among the most folders will have the highest performance during the brainstorming task.

CHAPTER 2

METHOD

2.1 Participants

The participants were undergraduate students enrolled in introductory psychology at the University of Texas at Arlington during the fall semester of 2010. A total of 162 students participated in the study. Two participants were deleted from the study due to experimenter error. Of the participants used in this study, 85 were female and 77 were male with an average age of 21. Up to three students could sign up to participate for any one session. Each participant was randomly assigned to one of the seven conditions used in this study.

2.2 Materials

A computer program was created specifically for the purpose of conducting this study. Depending on the condition, the computer would supply each participant with 28 or 112 preselected ideas over a 15 minute brainstorming period. The first idea appeared 30 seconds into the session and the last idea appeared with 30 seconds left, regardless of condition. For the 28 idea condition, each idea was supplied every 30 seconds while in the 112 idea condition participants received an idea every 7.5 seconds. The control condition, which did not receive ideas from the computer, performed the brainstorming task using AOL Instant Messenger (AIM). The presented ideas and the participant's ideas were placed into 1, 4, or 8 folders – creating 1, 4, or 8 lists of ideas. Ideas were added to each folder sequentially, regardless if it was submitted by a participant or by the program.

For the multi-folder conditions, participants could only view one folder and all of its contents, called the display folder, at a time. The program would only rotate to the next folder after the participants submitted an idea. The display folder rotated in order (e.g., the participant viewed folder 1 until they submitted an idea; then they could view folder 2). Therefore, the rotation of the display folder and the rotation of the folder that was next in line to receive an idea were independent from one another. For example, if participants submitted an idea while viewing folder 1, this idea might be added to folder 6

7

because the last idea added to the folders was placed in folder 5. If the participant chose not to submit any ideas, the program continued to propagate the folder with ideas. For instance, as a participant was viewing folder 3, the participant would be able to see any new ideas added to folder 3 but none of the other folders.

Following the 15 minute brainstorming task participants did a 5 minute maze task to reduce any primacy or recency effects and then completed a recognition memory test. Finally, participants were asked to complete a questionnaire assessing motivation, attention, facilitation, and perceived production.

2.3 Design and Procedure

This study employed a 2(Ideas: 28, 112) X 3(Folders: 1, 4, 8) design plus one control condition. Participants were first given a set of instructions informing them on how to use the EBS program, and they were provided with the brainstorming topic: "Ways in which to improve UTA." The experimenter then escorted each participant to their individual cubicle where the brainstorming session would take place. Once participants read the onscreen instructions, they were prompted to click a "start" button which would start a timer and begin the session.

After 15 minutes, the EBS program closed automatically, prohibiting the participant from submitting any more ideas. At this time, the experimenter returned to escort the participants back to the main lab room to complete the recognition test and questionnaire. Participants were first asked to work on a packet of mazes for 5 minutes to minimize any primacy or recency effects. Next, the participants were given the recognition tests which consisted of seven ideas that were presented by the computer and seven "lure" ideas. Participants were asked to indicate if the idea appeared during brainstorming and to rate the confidence in their decision on a three point scale (1-very confident, 3-not confident). Participants were given as much time as needed to complete the recognition test. After the recognition test was completed, participants were given a questionnaire which attempted to assess the participants' reaction to the brainstorming task. Participants were debriefed before being excused from the study. Sample recognition tests and the questionnaire are in Appendices A, B and C.

2.4 Coding

Ideas were coded by a trained rater for novelty and the utility of each idea. Novelty is defined as the uniqueness of the idea and utility was a measure of feasibility. Both were rated on a 5-point scale with 5 being very a novel/good idea and 1 being a very common/not feasible. A second trained rater coded 25% of the ideas to assess interrater reliability. If the raters were within one point of each other they were considered to be in agreement (Diehl & Stroebe, 1991). For the novelty rating Cronbach's alpha between raters was .91 and for the utility rating was .80, both indicating a high rate of consistency. Interclass correlation (ICC) statistics were consistent with the previous reliability ratings: .91 correlation for novelty rating and a .80 correlation for utility rating between raters.

