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Major professor

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THE EFFECTS OF PROCEDURE, PRIMING, AND PEERS ON BRAINSTORMING

By

Kenneth Joshua Levine

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ABSTRACT

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By

Kenneth Joshua Levine

Brainstorming has been tested in the laboratory for over 30 years, yet differences in brainstorming experience exist between the subjects in these past experiments and brainstormers in organizational and other non-experimental settings. Three types of brainstorming experience were identified: a history with the procedure through training; a history with the problem through priming; and a history with the group members through subject-intact peer groups. Providing brainstorming participants with a history of procedure, priming, and peers may help to reduce or eliminate the problems associated with process loss within interacting groups that may explain why nominal groups have outperformed brainstorming groups in previous studies. This study looked for main effects of these three types of experience, using the number of ideas generated as the dependent variable.

This study employed a 3 x 2 x 2 x 3 mixed design to compare the generation of creative ideas in nominal, traditional (zero-history) and subject-intact groups. Members of these groups were either trained or not trained in the brainstorming process, and primed or not primed with

the problem to be discussed. All groups met once a week for three weeks.

While data was not consistent with the hypotheses, training increased the level of productivity of the traditional groups to that of the nominal groups. Further, investigation into process variables has provided a better understanding of the process loss through production blocking that is associated with brainstorming groups.

To my Parents

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INTRODUCTION AND LITERATURE REVIEW

Overview

In 1953, Alex Osborn first published Applied imagination, principles and procedures of creative problem solving, where he documented the use of brainstorming, a creative idea generation technique used within industry. In the past four decades this technique has permeated the culture, and people now routinely engage in brainstorming. In the business community there is a widely held belief in the effectiveness of this idea generation technique, and participation in a brainstorming group seems to have a positive effect on employee morale.

Shortly after the publication of Osborn's book, researchers in the social sciences sought to document empirically both the effectiveness and efficiency of this technique. These brainstorming studies have found that idea generation groups produce fewer ideas, both in quantity and quality, than would be produced by the same number of people working alone on the same task.

Researchers suggest that the major cause of process loss in brainstorming groups is production blocking (Diehl & Stroebe 1987, 1992). Production blocking is defined as the

decrease ideation that results from only one person being able to speak at any given time during a group encounter. Diehl & Stroebe believe that persons waiting their turn to speak may either forget their own generated idea, or "suppress [the ideas] because they seem less relevant or less original at a later time" (Diehl & Stroebe, 1987, p. 498). Also, there is the possibility that some subjects cannot simultaneously listen and invent ideas.

This study proposes to examine previously untested features of experience which may reduce the process loss discussed above. The three types of experience under investigation are: (1) giving the participants in the study experience in the brainstorming procedure through training (2) giving the participants experience with the problem though providing the problem before the brainstorming session and (3) giving the participants experience with the group's members by working together over time. It is believed that these three experience variables will decrease process loss, and improve the output of brainstorming groups to a level equal to or greater than nominal groups.

Introduction

Osborn (1953, 1963) observed that people engaged in the task of creative idea generation produced a greater number of ideas when working together in groups than when working individually. Beginning in 1938, Osborn routinely employed brainstorming groups to maximize idea generation effectiveness. These groups were defined as "nothing more

than a creative conference for the sole purpose of producing a checklist of ideas - ideas which can serve as leads to problem-solution - ideas which can *subsequently* be evaluated and further processed" (Osborn, 1963, p. 151-152). Brainstorming remains a common practice throughout the business, social, and academic communities as a technique for groups to produce a list of creative alternatives to a given problem.

For Osborn, brainstorming was the best method available to spur creativity. To substantiate his claims and beliefs in the brainstorming process, he observed several industries which typically employed the technique, including his advertising firm, one of the nation's largest. Therefore, it is likely that the individuals Osborn observed had a unique familiarity with brainstorming by virtue of: (1) their experience in the activity of brainstorming, (2) their knowledge of the actual problem needing attention before beginning the task, and (3) their experience brainstorming with the same group of people. It is possible that these three factors played a major role in the success of Osborn's brainstorming groups, and as such, a proper investigation of brainstorming must include groups with similar characteristics.

Osborn proposed two basic principles to guide groups engaged in brainstorming: (1) that all judgment on ideas be deferred until a later time, and (2) that an increase in the quantity of available ideas would have the effect of

enhancing the quality of ideas from which the ultimate solution would be selected. To implement these principles, he developed four rules for brainstormers to follow in order to enhance idea generation. These rules specify that: (1) none of the ideas are to be evaluated during the idea generation session, (2) that group members should generate as many ideas as possible, (3) all ideas, including those that might be considered wild or off-the-wall, should be shared with the group, and (4) members are encouraged to piggy-back, or use another's ideas as a springboard for new suggestions. Osborn believed that piggybacking was the most important, as "it may transform mediocre ideas into sterling ideas" (Osborn, 1963, p. 158).

Osborn noted that it is important to distinguish between brainstorming and decision making, because the purpose of the brainstorming process is to generate as many solutions to the problem as possible. The final decision comes from discussing and evaluating the proposed solutions, and typically occurs at a later time. It is essential to instruct brainstorming participants to separate brainstorming from decision making in order for them to be able to concentrate on maximizing idea generation.

Beginning with Taylor, Berry, and Block (1958), studies have compared the effectiveness of brainstorming groups with nominal groups, collections of the unique ideas generated by individuals working alone and then combined for purposes of comparison. Despite Osborn's observations, and the use of

his rules by groups involved in the brainstorming process, the studies and reviews from the past 40 years have reported that brainstorming groups are relatively ineffective (e.g., Bouchard, 1969, 1972a, 1972b; Bouchard & Hare, 1970; Campbell, 1968; Dunnette, 1964; Dunnette, Campbell, & Jaasted, 1963; Dillon, Graham, & Aidells, 1972; Lamm & Trommsdorff, 1973; Milton, 1965; Madsen & Finger, 1978; Mullen, Johnson, & Salas, 1991; Paulus, Larey, & Ortega, 1995; Rotter & Portugal, 1969; Taylor, Berry, & Block, 1958; Stroebe & Diehl 1988, 1993).

Lamm and Trommsdorff (1972) wrote a review of the brainstorming literature and reported that in nine out of twelve early experiments, nominal groups were able to come up with more non-duplicative ideas than were brainstorming groups. The remaining three studies, all examining groups with only 2 members, found that the interactive groups performed only as well as the nominal groups, never better.

Steiner (1972) discussed the issue of group effectiveness and posited that the actual productivity of any group is its potential productivity minus its process loss. Process loss can be divided into two categories, motivational loss, which refers to the individual's incentive to contribute to the process, and coordination loss, which refers to the way in which available resources are coordinated to complete the task. For purposes of this discussion, the focus will be on coordination loss, as the causes and potential solutions to motivation loss are beyond

the scope of this inquiry. Lamm and Trommsdorff (1972) suggested that possible reasons for process loss in brainstorming groups include the fear of criticism, inadequate time for the interacting groups to work together, and too much spent time on irrelevant tasks.

A recent meta-analysis of the brainstorming literature by Mullen, Johnson, and Salas (1991) confirms that, on average, brainstorming groups generate substantially fewer unique ideas than do nominal groups. Mullen et al. suggested that the reason for the lack of ideas generated in brainstorming groups centers on three mechanisms: economic, procedural, and social psychological.

One example of an economic mechanism is social loafing, which posits that individuals are less inclined to work as hard in a group setting as when working alone (Harkins & Szymanski, 1989). Diehl and Stroebe's (1987) research into this mechanism has suggested little evidence for its role in the poor performance of brainstorming groups.

The most commonly studied procedural mechanism for productivity loss in brainstorming groups is production blocking. Lamm and Trommsdorff (1972) believed that lower output from brainstorming groups resulted from only permitting one member of the group to speak at a time. Diehl and Stroebe (1987) expanded this idea, suggesting:

> that group members who are prohibited from verbalizing their ideas as they occur, may forget or suppress them because they seem less relevant

> or less original at a later time. Finally, being forced to listen to the ideas of other group members may prove distractive and interfere with the subject's own thinking. (p. 498)

One of the social psychological mechanisms which may reduce the effectiveness of brainstorming groups is social facilitation. This group process has seldom been invoked to explain the relative ineffectiveness of brainstorming groups, although Bond and Van Leeuwen (1991) suggest that it may be of substantial importance.