CHAPTER 3

RESULTS

A 2 (Ideas: 28, 112) X 3 (Folder: 1, 4, 8) ANOVA was used to assess the effects of the experimental conditions. As a check on the manipulation, participants were asked to report the perceived number of ideas they saw during the brainstorming task. Surprisingly there was no main effect of the number of ideas but there was a main effect of folders, $F(2, 126) = 9.69$, $p < .001$. The 1 folder condition ($M = 24.38$, $SD = 2.18$) reported seeing significantly more ideas than the 4 ($M = 13.23$, $SD = 2.21$) or 8 ($M = 11.94$, $SD = 2.24$) folders conditions. There was no significant difference between the 4 and 8 folder conditions. For the recognition task, there was a main effect of ideas, $F(1, 132) = 16.09$, $p < .001$. The 28 idea condition ($M = 6.17$, $SD = .12$) correctly recognized more presented ideas than the 112 idea condition ($M = 5.50$, $SD = .12$). There was also a main effect for folders, $F(1, 132) = 3.08$, $p = .045$. The 1 folder condition ($M = 6.13$, $SD = .15$) recognized significantly more ideas than the 4 folder ($M = 5.67$, $SD = .15$) and 8 folder conditions ($M = 5.71$, $SD = .15$). Analysis of the questionnaire revealed only one significant effect: the participants in the 112 idea condition ($M = 3.08$, $SD = .19$) reported feeling significantly more overwhelmed than the ones is the 28 idea condition ($M = 2.36$, $SD = .19$), $F(1, 131) = 6.87$, $p = .008$. (See Table 1.1 and 2.1)

For the number of ideas generated there was a main effect of ideas presented, $F(1, 132) = 7.07$, $p = .01$, but no effect of folders and no significant interaction. As predicted, participants exposed to 112 ideas produced significantly more ideas than those who were exposed to 28 ideas. For novelty, there was a marginal effect of ideas, $F(1, 132) = 3.17$, $p = .077$. As expected, the 112 idea condition had slightly more unique ideas than the 28 idea condition. The number of good ideas produced was measured by the number of ideas that had a rating of 3 or better for both novelty and utility. For this measure there was also a main effect for ideas, $F(1, 132) = 8.64$, $p = .004$, but no effect of folders and no significant interaction. Again, the 112 idea condition produced a significantly higher number of good ideas than the 28 idea condition. (See Table 1.1 and 2.1 for means and standard deviations)

10

Specific comparisons were used to assess the differences among the nominal and experimental conditions. The nominal condition was compared to all experimental conditions collapsed and then to each individually (example: nominal vs. 28 ideas condition or nominal vs. 4 folders condition). The 112 idea condition produced more ideas than the nominal condition, t (155) = 1.84, p = .07, but this was only marginally significant. The nominal condition generated significantly more novel ideas than the average of all of the experimental conditions, t (155) = 2.10, p = .04. In particular, individual comparisons revealed that the nominal condition had significantly more unique ideas than the 28 idea condition, t (155) = 2.61, p = 0.01, and the 4 folder condition, t (155) = 2.06, p = .04. For the number of good ideas there were no significant differences between the nominal and the experimental conditions. (See Table 3.1 for means and standard deviations of the nominal condition)

Table 3.1 Means and Standard Deviations for 28 Idea Condition

	28 Ideas			
	1 Folder	4 Folders	8 Folders	Total
Number	21.83 (7.43)	21.22 (6.80)	24.87 (13.97)	22.64 (9.93)
Novelty	3.16 (0.44)	3.10 (0.33)	3.19 (0.45)	3.15 (0.41)
Good Ideas	1.39 (1.20)	1.26 (1.36)	1.61 (1.73)	1.42 (1.43)
Perceived Exposure	24.17 (18.86)	11.35 (7.24)	8.28 (7.27)	24.59 (23.96)