Social Facilitation Theory

In the Drive Model of Social Facilitation Zajonc (1965) proposed that because people are at a higher state of drive when they are in the presence of others, whether the others are co-actors, audiences, or just bystanders, they will increase the speed, strength, and probability of performing the dominant response to a specific task. A dominant response is defined as a habitual act. Zajonc believed that persons in the presence of others will perform dominant tasks better, and novel tasks worse than if they were working alone. Therefore, whether the activity will be performed well in a group setting is directly related to each individual's experience with the activity.

The application of this model to the brainstorming process was initially proposed by Osborn. He suggested that "free associations on the part of adults are from 65 to 93 percent more numerous in group activity than when working

alone" (p.154). Thus, Osborn realized that experience working with others and with the procedure should help facilitate performance for brainstorming groups. Therefore, this model may be one of the underlying explanations why brainstorming was effective for Osborn and not for others.

Although most researchers agree on the lack of empirical evidence to support Osborn's claims, industry has a strong belief in the effectiveness of brainstorming groups. Stroebe and Diehl (1993) explain this continued support of the group process by suggesting that managers vastly overestimate the ideas that come from involvement in group settings. Also, Stroebe and Diehl suggest that because nominal groups may be used infrequently in business, these organizational leaders lack the baseline information available from nominal groups that would assist in comparing the difference in output between the two types of groups.

There may be other reasons why the litany of brainstorming studies performed to date have been unable to replicate Osborn's findings[1]. As mentioned above, Osborn's groups differed from most of the studies' samples on 3 types of experience, procedure, priming and peers.

Experience with the Procedure through Training

Few studies have assessed the effect of training on brainstorming performance. One early study, Cohen, Whitmyre, and Funk (1960), studied groups of hospital administrators and nurses. The administrators were exposed to 10 hours of creative thinking courses; whereas the nurses

were asked to participate in idea generation sessions without training. Cohen et al. found that highly cohesive trained dyadic groups generated more ideas than their untrained counterparts, but only when working on ego-involving problems.

Dillon, Graham, and Aidells (1972) examined the effectiveness of a training videotape on group brainstorming productivity. After viewing the four minute training videotape, subjects were instructed in Osborn's four brainstorming rules. The four person groups then worked for 10 minutes, had their ideas and materials collected, and then worked for an additional 25 minutes on the same problem.

There was a significant main effect for training, but in the opposite direction than was expected, suggesting that training attenuated productivity. The authors speculated that watching a perfect brainstorming group on the videotape had the effect of intimidating the group members, producing expectations of future failure. They concluded that the results for training "might have been quite different had the videotape focused on errors and common violations of the brainstorming rules rather the perfect performance" (p. 489-490).

Bouchard (1972a) examined the effects of training, motivation, and group composition on brainstorming. The researcher believed that using zero-history groups did not properly simulate the conditions found in business and

industry, and he expected that using groups whose members knew each other would increase motivation. The study examined the productivity of four man groups and varied motivation by including or not including a reward for the best group performance. The training induction was communicated via a tape recorded message.

The subjects were divided into groups according to their interpersonal effectiveness, determined by an individual's scores on a series of personality tests. During the session participants took turns presenting their ideas to the group, and were required to either generate an idea or pass when their turn arrived. The groups met four times over a two week period, and knew that their performance would be compared to that of untrained groups.

For the subjects scoring high in interpersonal effectiveness, an interaction of training with motivation was found, ($F(1,22) = 9.34$, $p < .01$). When interpersonal effectiveness was low, there was a significant main effect for nominal groups, again outperforming the interactive groups ($F(1,22) = 12.61$ $p < .01$). Bouchard was encouraged that there was a reduction in the difference between the output of nominal and traditional groups. He attributed this finding to the unique requirement in the brainstorming session where the participants either made a contribution of a creative idea or passed when their turn arrived.

Meadow and Parnes (1959) found that trained brainstorming groups outperformed untrained groups, however,

there was no comparison to nominal groups. The subjects were enrolled in a university-level problem solving course, with the untrained session being administered at the beginning of the term, and the trained session at the term's end.

Other researchers have used practice in the brainstorming task as another type of training induction (Dillon, Graham & Aidells, 1972; Graham & Dillon, 1974; Rotter & Portugal, 1969) Subjects in Rotter and Portugal's (1969) study all began with a practice session, either as part of a group or individually. Following the practice period, the subjects participated in another brainstorming session, with some subjects staying in their first experimental condition (group or alone), while the others generated ideas in the alternative condition. The participants in the individual condition outperformed the groups, even when the group members had practiced the brainstorming task as an individual.

Graham and Dillon (1974) investigated the stability and reliability of individual brainstorming performance over time. Based upon the subjects' performance during a practice session, the researcher placed the top performers into brainstorming supergroups and the other subjects into low achiever groups. These groups were then compared to brainstorming groups from prior published studies. The supergroups were found to be superior to all other groups tested, both in this and past studies.

The Graham and Dillon study lacks internal validity as each of the prior experiments used for comparison utilized a different length of time to generate ideas. Whether this difference in time allotment was considered in determining the results was not reported. Despite this problem, it is possible to reinterpret these results for the present inquiry as an indication that training and\or practice may play a role in brainstorming effectiveness.

In sum, whether the researchers induced training or practice, nominal groups generated more ideas than did interactive groups. In Cohen et al. was there an indication that under certain conditions, trained groups would produce as many ideas as individuals, and in both Meadow and Parnes (1959) and Parnes and Meadow (1959) there was the finding that trained groups outperformed untrained groups. Nevertheless, there are theoretical reasons to believe that effective training or adequate practice or both could lead brainstorming group performance to exceed nominal group performance.

For example, social facilitation effects would suggest that experience with the procedure should improve brainstorming group performance. Zajonc (1965) proposed that because people are at a higher state of arousal when they are in the presence of others, they will increase the speed, strength, and probability of performing the dominant response to a specific task. When a task is not well-learned, increasing arousal impairs task performance because

effective responses have not yet become dominant. Therefore, the likelihood that the activity will be performed well in a group setting is directly related to each individual's experience with the task.

It follows that if a person is not experienced with brainstorming, it would be considered a complex task. Thus the heightened arousal brought about by the presence of other group members should cause the activity to be performed less well. For people who participate in idea generation groups often, brainstorming is a simple task, and these people will be able to perform better in groups than alone.

> Hypothesis #1: Training in the specialized procedures of creative idea generation before engaging in a group idea generation task will produce an increase in the number of ideas generated by the trained groups compared with both untrained groups and nominal groups.

Experience with the Problem through Priming

Although instructional pieces in popular publications often advance the idea of priming, the act of pre-directing the subject's thoughts to a particular problem to promote output has not been tested specifically in past brainstorming studies (Hurt, 1994; Thiagarajan, 1991). Hurt suggests that to improve output, all participants should be sent "a copy of the problem statement a few days before the brainstorming session. Don't send it more than one week in

advance; people tend to forget the topic and lose enthusiasm" (Hurt, 1994, pg. 57-58).

Studies looking at the differences between brainstorming experts and novices peripherally address the priming issue. Brainstorming experts are better able to verbalize the reasons for their ideas (Renner & Renner, 1993). Novices spend more time searching for an approach to the problem, display little concern for efficiency, and work more slowly than do experts (Bookman, 1992). It would follow that prior knowledge of the problem would facilitate the individual's ability to verbalize creative ideas. Without this prior knowledge brainstormers would spend the beginning of the sessions attempting to understand the problem, thus taking time away from the idea generation process. Therefore, if members of the brainstorming groups have the experience of knowing the problem being discussed in advance of the session, they should be able to produce and verbalize their ideas better than those group members without the prior knowledge of the topic to be discussed.