Table 3.2 Means and Standard Deviations for 112 Idea Condition

	112 Ideas			
	1 Folder	4 Folders	8 Folders	Total
Number	30.87 (14.52)	27.75 (14.67)	25.64 (11.94)	28.12 (13.77)
Novelty	3.26 (0.50)	3.28 (0.42)	3.30 (0.40)	3.28 (0.44)
Good Ideas	2.70 (1.89)	2.46 (2.59)	1.77 (1.48)	2.32 (2.06)
Perceived Exposure	24.59 (23.96)	15.12 (11.59)	15.60 (10.53)	18.58 (17.07)

Table 3.3 Means and Standard Deviations for Nominal Condition

	Nominal
Number	23.00 (9.28)
Novelty	3.41 (0.37)
Good Ideas	1.88 (2.40)

CHAPTER 4

DISCUSSION

Contrary to the hypotheses, the number of folders did not influence idea generation. The number of ideas, number of good ideas, and novelty of ideas were only influenced by the number of ideas presented. This finding is consistent with previous research that the number of ideas to which a brainstormer is exposed influences idea production. When individuals are exposed to a high number of ideas, the quantity and novelty of ideas generated significantly increases compared to those who are exposed to few ideas.

Since idea exposure seems to be the underlying factor that drives increased idea generation, it would be interesting to see if there is a ceiling or optimal level that can be obtained. Previous studies have already shown that increasing idea exposure is related to increased ideation (Paulus et al., 2000; Paulus & Dugosh, 2005; Munkes & Diehl, 2003). Possibly presenting an even larger number of ideas than used in this study may lead to the overload that has been predicted with high idea exposure (Santanen et al.2004). By varying the number of ideas to and above 112, we might be able discover an optimal number for this paradigm.

We found no evidence for the negative effects of cognitive overload. The number of folders had no significant effect on idea production in terms of the number of ideas produced, novelty of ideas, and the goodness of these ideas. The condition that actually produced the most ideas was the one in which participants were exposed to 112 ideas and these ideas were not divided among any folders. Although those in the 112 idea condition reported significantly higher feelings of being overwhelmed than participants who were exposed to 28 ideas on the post task questionnaire, their average rating was a 3 (on a 7-point scale), indicating a relatively low level of feeling overwhelmed in general. Gallupe and Cooper (1993) suggest that overload can be a problem when there is a need to organize and evaluate a lot of data. Others attribute overload to having too many tasks to perform at once (McGrath and Hollingshead, 1994). In our study, participants were not required to attend to the presented ideas or

12

make judgments about them, possibly explaining the absence of overload type of effects. Since they were not specifically instructed to attend to the additional ideas and were not told that they would be performing a recognition task following brainstorming, participants may have selectively attended to ideas only when they felt a need to do so. Thus, overload may not have occurred because brainstormers might not have read many of the ideas presented to them.

Interestingly, although number of ideas generated has been found to correlate to increased novelty of ideas (Diehl & Stroebe, 1987; Taylor et al., 1958), it was those in the nominal condition that performed the best on this measure. There may be a limiting factor to working in groups. As a nominal participant you are free to submit whatever ideas come to mind and there is no interference from seeing others input. As a group member, uniqueness may decrease slightly because attending to others' contributions may promote ideation of a similar topic or path of ideation (Ziegler, Diehl, & Zijlstra, 2000). Having a large pool of stored ideas may promote directed ideation or creating clusters of ideas (Nagasundaram & Bostrom, 1995). Individuals working as a nominal have much more freedom and therefore may not succumb to the somewhat limiting effects of group collaboration.

Since number of ideas appears to play a critical role in idea generation, future research should be in the direction of evaluating the factors accompanying high idea exposure. In particular, it would be of interest to determine whether this effect is due in large part to increased competition, cognitive stimulation, or some other factor. Prior research seems to suggest that cognitive stimulation plays a critical role in idea generation. Dugosh et al. (2005) found a significant correlation between number of ideas recalled and number of ideas generated. In the present study, a recognition test was used instead of free recall. The 28 idea condition did better on the recognition task than the 112 idea condition, but this could be due to the large discrepancy between the number of ideas participants were exposed to in those conditions. Furthermore, as mentioned earlier, participants were not told beforehand that they would be completing a post brainstorming recognition test. It would be predicted that if participants were told in advance to attend to ideas because a free recall test were to follow, the participants in the 112 idea condition would perform significantly better on the recall test than the 28 idea condition in the total number of ideas recalled. It would be interesting to replicate the present study with instructions for

13

brainstormers to attend to the ideas. This would most likely increase cognitive stimulation, but the quantity of ideas generated maybe lower because it does take time to read through and process these additional ideas. Again, there may be some optimal level of idea exposure in which participants are fully able to attend to ideas but also still achieve a high rate of productivity.

Social comparison or competition among group members may promote idea generation and help to increase overall productivity (Allscheid & Cellar, 1996; Baer, Leenders, Oldham, & Vadera, 2010; Munkes & Diehl, 2003; Paulus, Larey, & Dzindolet, 2001). It is possible the increased number of ideas generated in the high idea exposure condition was due to feelings of competition. However, results of this study suggest that competition is not a critical factor in increasing idea generation. The instructions given to participants at the very beginning of the study explicitly indicated that they were not working with any other participants; rather, the computer would be presenting ideas that came from other participants who had previously participated in the study. Therefore, brainstormers knew that they would not be directly working with any other group members in a real-time fashion. They had no reason to believe their performance would be judged in comparison to students who happened to be participating at the same time. Secondly, participants did not perceive a difference in idea exposure between conditions. Feelings of competition would seem to require that participants notice how many ideas the computer was submitting and feel a need to be as productive. Yet, even with a high rate of ideas being submitted by the computer, participants did not report seeing an equally high number of ideas. It would be interesting to manipulate social comparison by telling certain participants the computer will be presenting ideas to them and telling others that the ideas will be coming from other participants who they will be working with simultaneously. It may be critical for participants to believe they are interacting with real people to induce a feeling of competition (Lount & Phillips, 2007; Parthasarathy, 2010).

Although competition does not seem to be a influencing the results, it is possible that the timed presentation of the ideas produced a motivational factor to keep up with the pace of the computer, leading to increased idea generation in the high idea exposure group. Social comparison theory suggests a matching effect in that performance tends to converge to the performance of the other group members (Dugosh & Paulus, 2005; Paulus & Brown, 2007). Participants tended to increase or decrease in

14

performance based on idea exposure, which is consistent with the results found in this study. Brainstormers in the 112 idea/1 folder condition were not only exposed to the highest number of ideas, but these ideas came at the fastest rate possible. Similarly, the concept of entrainment suggests rate of performance in one phase of a task's performance may carry over to another (Paulus & Dzindolet, 1993; Kelley, 1988). The computer's rate exposing ideas to the participants may have induced a higher rate if performance in the 112 idea condition than in the 28 idea condition.

This study has demonstrated that the effects of group size in EBS are likely related to increased exposure to a high number of ideas independent of the number of folders. Future studies will need to examine in more detail the motivational and cognitive factors that play a role in the effects of exposure to high numbers of ideas. Although increasing the number of folders did not enhance idea generation, it is possible that presenting ideas in semantically similar sets or categories may be most helpful (Coskun, Paulus, Brown, & Sherwood, 2000). This would be consistent with a cognitive perspective of collaborative ideation (Paulus & Brown, 2007). However, if rate of presentation is more influential then type of ideas (e.g., unique or common), the social competition hypothesis would gain increased support.

APPENDIX A

RECOGNITION TEST FOR 28 IDEAS CONDITON

Recognition Test(28)

The following is a list of ideas that might or might not have appeared in the idea viewing window. Please indicate "yes" if you think the idea appeared or "no" if you think that it did not. Also, please rate how confident you are in your decision.