The social facilitation effect provides a theoretical justification for this hypothesis. Priming serves to make the task simple for participants. Subsequently, the arousal experienced by working with others, contrasted with working alone, should promote task performance (Baron, 1986; Baron, Moore & Sanders, 1978)

Hypothesis #2: Group members who know the problem before beginning the group brainstorming task will generate a larger number of creative ideas than groups in which the idea is only given to them at the beginning of the session.

Experience with Peers through Subject-Intact Groups

Few studies have had the participants brainstorm on more than one occasion. Jablin, Seibold, and Sorenson (1977) created brainstorming groups with a history of interaction by assigning the subjects to work together on a class assignment for 6 hours before the experimental session. Zero-history groups and nominal groups were used for comparison. The nominal groups did not significantly outperform the interacting groups and no difference was found between the history and zero-history groups.

Two other studies, Dunnette, Campbell and Jaastad (1963) and Campbell (1968) created both history and zero-history groups. However, there was no comparison of performance between the different group conditions. Bouchard (1972a) had the subjects brainstorm over time, but did not measure the differences in output between the different time periods.

The social facilitation effect would suggest that continued experience with group members might facilitate performance of the group members over time, by reducing anxiety in the history groups. A history of interaction might also improve the coordination between the group

members, suggesting fewer interruptions and an understanding of the work habits of the other participants. These outcomes could reduce the potential effects of production blocking, as the members would know how to work together and have members both listen and generate ideas at the same time.

Therefore, the experience of working with a particular group of people over time should have the effect of improving the final output. This should result in brainstorming groups with peer experience outperforming the groups without peer-experience as well as nominal groups.

> Hypothesis #3: Permitting a brainstorming group to establish a history of working together while simultaneously engaging in the brainstorming task will increase the number of ideas generated over a group with no history of interaction.

Conclusion

In conclusion, the effect of these three types of experience (procedure, priming and peers) on subjects, should permit Osborn's findings to be replicated. Varying these factors may overcome the process loss associated with groups and insure that large numbers of creative ideas are generated during group interaction.

Chapter 2

METHODS

Subjects

Participants were recruited from undergraduate classes in communication, telecommunication, advertising, social psychology, and billiards at Michigan State University. All subjects were given extra credit for their participation. The subjects were told that the focus of the experiment was creative idea generation, and that to get credit they would have to attend three sessions, once a week for three weeks at the same hour.

Design

The study employed a 3 x 2 x 2 x 3 mixed design. Participants were assigned to one of the three independent groups procedure conditions: (1) nominal groups, (2) traditional brainstorming groups (zero-history), or (3) subject-intact brainstorming groups. Members of the different group types were then either trained or untrained and primed or unprimed. Within each of these conditions, all subjects met for 3 separate brainstorming sessions. The first three factors were independent groups factors, and the fourth factor was a repeated measure.

Instrumentation

A pretest was completed by all participants at the beginning of the first session. Items were designed to determine subjects' familiarity and experience with the brainstorming process. Those subjects indicating brainstorming experience were asked the number of times that they had brainstormed and in what context the activity took place. The subjects were also asked to list members of the class with whom they had worked previously on a group project or assignment. Last, the pretest included a series of demographic questions, including age, sex, year in school, and major.

The order of the problems used in the three brainstorming sessions was randomized. Groups were given three of the four selected questions over the course of the experiment. The four questions used were: (1) *Fame and Immortality* - How can the average person achieve fame and immortality in his/her own lifetime? (2) *Parking* - A committee has formed to discuss ways to revamp the parking regulations here on campus. What ideas would you suggest to the Department of Public Safety on this subject? (3) *Dorms* - Michigan State University is looking for ways to persuade students to remain in the residence halls for their junior and senior years. What ideas can you suggest to the Administration to accomplish this task? and (4) *Election* - The City of East Lansing is about to elect new members to its city council. As students at Michigan State University,

what issues would you like to bring to the attention of these new council members?

For the fame question the groups produced a mean of 41.34 ideas with a standard deviation of 15.01. The parking questions produced 21.74 ideas on average with a standard deviation of 8.74. The dorm problem generated a mean of 32.77 ideas with a standard deviation of 13.50, and the election problem resulted in a mean of 18.33 ideas with a standard deviation of 5.57.

The generated ideas from the traditional and subject-intact groups were transcribed and counted. To create the nominal groups, ideas from three individuals within a condition were randomly combined by question order, and the number of unique ideas generated became the dependent measure. The four different problems produced a varied numbers of ideas, so the number of generated ideas for each group was standardized by converting it to a z-score.

Procedure

All participants for a given time period entered the laboratory together, regardless of experimental condition. The detailed training session occurred in a large room within the laboratory, which also served as one of the two brainstorming rooms. In each of the rooms where the groups interacted there were four desks set aside in a circle facing each other. There were no materials for the participants on three of the desks, and the fourth desk was used to hold the tape recorder. The videotape equipment was

hidden from view. The subjects in the nominal condition were placed into an empty classroom for their sessions.

There were three facilitators used during this experiment. The primary investigator trained the facilitators to perform all duties for each of the different conditions. During any one session subjects could be exposed to one, two, or all three facilitators.

Group Type Induction

The traditional and subject-intact groups included three members. At the first meeting, using information from the pretest screening, the subjects were placed into groups of strangers. The groups were assigned randomly to training and priming treatment conditions. For the traditional brainstorming groups the subjects were placed with different non-acquaintance group members at every session, whereas subject membership in the intact brainstorming groups remained constant throughout the experiment.

Across all conditions the subjects participated in three, 10 minute brainstorming sessions. The traditional and subject-intact groups used a tape recorder to record all ideas. The nominal groups used pencil and paper to record their ideas and did not interact during the actual sessions.

Training Induction

Approximately one-half of the participants were given training in brainstorming at the beginning of each of their three meetings. The training induction consisted of three parts; Osborn's rules, the brainstorming technique, and a

post-session discussion and review. The facilitator began all training sessions began with detailed instructions using Osborn's four brainstorming rules. These instructions included explanation of the rules, including definitions of evaluation and piggybacking.

At time 1 the groups/individuals watched a facilitator engage in a scripted simulation of a brainstorming session using the "thumbs" problem. A copy of the facilitator's script can be found in Appendix C. At time 2 the subjects watched a videotape of the primary investigator detailing the four rules and discussing the output of another scripted brainstorming session, this time using the "tourist" problem. A copy of the script can be found in Appendix D. For time 3 a videotape of three undergraduate students engaged in a 10 minute brainstorming session was viewed, after which the facilitator engaged the subjects in a critique of the videotaped session.

After the training was completed the groups/individuals were given 10 minutes to engage in the idea generation task. In the third part of the training, the facilitator reviewed the ideas which had been generated by the subjects. During this discussion, the facilitator was trained to point out or ask for ideas that were a product of "piggy-backing," and asked the participants to identify any self-evaluation and production blocking which may have inhibited the production of ideas. Also, the facilitator asked the subjects for any ideas that they had not offered to the group, and then

discussed the importance of contributing all ideas during the brainstorming session in order to assemble the best possible list of creative ideas.

The no training group was simply read the four brainstorming rules at the beginning of each session. They did not receive the detailed explanation, see the brainstorming simulations, or receive the detailed instructions and debriefing feedback.

Priming Induction

Approximately one-half of the participants were given the problem to think about before they engaged in their brainstorming sessions. At the first session the members were given the problem when they arrived at the laboratory and before completing the pretest or entering the brainstorming rooms. All of these groups were then intentionally delayed from beginning the sessions for 5 minutes, thus giving the subjects time to think about the problem before beginning the idea generation task. At the conclusion of both the first and second sessions the problem for the next meeting was given to the participants by the facilitator, with specific instructions to think about the problem before the next meeting. If the groups were both trained and primed at time 1, the priming occurred before the training.

There was considerable attrition in all three group type conditions. For the nominal and subject-intact groups the results only include groups in which all three subjects

participated in each of the three sessions. For the traditional groups, all 3-member groups were included in the analysis, but as a result of the large attrition at each time period there are more data for time 1 than for time 2 or time 3.

The audiotapes and videotapes were reviewed and coded twice. Initially the tapes were coded to identify the number of ideas generated, and the second coding identified a series of procedural variables subsequently used as a test of the training induction. The intercoder reliability coefficient was $k = .74$. All conflicts in coding were resolved through conversation between the coders.

Chapter 3

RESULTS

Primary Analysis

A three-way analysis of variance was calculated to measure the effect of priming, training, and group type on the number of ideas generated for each of the three points in time. As cell sizes were unequal, an unweighted means analysis was employed. Table 1 displays the means, standard deviations and cell sizes for this analysis.

For time 1 there was a statistically significant main effect for group type ($F(2,103) = 4.236$, $p=.017$, $n^2=.01$, $r=.09$), and a main effect for training that approached significance ($F(1,103) = 2.843$, $p=.095$, $n^2=.009$, $r=.09$). There were no statistically significant two-way interactions between the factors at this time period, but the interactions for training with group type ($F(2,103) = 2.610$. $p=.078$) and priming with group type ($F(2,103) = 2.135$, $p=.093$) were close to conventional levels of statistical significance. No three-way interaction was found.

The marginal means are based on the standardized scores for the number of ideas generated. Thus, a negative score indicates that the group produced a lower number of ideas than the average group on the particular problem in

question. The means for group type revealed that nominal groups produced the highest number of ideas (.36), followed by traditional groups (-.10) and subject-intact groups (-.27). At the .05 level of significance, the two-tailed Student-Newman-Kuels test reveals that the nominal groups produced a significantly greater number of ideas than the traditional or subject-intact groups. The traditional and subject-intact groups did not differ significantly from each other.

Trained groups outperformed untrained groups (trained = .17; untrained = -.15) respectively. The training by group type interaction indicated that training had no impact on performance in nominal groups, (untrained = .46; trained = .26, $t(32) = .50$, $p > .05$, Student-Newman-Kuels two-tailed test) and no impact on subject-intact groups (subject-intact trained = -.07, subject-intact untrained = -.43, $t(32) = -1.33$, $p > .05$, Student-Newman-Kuels two-tailed test). Training aided in the idea generation process for the traditional group type (traditional trained = .29, traditional untrained = -.35, $t(45) = -2.17$, $p < .05$, Student-Newman-Kuels two-tailed test).

Priming decreased nominal group productivity at a rate approaching conventional levels of significance (primed = .01; unprimed = .72, $t(32) = 1.86$, $p = .073$, Student-Newman-Kuels two-tailed test). There was no impact on either subject-intact group productivity (primed = -.49, unprimed = -.14, $t(32) = 1.45$, $p > .05$, Student-Newman-Kuels two-tailed

test) or traditional groups (primed = .00; unprimed = -.28, $t(45) = -.89$, $p > .05$, Student-Newman-Kuels two-tailed test). The analysis of variance table for these data are listed in Table 2.

At time 2 there were no significant main effects, Student-Newman-Kuels two-way interactions or three-way interactions. At a significance level of $p=.10$, there would be two main effects, training ($F(1,95) = 3.528$, $p=.063$, $n^2=.08$, $r=.29$), and group type ($F(2,95) = 2.610$, $p=.079$, $n^2=.04$, $r=.10$). The marginal means for group type again found that nominal groups produced the significantly highest number of ideas (.36), than either traditional groups (.00) and subject-intact groups (-.14), however there was no difference between the traditional and subject-intact groups (Student-Newman-Kuels, $p <.05$). Trained groups outperformed untrained groups (trained = .24; untrained = -.13). The training by group type interaction, while not statistically significant at conventional levels, is interesting as it indicated that training had no effect on nominal groups (trained and untrained = .36, $t(32) = 0.00$, $p > .05$, Student-Newman-Kuels two-tailed test), or subject-intact groups (trained = .09, untrained = -.32, $t(32) = -1.14$, $p > .05$, Student-Newman-Kuels two-tailed test), but aided traditional groups (trained = .26, untrained = -.37, $t(37) = -2.36$, $p < .05$, Student-Newman-Kuels two-tailed test). The results of the analysis of variance performed on these data are listed in Table 3.

At time 3 there was a main effect for group type, ($F(2,87) = 8.258$, $p=.001$, $n^2=.024$, $r=.16$) which was superseded by two two-way interactions, training by group type ($F(2,87) = 4.261$, $p=.017$), and priming by group type ($F(,87) = 4.939$, $p=.009$). There was no three-way interaction.

For the group type main effect, nominal groups produced a significantly greater number of ideas (.44) than the traditional groups (-.08, Student-Newman-Kuels $p < .05$) and the traditional groups produced a significantly higher number of ideas (-.08) than the subject-intact groups (-.31, Student-Newman-Kuels $p < .05$). The training by group type interaction indicates that training had no effect on nominal groups (trained = .27, untrained = .58, $t(32) = .92$, $p > .05$), and subject-intact groups (trained = -.18, untrained = -.42, $t(32) = -.96$, $p > .05$, Student-Newman-Kuels two-tailed test) but aided the traditional groups (trained = .34, untrained = -.35, $t(29) = -2.50$, $p < .05$, Student-Newman-Kuels two-tailed test). The priming by group type interaction demonstrated that priming significantly hurt the nominal (primed = .01; unprimed = .86, $t(32) = 2.79$, $p < .05$, Student-Newman-Kuels two-tailed test) and had no effect on the traditional groups (primed = -.10, unprimed = -.05, $t(29) = .15$, $p > .05$, Student-Newman-Kuels two-tailed test) or subject-intact groups (primed = -.13; unprimed = -.43, $t(32) = -1.12$, $p > .05$, Student-Newman-Kuels two-tailed test). The results of the analysis of variance performed on

these data are listed in Table 4.

TABLE 1
Cell Means, Standard Deviations and Cell Sizes for Total Number of Ideas Generated.

			Time 1		Time 2		Time 3	
			No Priming	Priming	No Priming	Priming	No Priming	Priming
Subject-Intact	Training	means	.20	-60	.27	-.27	-.08	-.38
		st dev.	.90	.78	1.26	.64	.68	.45
		N	10	05	10	05	10	05
	No Training	means.	-.44	-.42	-.52	-.06	-.74	.03
		st.dev.	.67	.49	.79	1.16	.54	.95
		N	11	08	11	08	11	08
Traditional Groups	Training	means	.40	.24	.10	.36	.38	.32
		st.dev.	1.66	.78	.86	.65	.82	.81
		N	06	12	06	10	04	08
	No Training	means	-.66	-.16	-.83	-.06	-.27	-.40
		st.dev.	.55	.85	.44	1.06	.90	.57
		N	11	18	09	14	08	11
Nominal Groups	Training	means	.59	-.15	.54	.13	.66	-.22
		st. dev.	.59	.46	1.45	1.13	1.00	.52
		N	09	07	09	07	09	07
	No Training	means.	.87	.13	.46	.29	1.10	.17
		st.dev.	1.22	1.62	.84	.99	.82	1.02
		N	08	10	08	10	08	10

TABLE 2
Anova Table for Time 1

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	4	2.816	3.213	.016		
TRAINING	1	2.491	2.843	.095	.02	.15
PRIMING	1	1.075	1.226	.271	.009	.10
GROUP TYPE	2	3.712	4.236	.017		
Linear	1	1.692	7.400	.007	.01	.12
Deviation	1	0.630	0.670	.410	.005	.07
2-way Interactions	5	2.000	2.282	.052	.01	.12
TRAINING PRIMING	1	1.577	1.800	.183	.02	
TRAINING TYPE	2	2.287	2.610	.078	.02	
PRIMING TYPE	2	2.135	2.436	.093		
3-way Interactions	2	.392	.448	.640	.003	
TRAINING-PRIMING-GROUP TYPE	2	.392	.448	.640		
Explained	11	2.004	2.287	.015		
Residual	103	.876				
Total	114	.985				