1 = not confident, 2 = somewhat confident, 3 = very confident

	Appearance		Confidence Rating		
1. More organize school bus system	*yes*	*no*	*1*	*2*	*3*
2. More bike racks	*yes*	*no*	*1*	*2*	*3*
3. Better housing options	*yes*	*no*	*1*	*2*	*3*
4. Allow for pets in the dorms	*yes*	*no*	*1*	*2*	*3*
5. Better drainage when it rains	*yes*	*no*	*1*	*2*	*3*
6. Free private tutoring	*yes*	*no*	*1*	*2*	*3*
7. Advertise sporting events	*yes*	*no*	*1*	*2*	*3*
8. More security patrols in the park areas	*yes*	*no*	*1*	*2*	*3*
9. 24 hour access computer lab	*yes*	*no*	*1*	*2*	*3*
10. Lower prices on books	*yes*	*no*	*1*	*2*	*3*
11. More security in the parking lot	*yes*	*no*	*1*	*2*	*3*
12. Incorporate UTA with UT system more	*yes*	*no*	*1*	*2*	*3*
13. Better greek life	*yes*	*no*	*1*	*2*	*3*
14. Renovate dorms	*yes*	*no*	*1*	*2*	*3*

APPENDIX B

RECOGNITION TEST FOR 112 IDEAS CONDITON

Recognition Test(112)

The following is a list of ideas that might or might not have appeared in the idea viewing window. Please indicate "yes" if you think the idea appeared or "no" if you think that it did not. Also, please rate how confident you are in your decision.

1 = not confident, 2 = somewhat confident, 3 = very confident

	Appearance		Confidence Rating		
1. More police escorts at night	*yes*	*no*	*1*	*2*	*3*
2. More lighting at night	*yes*	*no*	*1*	*2*	*3*
3. Better drainage when it rains	*yes*	*no*	*1*	*2*	*3*
4. No smoking on campus	*yes*	*no*	*1*	*2*	*3*
5. Better lab TAs	*yes*	*no*	*1*	*2*	*3*
6. More opportunities for research participation	*yes*	*no*	*1*	*2*	*3*
7. Make UTA separate from UTD, UTSA, etc	*yes*	*no*	*1*	*2*	*3*
8. Have a recreational swimming area	*yes*	*no*	*1*	*2*	*3*
9. Allow pets in the dorms	*yes*	*no*	*1*	*2*	*3*
10. More leadership groups	*yes*	*no*	*1*	*2*	*3*
11. Free private tutoring	*yes*	*no*	*1*	*2*	*3*
12. 24 hour access computer lab	*yes*	*no*	*1*	*2*	*3*
13. Fix cell phone signal problems in library	*yes*	*no*	*1*	*2*	*3*
14. Longer dining hours	*yes*	*no*	*1*	*2*	*3*

APPENDIX C

QUESTIONNAIRE

Questionnaire

1) I looked at the ideas appearing in the idea viewing panel often.

1	2	3	4	5	6	7
strongly disagree		*neither agree nor disagree*				*strongly agree*

2) I used the ideas in the idea viewing panel to stimulate my own idea generation.

1	2	3	4	5	6	7
strongly disagree		*neither agree nor disagree*				*strongly agree*

3) When I started to run out of ideas I looked at others' ideas more.

1	2	3	4	5	6	7
strongly disagree		*neither agree nor disagree*				*strongly agree*

4) I used other's ideas more earlier in the session than later.

1	2	3	4	5	6	7
strongly disagree		*neither agree nor disagree*				*strongly agree*

5) I did not use any of the others' ideas to stimulate my own idea generation.

1	2	3	4	5	6	7
strongly disagree		*neither agree nor disagree*				*strongly agree*

6) As I received more ideas from the computer, I became overwhelmed and ignored them.

1	2	3	4	5	6	7
strongly disagree		*neither agree nor disagree*				*strongly agree*

7) Approximately how many distinct ideas do you remember seeing? _____

21

Age: _____   Gender: _____

REFERENCES

Allscheid, S. P., & Cellar, D. F. (1996). An interactive approach to work motivation: The effects of competition, rewards, and goal difficulty on task performance. *Journal of Business and Psychology, 11*(2), 219-237.

Baer, M., Leenders, R. T. A. J., Oldham, G. R., & Vadera, A. K. (2010). Win or lose the battle for creativity: The power and perils of intergroup competition. *Academy of Management Journal, 53*(4), 827-845.