TABLE 3
Anova Table for Time 2

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	4	2.344	2.367	.058		
TRAINING	1	3.494	3.528	.063	.03	.18
PRIMING	1	.474	.478	.491	.00	.06
TYPE	2	2.585	2.610	.079		
Linear	1	4.360	4.300	.040	.04	.20
Deviation	1	1.190	1.170	.280	.01	.10
2-way Interactions	5	1.392	1.405	.229		
TRAINING PRIMING	1	2.044	2.064	.154	.02	.14
TRAINING TYPE	2	1.145	1.156	.319	.01	
PRIMING TYPE	2	1.479	1.493	.230	.01	
3-way Interactions	2	.300	.303	.740		
TRAINING PRIMING TYPE	2	.300	.303	.740	.00	
Explained	11	1.540	1.555	.125		
Residual	95	.990				
Total	106	1.047				

TABLE 4
Anova Table for Time 3

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	4	2.954	4.804	.002		
TRAINING	1	.728	1.183	.280	.00	.10
PRIMING	1	1.036	1.685	.198	.01	.12
TYPE	2	5.078	8.258	.001		
Linear	1	1.953	13.41	.0004	.02	.16
Deviation	1	1.4370	0.610	.43	.02	.14
2-way Interactions	5	2.246	3.652	.005		
TRAINING PRIMING	1	.606	.985	.324	.00	.08
TRAINING TYPE	2	2.620	4.261	.017	.03	
PRIMING TYPE	2	3.037	4.939	.009	.04	
3-way Interactions	2	.831	1.352	.264		
TRAINING PRIMING TYPE	2	.831	1.352	.264	.01	
Explained	11	2.246	3.652	.000		
Residual	87	.615				
Total	98	.798				

Modified Analysis

The traditional brainstorming groups included different individuals in the groups at each time period. With the high rate of attrition within this condition, the cell sizes were different each week. This mortality rate may have caused the lack of statistical power in many of the different cells, and may be a threat to internal validity. Specifically, this study suffered from differential mortality, as there was a different drop out rate in the various different cells. Thus, to compare results across time, a secondary analysis was undertaken comparing only nominal and subject-intact groups. At all three time periods, the nominal groups outperformed the subject-intact groups, reaching statistical significance at times 1 and 3. Table 5 lists the cell means, standard deviations and cell sizes for this analysis.

For time 1 of the modified analysis there were main effects for group type ($F(1,67) = 9.050$, $p=.004$, $n^2=.118$, $r=.34$), and priming ($F(1,67) = 5.125$, $p=.027$, $n^2=.067$, $r=.26$). There were no two-way or three way interactions between the factors at this time period. Priming decreased productivity (primed = -.21, not primed = .25). Nominal groups outperformed subject-intact group (nominal = .35, traditional = -.31). The results of the analysis of variance performed on these data are listed in Table 6.

There were no significant main effects, two-way or three-way interactions at time 2 of the modified analysis.

The group type main effect neared conventional statistical significance ($F(1,67) = 3.793$, $p=.056$, $n^2=.056$, $r=.24$). Nominal groups outperformed subject-intact groups (nominal = .36, subject-intact = -.14). The results of the analysis of variance performed on these data are listed in Table 7.

At time 3 there was a main effect for group type, ($F(1,67) = 16.275$, $p=.000$, $n^2=.176$, $r=.42$), with nominal groups again outperforming subject-intact groups (nominal = .44, subject-intact groups = -.31). This effect is superseded by a two-way interaction for priming with group type ($F(1,67) = 9.197$, $p=.004$). Priming decreased nominal productivity (primed = .01; unprimed = .86, $t(32) = 2.79$, $p < .05$, Student-Newman-Kuels two-tailed test) but had no effect on subject-intact productivity (primed = -.13, not primed = -.43, $t(32) = -1.12$, $p > .05$, Student-Newman-Kuels two-tailed test). There was no three-way interaction. The results of the analysis of variance performed on these data are listed in Table 8. Also, there were no trends for the number of ideas generated over time. The results of the repeated measures multiple analysis of variance performed on these data is reported in Table 9.

TABLE 5
Cell Means, Standard Deviations and Cell Sizes for Modified Analysis.

			Time 1		Time 2		Time 3	
			No Priming	Priming	No Priming	Priming	No Priming	Priming
Subject-Intact	Training	means	.20	-.60	.27	-.27	-.08	-.38
		st dev	.90	.78	1.26	.03	.68	.45
		N	10	05	10	05	10	05
	No Training	means	-.44	-.42	-.52	-.06	-.74	.03
		st dev	.67	.49	.79	1.16	.54	.95
		N	11	08	11	08	11	08
Nominal Groups	Training	means	.58	-.15	.54	.13	.66	-.22
		st dev	.59	.47	1.45	1.13	1.00	.52
		N	09	07	09	07	09	07
	No Training	means	.86	.12	.46	.29	1.10	.17
		st dev	1.22	1.62	.84	.99	.81	1.02
		N	08	10	08	10	08	10

TABLE 6
Anova Table for Time 1 - Modified Analysis

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	3.893	4.301	.008		
TRAINING	1	.015	.017	.897	.000	.01
PRIMING	1	4.639	5.125	.027	.067	.26
TYPE	1	8.192	9.050	.004	.118	.34
2-way Interactions	3	.897	.991	.403		
TRAINING PRIMING	1	.618	.683	.412	.01	.09
TRAINING TYPE	1	1.314	1.452	.233	.02	.14
PRIMING TYPE	1	.627	.692	.409	.00	.10
3-way Interactions	1	.682	.754	.389		
TRAINING PRIMING TYPE	1	.682	.754	.389	.00	.10
Explained	7	2.150	2.375	.033		
Residual	60	.905				
Total	67	1.035				

TABLE 7
Anova Table for Time 2 - Modified Analysis

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	1.772	1.513	.220		
TRAINING	1	.619	.529	.470	.007	.09
PRIMING	1	.245	.209	.649	.003	.06
TYPE	1	4.441	3.793	.056	.056	.24
2-way Interactions	3	.878	.750	.527		
TRAINING PRIMING	1	1.483	1.267	.265	.018	.14
TRAINING TYPE	1	.571	.487	.488	.007	.09
PRIMING TYPE	1	.348	.297	.588	.004	.07
3-way Interactions	1	.586	.500	.482		
TRAINING PRIMING TYPE	1	.586	.500	.482	.007	.14
Explained	7	1.219	1.041	.412		
Residual	60	1.171				
Total	67	1.176				

TABLE 8
Anova Table for Time 3 - Modified Analysis

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	3.675	5.785	.002		
TRAINING	1	.078	.123	.727	.001	.04
PRIMING	1	1.469	2.313	.134	.024	.16
TYPE	1	10.340	16.275	.000	.176	.42
2-way Interactions	3	2.797	4.403	.007		
TRAINING PRIMING	1	.986	1.552	.218	.017	.13
TRAINING TYPE	1	1.573	2.476	.121	.027	.16
PRIMING TYPE	1	5.843	9.197	.004	.099	.32
3-way Interactions	1	1.272	2.003	.162		
TRAINING PRIMING TYPE	1	1.272	2.003	.162	.022	.15
Explained	7	2.956	4.652	.000		
Residual	60	.635				
Total	67	.878				

TABLE 9
Manova Results for Time Trends

REPEATED MEASURES ANALYSIS OF VARIANCE

Source of Variation	DF	MS	F	Sig of F
WITHIN CELLS	120	.51		
TIME	2	.12	.23	.792
PRIME BY TIME	2	.65	1.26	.286
TRAIN BY TIME	2	.30	.58	.563
GROUP BY TIME	2	.21	.42	.661
PRIME BY TRAIN BY TIME	2	.05	.09	.914
PRIME BY GROUP BY TIME	2	.95	1.85	.162
TRAIN BY GROUP BY TIME	2	.06	.11	.894
PRIME BY TRAIN BY GROUP BY TIME	2	.04	.07	.929

Process Variables

There were several process variables which were coded as part of a manipulation check for the training induction within the traditional and subject-intact groups. These process variables included the number of evaluative comments made to others during the session, the number of self-evaluative comments made during the session, the total number of interruptions between the participants, the total talk time of the group, the number of talk turns by the group members and the number of times that piggybacking occurred. The process variables could only occur in interacting groups, thus the following analyses only compare traditional groups to subject-intact groups. Table 10 lists the cell means, standard deviations and cell sizes for this analysis.