Bouchard, T.J., & Hare, M. (1970). Size, performance, and potential in brainstorming groups. *Journal of Applied Psychology, 54* (1), 51-55.

Chin, W.W., Hayne, S., Licker, P. (1992). The group's consolidation problem during GSS usage: A new approach and initial empirical evidence. *Journal of Information Technology Management, 3* (2), 15-27.

Coskun, H., Paulus, P.B., Brown, V., & Sherwood, J.J. (2000). Cognitive stimulation and problem presentation in idea-generating groups. *Group Dynamics: Theory, Research, and Practice, 4* (4), 307-329.

Dennis, A.R. (1996). Information exchange and use in group decision making: You can lead a group to information, but you can't make it think. *MIS Quarterly, 20* (4), 433-457.

Dennis, A.R, & Gallupe, R.B. (1993). A history of group support systems empirical research: Lessons learned and future directions. In: Jessup, L.M., Valacich, J.S. (Eds.), *Group support systems: New perspectives*, New York: Macmillan Publishing Company.

Dennis, A.R., & Valacich, J.S. (1993). Computer brainstorms: More heads are better than one. *Journal of Applied Psychology, 78* (4), 531-537.

Dennis, A.R., & Valacich, J.S. (1999). Research note: Electronic brainstorming: Illusions and patterns of productivity. *Information Systems Research, 10* (4), 375-377.

Dennis, A.R., Williams, M.L. (2005). A meta-analysis of group size effects in electronic brainstorming: More heads are better than one. *International Journal of e-Collaboration, 1* (1), 24-42.

Derosa, D.M., Smith, C.L., Hantula, D.A. (2007). The medium matters: Mining the long-promised merit of group interaction in creative idea generation tasks in a meta-analysis of the electronic group brainstorming literature. *Computers in Human Behavior, 23* (3), 1549-1581.

Diehl, M., & Stroebe, W. (1987). Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of Personality and Social Psychology, 53*(3), 497-509.

Dugosh, K. L. (2001). Social comparison and cognitive stimulation in brainstorming. Unpublished doctoral dissertation. University of Texas at Arlington. Dugosh, K. L., & Paulus, P. B. (2005). Cognitive and social comparison processes in brainstorming. *Journal of Experimental Social Psychology, 41*(3), 313-320.

Dugosh, K.L., Paulus, P.B., Roland, E.J., & Yang, H. (2000). Cognitive stimulation in brainstorming. *Journal of Personality and Social Psychology, 79*, 722-735.

Garcia, S.M., & Tor, A. (2009). The N-effect: More competitors, less competition. *Psychological Science, 20*, 871-877.

Gallupe, R.B. & Cooper, W.H. (1993). Brainstorming electronically. *Sloan Management Review, 35* (1), 27-39.

Gallupe, R.B., Dennis, A.R., Cooper, W.H., Valacich, J.S., Bastianutti, L.M., Nunamaker, J.F. (1992). Electronic brainstorming and group size. *Academy of Management Journal, 35 (2)*, 350-369.

Grise, M., & Gallupe, R.B. (2000). Information overload: Addressing the productivity paradox in face-to-face electronic meetings. *Journal of Management Information Systems, 16*, 157-185.

Kelly, J.R. (1988). Entrainment in individual and group behavior. In J. E. McGrath (Ed.), *The social psychology of time: New perspectives* (pp. 89-110). Newbury Park, CA: Sage.

Lamm, H., & Tromsdorff, G. (1973). Group versus individual performance on task requiring ideational proficiency (brainstorming): A review. *European Journal of Social Psychology, 3*, 361-387.

Lount, R.B. Jr., & Phillips, K.W. (2007). Working harder with the out-group: The impact of social category diversity on motivation gains. *Organizational Behavior and Human Decision Processes, 103* (2), 214-224.

McGarth, J.E., & Hollingshead, A.B. (1994). *Groups interacting with technology: Ideas, evidence, issues, and an agenda.* Thousand Oaks, CA: Sage Publications.

Mullen, B., Johnson, C., & Salas, E. (1991). Productivity loss in brainstorming groups: A meta-analytic integration. *Basic and Applied Social Psychology, 12,* 3-24.

Munkes, J., & Diehl, M. (2003). Matching or competition? Performance comparison processes in an idea generation task. *Group Processes & Intergroup Relations, 6* (3), 305-320.

Nagasundaram, M., & Bostrom, R.P. (1995). The structuring of creative processes using GSS: A framework for research. *Journal of Management Information Systems, 11* (3), 89-116.

Nagasundaram, M., & Dennis, A.R. (1993). When a group is not a group: The cognitive foundation of group idea generation. *Small Group Research, 24*, 463-489.

Osborn, A.F. (1957). *Applied imagination: Principles and procedures of creative thinking*, New York: Scribner.

Parthasarathy, N. (2010). Ingroup and outgroup members as determinants of performance on a brainstorming task. Unpublished doctoral dissertation. University of Texas at Arlington.

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

Paulus, P.B., Brown, V.R. (2007). Toward more creative and innovative group idea generation: A cognitive-social-motivational perspective of brainstorming. *Social and Personality Psychology Compass, 1* (1), 248-265.

Paulus, P. B., & Coskun, H. (In press). Group creativity. In J. M. Levine (Ed.), *Group processes.* Psychology Press

Paulus, P.B., & Dzindolet, M.T. (1993). Social influence processes in group brainstorming. *Journal of Personality and Social Psychology, 64* (4), 575-586.

Paulus, P. B., Larey, T. S., & Dzindolet, M. T. (2001). Creativity in groups and teams. In M. E. Turner (Ed.), *Groups at work: Theory and research.* (pp. 319-338). Mahwah, NJ US: Lawrence Erlbaum Associates Publishers.

Paulus, P. B., Larey, T. S., Putman, V. L., Leggett, K. L., & Roland, E. J. (1996). Social influence processes in computer brainstorming. *Basic and Applied Social Psychology*, 18 (1), 3-14.

Paulus, P.B., & Yang, H. (2000). Idea generation if groups: A basis for creativity in organizations. *Organizational Behavior and Human Decision Processes, 82*, 76-87.

Pinsonneault, A., & Barki, H. (1999). The illusion of electronic brainstorming productivity: Theoretical and empirical issues. *Information Systems Research, 10* (4), 378-382.

Pinsonneault, A., Barki, H., Gallupe, R.B., & Hoppen, N. (1999). Research Note: The illusion of electronic brainstorming productivity: Theoretical and empirical issues. *Information Systems Research, 10* (4), 378-380.

Santanen, E.L., Briggs, R.O., & de Vreede, G. (2004). Causal relationship in creative problem solving: Comparing facilitation interventions for Ideation. *Journal of Management Information Systems, 20* (4), 167-197.

Taylor, D.W., Berry, P.C., & Block, C.H. (1958). Does group participation when using brainstorming facilitate or inhibit creative thinking? *Administrative Science Quarterly, 3*, 23-47.

Valacich, J.S., Dennis, A.R., & Connolly, T. (1994). Idea generation in computer-based groups: A new ending to an old story. *Organizational Behavior and Human Decision Processes, 57* (3), 448-467.

Ziegler, R., Diehl, M., & Zijlstra, G. (2000). Idea production in nominal and virtual groups: Does computer mediated communication improve group brainstorming? *Group Processes & Intergroup Relations, 3* (2), 141-158.

BIOGRAPHICAL INFORMATION

Lauren Arditti graduated from Texas A&M University where she received a bachelor's of science in psychology. She is currently attending graduate school at the University of Texas at Arlington. Lauren has been working under the guidance of Dr. Paul B. Paulus in his research laboratory. She has worked on a number of successful projects assessing group collaboration and creative ideation. Her work on a study examining the effects of varying instruction rules on brainstorming entitled "Effects of Quantity and Quality Instructions on Brainstorming" has already been accepted for publication in the *Journal of Creative Behavior*. Lauren Arditti plans on graduating with a master's of science in health psychology in May 2011 and continuing her education thereafter.