Piggybacking Analysis

An analysis for the piggybacking variable found a main effect for training at time 1, ($F(1,50) = 4.044$, $p=.05$, $n^2=.04$, $r=.22$) superseded by a priming by training interaction ($F(1,50) = 17.962$, $p=.00$, $n^2=.21$, $r=.46$) and a training by group type interaction ($F(1,50) = 6.120$, $p=.02$, $n^2=.07$, $r=.27$). The three-way interaction was significant ($F(1,50) = 4.882$, $p=.03$, $n^2=.06$, $r=.24$).

Trained groups piggybacked more than untrained groups (trained = 10.95, untrained = 7.08). The training by group type interaction found that piggybacking approached conventional levels of statistical significance with

training in the traditional groups (traditional trained = 12.88, traditional untrained = 6.78, t(38) = -1.99 p = .059, Student-Newman-Kuels two-tailed test) but had no effect for the training in the subject-intact groups (subject-intact trained = 4.40, subject-intact untrained = 7.62, t(16) = 1.51, p >.05, Student-Newman-Kuels two-tailed test). The unprimed groups piggybacked more than the primed groups (unprimed = 9.27, primed = 7.97). The priming by training interaction found piggybacking occurred most when trained, not primed (18.63), followed by primed, not trained (9.06), primed and trained (6.57) and not primed, not trained (5.11). There was no effect for priming on the untrained groups (t(34) = -1.88, p >.05, Student-Newman-Kuels two-tailed test), however, the effect for priming on trained groups was statistically significant (t(20) = 2.38, p <.05, Student-Newman-Kuels two-tailed test). The results of the analysis of variance performed on these data are listed in Table 11.

A means analysis of the 3-way interaction required 2 analysis of variance statistics, one each for traditional and subject-intact groups, with piggybacking as the dependent variable. For the traditional groups, there was a main effect for training, (F(1,40) = 7.633, p=.00, n^2=.11, r=.34) which was superseded by the training by priming interaction (F(1,40) = 21.514, p=.00, n^2=.32, r=.57). The results of this analysis can be found in Table 12. The priming by training interaction found piggybacking occurred

most when trained, not primed (23.00), followed by primed and not trained (9.46), primed and trained (7.36) and not trained, not primed (3.30). There effect for not primed trained groups was statistically significant ($t(14) = -3.59$, $p < .05$, Student-Newman-Kuels two-tailed test).

There were no significant main effects of piggybacking for the subject-intact groups. The results of the analysis of variance for these data can be found in Table 13.

There was a piggybacking main effect for group type at time 2, ($F(1,51) = 6.540$, $p=.01$, $n^2=.08$, $r=.28$) superseded by a priming by group type interaction ($F(1,51) = 4.185$, $p=.05$, $n^2=.05$, $r=.23$) a training by group type interaction ($F(1,51) = 6.985$, $p=.01$, $n^2=.09$, $r=.29$), and a priming by training interaction ($F(1,51) = 9.585$, $p=.00$, $n^2=.12$, $r=.34$) The three-way interaction was not statistically significant.

In the priming by group type interaction, piggybacking was not impacted by priming in either the traditional groups (not primed = 7.82, primed = 5.31, $t(28) = -1.60$, $p > .05$, Student-Newman-Kuels two-tailed test) or the subject-intact groups (primed = 8.50, not primed = 10.29, $t(27) = .90$, $p > .05$, Student-Newman-Kuels two-tailed test). The training by group type interaction found that piggybacking was not impacted by training in the traditional groups (trained = 5.57, untrained = 7.75, $t(28) = 1.43$, $p > .05$, Student-Newman-Kuels two-tailed test) but had a statistically significant effect on subject-intact groups (trained =

12.50, untrained = 7.47, t(27) = -2.42, p <.05, Student-Newman-Kuels two-tailed test).

The priming by training interaction again found piggybacking occurred most when trained, not primed (10.00), followed by not primed and trained (5.83), primed and trained (5.38) and not primed, not trained (4.86). There was a significant effect for priming on the untrained groups (t(31) = -2.08, p <.05, Student-Newman-Kuels two-tailed test), and for priming on trained groups (t(24) = 2.21, p <.05, Student-Newman-Kuels two-tailed test). The results of the analysis of variance performed on these data are listed in Table 14.

The analysis of variable for piggybacking found no statistically significant main effects, two-way interactions or three-way interactions at time 3. However, the priming by training interaction approached conventional levels of significance. A post-hoc analysis found a significant effect for priming on the untrained groups (t(29) = -2.35, p <.05, Student-Newman-Kuels two-tailed test), but no effect for priming on trained groups (t(22) = .77, p >.05, Student-Newman-Kuels two-tailed test). The results of this analysis are listed in Table 15.

TABLE 10
Cell Means, Standard Deviations and Cell Sizes for Piggybacking Analysis.

		Time 1		Time 2		Time 3	
		No Priming	Priming	No Priming	Priming	No Priming	Priming
Subject-Intact							
Training	means	5.50	3.67	15.42	8.40	5.86	5.00
	st dev	3.53	1.15	6.16	5.60	3.13	1.22
	N	2	3	7	5	7	5
No Training	mean	7.38	8.00	6.70	8.57	5.00	4.60
	st dev	4.38	10.24	3.23	5.68	3.12	1.94
	N	8	5	10	7	9	5
Traditional Groups							
Training	means	23.00	7.36	5.83	5.38	7.00	4.25
	st dev	13.31	4.86	2.22	2.07	6.68	3.57
	N	6	11	6	8	4	8
No Training	means	3.30	9.46	4.86	10.00	2.75	7.00
	st dev	2.45	7.38	5.33	5.07	1.90	2.31
	N	10	13	7	9	8	9

TABLE 11
Anova Table for Piggybacking - Time 1

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	107.368	2.232	.096		
PRIMING	1	62.528	1.300	.260	.02	.12
TRAINING	1	194.489	4.044	.050	.05	.22
TYPE	1	69.992	1.455	.233	.02	.13
2-way Interactions	3	366.836	7.627	.000		
PRIMING TRAINING	1	863.959	17.962	.000	.21	.45
PRIMING TYPE	1	.905	.019	.891	.00	.01
TRAINING TYPE	1	294.348	6.120	.017	.07	.27
3-way Interactions	1	234.814	4.882	.032		
PRIMING TRAINING TYPE	1	234.814	4.882	.032	.06	.24
Explained	7	236.775	4.923	.000		
Residual	50	48.098				
Total	57	71.269				

TABLE 12
Anova Table for Piggybacking in Traditional Groups

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	433.943	2	216.972	4.269	.022		
PRIME	70.246	1	70.246	1.382	.247	.02	.14
TRAIN	388.006	1	388.006	7.633	.009	.11	.34
2-way Interactions	1093.555	1	1093.555	21.514	.000		
PRIME TRAIN	1093.555	1	1093.555	21.514	.000	.33	.57
Explained	1527.499	3	509.166	10.017	.000		
Residual	1829.876	36	50.830				
Total	3357.375	39	86.087				

TABLE 13
Anova Table for Piggybacking in Subject-Intact Groups

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	37.352	2	18.676	.455	.644		
PRIME	.018	1	.018	.000	.984	.00	.00
TRAIN	35.616	1	35.616	.867	.368	.06	.24
2-way Interactions	5.217	1	5.217	.127	.727		
PRIME TRAIN	5.217	1	5.217	.127	.727	.01	.09
Explained	42.569	3	14.190	.345	.793		
Residual	575.042	14	41.074				
Total	617.611	17	36.330				

TABLE 14
Anova Table for Piggybacking - Time 2

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	48.213	2.524	.068		
PRIMING	1	2.319	.121	.729	.00	.04
TRAINING	1	25.083	1.313	.257	.02	.13
TYPE	1	124.932	6.540	.014	.08	.28
2-way Interactions	3	146.539	7.671	.000		
PRIMING TRAINING	1	183.117	9.585	.003	.12	.34
PRIMING TYPE	1	79.955	4.185	.046	.05	.23
TRAINING TYPE	1	133.440	6.985	.011	.09	.30
3-way Interactions	1	9.619	.503	.481		
PRIMING TRAINING TYPE	1	9.619	.503	.481	.01	.08
Explained	7	84.839	4.441	.001		
Residual	51	19.104				
Total	58	27.037				

TABLE 15
Anova Table for Piggybacking - Time 3

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	4.017	.376	.770		
PRIMING	1	6.051	.567	.455	.01	.10
TRAINING	1	4.605	.432	.514	.01	.09
TYPE	1	.002	.000	.989	.00	.00
2-way Interactions	3	19.083	1.788	.162		
PRIMING TRAINING	1	37.714	3.534	.066	.06	.25
PRIMING TYPE	1	14.807	1.388	.245	.02	.16
TRAINING TYPE	1	.831	.078	.781	.00	.04
3-way Interactions	1	26.526	2.486	.122		
PRIMING TRAINING TYPE	1	26.526	2.486	.122	.04	.21
Explained	7	13.689	1.283	.279		
Residual	47	10.671				
Total	54	11.063				

Speaking Time Analysis

Two of the process variables, total talk time within the session and the number of talk turns per session, were combined to determine the average speaking length per talk turn. Descriptive statistics of these two variables for both traditional and subject-intact groups demonstrate that at time 1, the average speaking length per talk turn was 8.704 seconds (standard deviation = 3.345) 12.245 seconds (standard deviation = 6.241) at time 2 and 12.371 seconds at time 3, (standard deviation = 4.826). Table 16 lists the cell means, standard deviations and sample sizes for this analysis.

At time 1 an analysis for speaking time found a main effect for training ($F(1,49) = 5.840$, $p=.02$, $n^2=.10$, $r=.31$) and priming ($F(1,49) = 3.901$, $p=.05$, $n^2=.06$, $r=.25$). There were no two or three way interactions. Untrained groups members spoke longer than trained groups (untrained = 9.43, trained = 7.55). The members of the primed groups spoke longer than the unprimed groups (primed = 9.36, unprimed = 7.92). The results of the analysis of variance performed on these data are listed in Table 17.

There were no significant main effects or three way interactions for speaking time at time 2. There was one statistically significant two-way interaction between priming and group type ($F(1,51) = 4.658$, $p=.04$, $n^2=.08$, $r=.28$). In the priming by group type interaction, no effect was found for priming on traditional groups (not primed =

15.03, primed = 10.10, t(28) = 1.73, p >.05, Student-Newman-Kuels two-tailed test), or for subject-intact groups (primed = 13.37, unprimed = 11.47, t(27) = -.94, p>.05, Student-Newman-Kuels two-tailed test). The results of the analysis of variance performed on these data are listed in Table 18.

The only statistically significant effect at time 3 for speaking time was the priming by training interaction (F(1,47) = 8.831, p=.00, n^2=.13, r=.36). In this interaction, there was no effect for speaking length on the untrained primed groups (not primed = 11.86, primed = 11.43, t(29) = 1.65, p >.05, Student-Newman-Kuels two-tailed test), but a significant effect exists for speaking length on the trained primed groups (not primed = 12.75, primed = 13.99, t(22) = -2.40, p <.05, Student-Newman-Kuels two-tailed test), and no effect for speaking length on the primed trained groups (not trained = 12.75, trained = 13.99, t(25) = -.72, p >.05, Student-Newman-Kuels two-tailed test). The results of the analysis of variance performed on these data are listed in Table 19.

TABLE 16
Cell Means, Standard Deviations and Cell Sizes for Speaking Time Analysis.

		Time 1		Time 2		Time 3	
		No Priming	Priming	No Priming	Priming	No Priming	Priming
Subject-Intact							
Training	means	7.33	9.30	11.12	16.12	8.98	16.99
	st dev	3.67	2.60	4.31	5.09	1.387	5.48
	N	2	3	7	5	7	5
No Training	mean	8.55	9.10	11.70	11.40	15.71	11.08
	st dev	3.45	4.53	4.66	6.05	5.32	2.18
	N	8	5	10	7	9	5
Traditional Groups							
Training	means	5.14	8.50	12.99	9.65	9.34	10.56
	st dev	.62	2.74	3.43	3.17	3.93	3.63
	N	6	11	6	8	4	8
No Training	means	9.20	10.26	16.79	10.49	13.11	12.20
	st dev	3.39	3.64	13.24	3.97	5.70	4.89
	N	10	13	7	9	8	9

TABLE 17
Anova Table for Speaking Time - Time 1

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	30.180	2.891	.045		
PRIMING	1	40.718	3.901	.054	.06	.25
TRAINING	1	60.962	5.840	.019	.10	.31
TYPE	1	.084	.008	.929	.00	.01
2-way Interactions	3	7.933	.760	.522		
PRIMING TRAINING	1	12.392	1.187	.281	.02	.14
PRIMING TYPE	1	2.224	.213	.646	.00	.06
TRAINING TYPE	1	11.865	1.137	.292	.02	.14
3-way Interactions	1	.850	.081	.777		
PRIMING TRAINING TYPE	1	.850	.081	.777	.00	.04
Explained	7	16.455	1.576	.165		
Residual	49	10.439				
Total	56	11.191				

TABLE 18
Anova Table for Speaking Time - Time 2

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	12.671	.333	.801		
PRIMING	1	36.453	.959	.332	.02	.13
TRAINING	1	1.450	.038	.846	.00	.03
TYPE	1	.828	.022	.883	.00	.02
2-way Interactions	3	92.677	2.439	.075		
PRIMING TRAINING	1	59.225	1.559	.218	.03	.16
PRIMING TYPE	1	177.015	4.658	.036	.08	.28
TRAINING TYPE	1	67.086	1.765	.190	.03	.17
3-way Interactions	1	4.794	.126	.724		
PRIMING TRAINING TYPE	1	4.794	.126	.724	.00	.05
Explained	7	45.834	1.206	.316		
Residual	51	37.999				
Total	58	38.944				

TABLE 19
Anova Table for Speaking Time - Time 3

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	33.741	1.780	.164		
PRIMING	1	4.358	.230	.634	.00	.06
TRAINING	1	63.560	3.352	.073	.05	.22
TYPE	1	44.388	2.341	.133	.04	.19
2-way Interactions	3	58.781	3.100	.036		
PRIMING TRAINING	1	167.451	8.831	.005	.13	.26
PRIMING TYPE	1	2.066	.109	.743	.00	.04
TRAINING TYPE	1	16.455	.868	.356	.01	.11
3-way Interactions	1	89.140	4.701	.035		
PRIMING TRAINING TYPE	1	89.140	4.701	.035	.07	.27
Explained	7	52.386	2.763	.017		
Residual	47	18.961				
Total	54	23.294				

Evaluation Analysis

The occurrence of evaluative comments, both self-evaluation and evaluation of others, made during the brainstorming session was examined. Table 20 has the cell means and sample sizes for this analysis. At time 1 the analysis uncovered no main effects, two-way interactions or three-way interactions for the evaluation process variable. The results of this analysis are listed in Table 21.

There were also no significant main effects, two or three way interactions for evaluation at time 2. An analysis of variance was performed on these data and the results are listed in Table 22.

At time 3 there was a statistically significant main effect for both priming ($F(1,47) = 5.786$, $p=.02$, $n^2=.08$, $r=.29$) and group type ($F(1,47) = 8.156$, $p=.00$, $n^2=.12$, $r=.34$). These were both superseded by a priming by group type interaction ($F(1,47) = 5.131$, $p=.03$). The members of the primed groups evaluated more than the unprimed groups (primed = 7.04, unprimed = 5.18), and the members of the subject-intact groups evaluated more than the traditional groups (subject-intact = 7.12, traditional = 4.31). An analysis of variance was performed on these data and the results are listed in Table 23. In the priming by group type interaction, there was no effect for evaluation on traditional groups (not primed = 4.75, primed = 5.00, $t(27) = .20$, $p > .05$, two-tailed test), yet a significant effect exists for the subject-intact groups (primed = 10.50,

unprimed = 5.50, t(24) = -2.29, p <.05, Student-Newman-Kuels two-tailed test).

TABLE 20
Cell Means, Standard Deviations and Cell Sizes for Evaluation Analysis.

			Time 1		Time 2		Time 3	
			No Priming	Priming	No Priming	Priming	No Priming	Priming
Subject-Intact	Training	means	8.50	8.33	6.00	7.60	4.86	7.40
		st dev	10.60	2.89	2.38	7.83	3.08	4.39
		N	2	3	7	5	7	5
	No Training	mean	7.88	7.20	7.70	5.86	6.00	13.60
		st dev	10.75	7.92	4.62	3.58	3.642	6.95
		N	8	5	10	7	9	5
Traditional Groups	Training	means	8.17	6.36	4.67	5.62	4.00	4.88
		st dev	5.50	5.81	4.08	5.26	2.94	3.60
		N	6	11	6	8	4	8
	No Training	means	10.80	11.70	4.86	3.78	5.12	5.11
		st dev	5.20	11.32	5.50	3.46	3.52	3.76
		N	10	13	7	9	8	9

TABLE 21
Anova Table for Evaluation - Time 1

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	49.641	.717	.547		
TRAINING	1	111.912	1.616	.210	.03	.17
PRIMING	1	.430	.006	.938	.00	.01
TYPE	1	52.660	.760	.387	.01	.12
2-way Interactions	3	26.658	.385	.764		
TRAINING PRIMING	1	10.500	.152	.699	.00	.05
TRAINING TYPE	1	65.017	.939	.337	.02	.13
PRIMING TYPE	1	.905	.013	.909	.00	.16
3-way Interactions	1	6.444	.093	.762		
TRAINING PRIMING TYPE	1	6.444	.093	.762	.00	.04
Explained	7	33.620	.485	.841		
Residual	50	69.252				
Total	57	64.876				

TABLE 22
Anova Table for Evaluation - Time 2

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	23.234	1.075	.368		
TRAINING	1	1.934	.090	.766	.00	.04
PRIMING	1	1.039	.048	.827	.00	.03
TYPE	1	63.693	2.948	.092	.05	.23
2-way Interactions	3	10.654	.493	.689		
TRAINING PRIMING	1	26.102	1.208	.277	.02	.15
TRAINING TYPE	1	2.399	.111	.740	.00	.04
PRIMING TYPE	1	.077	.004	.953	.00	.01
3-way Interactions	1	1.745	.081	.777		
TRAINING PRIMING TYPE	1	1.745	.081	.777	.00	.04
Explained	7	14.773	.684	.685		
Residual	51	21.603				
Total	58	20.779				

TABLE 23
Anova Table for Evaluation - Time 3

Source of Variation	DF	Mean Square	F	Signif of F	eta sq	r
Main Effects	3	71.716	4.495	.007		
TRAINING	1	47.411	2.971	.091	.04	.21
PRIMING	1	92.310	5.786	.020	.08	.29
TYPE	1	130.128	8.156	.006	.12	.34
2-way Interactions	3	34.518	2.163	.105		
TRAINING PRIMING	1	12.453	.780	.381	.01	.11
TRAINING TYPE	1	27.968	1.753	.192	.03	.16
PRIMING TYPE	1	81.865	5.131	.028	.07	.27
3-way Interactions	1	27.947	1.752	.192		
TRAINING PRIMING TYPE	1	27.947	1.752	.192	.00	.04
Explained	7	49.521	3.104	.009		
Residual	47	15.955				
Total	54	20.306				

Interruption Analysis

The last process variable to be analyzed was the number of interruptions by groups members during the brainstorming sessions. There were no main effects, two-way or three-way interactions between any of the variables at any of the three time periods for this analysis.

Mediational Analysis

A mediational analysis was undertaken to determine whether one of the process variables was affecting the relationship between the independent and dependant variables. As with the above process variables this analysis was only computed using the traditional and subject-intact group types. A correlational analysis at time 1 demonstrates that the only process variable that is statistically related to the number of ideas generated is piggybacking ($r=.58$, $N=57$). The results of this analysis are found in Table 24. Further, the training by group type interaction is significantly correlated with piggybacking at time 1 ($r=.29$, $N=57$). The contrast effects for the training by group type interaction demonstrates that piggybacking is effected by subject-intact groups in the training condition evenly (untrained = 0, trained = 0), but disproportionally affecting by traditional groups in the training condition (untrained = 1, trained = -1). Recoding these interactions effects as a variable permits the testing of a causal string, with the training by group type interaction positively affecting piggybacking which then positively

affects the generation of ideas at time 1. A graphic depiction of this causal string can be found in Figure 1.

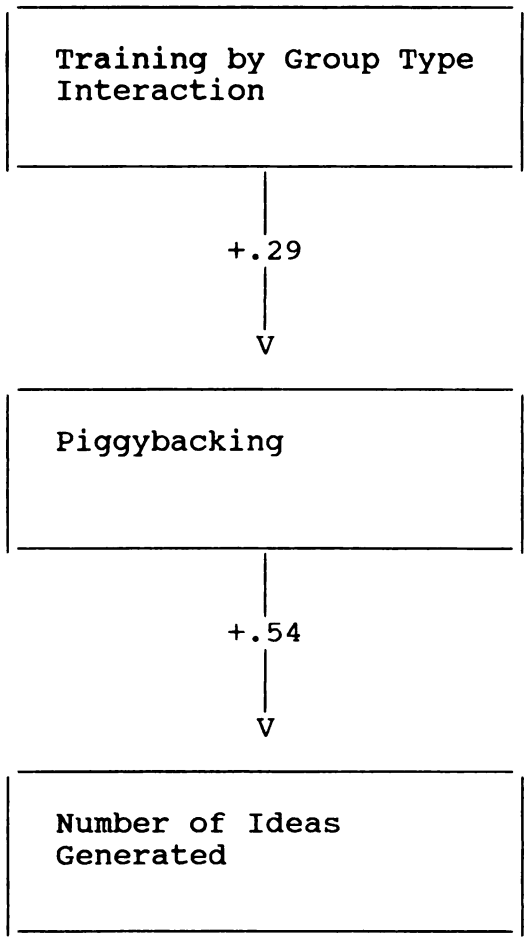

FIGURE 1
Causal String for the Mediational Effect of Piggybacking

Performing a path analysis for this model at time 1 produces a $x^2(1) = .60$, $p > .05$ suggesting that the model is consistent with the data. At time 2 and time 3 there are no process variables that mediate the effectiveness of the experimentally induced manipulations on the number of ideas generated. The results of these correlational analysis can be found in Tables 25 and 26 respectively. This finding is

supported by the relationship between the number of ideas generated at the three time periods. The best predictor of the number of ideas that would be generated at time 2 was the number of ideas generated at time 1 (.50), and the best predictor for the number of ideas generated at time 3 was the number of ideas generated at time 2 (.51). The results of this correlational analysis can be found in Table 27.

TABLE 24
Correlation Table for Process Variables at Time 1

TABLE 24
Correlation Table for Process Variables at Time 1

Correlations	IDEAS AT TIME 1	PIGGY-BACKING	SPEAKING LENGTH	EVALUATION	INTERRUPTIONS
TIME1	1.0000	.5753**	-.3090	.0080	.1432
PIGGYBACK	.5753**	1.0000	-.3342	-.0086	.0979
SPEAK	-.3090	-.3342	1.0000	-.1308	-.1845
EVALUATION	.0080	-.0086	-.1308	1.0000	.3486
INTERRUPTION	.1432	.0979	-.1845	.3486	1.0000

N = 57 1-tailed Signif: ** - .001

TABLE 25
Correlation Table for Process Variables at Time 2

Correlations	IDEAS AT TIME 2	PIGGY-BACKING	SPEAKING LENGTH	EVALUATION	INTERRUPTIONS
TIME2	1.0000	.2336	-.2461	.2335	-.2983
PIGGYBACK	.2336	1.0000	-.2903	.1991	.3478
SPEAK	-.2461	-.2903	1.0000	.0350	-.3804
EVALUATION	.2335	.1991	.0350	1.0000	-.0129
INTERRUPTION	-.2983	.3478	-.3804	-.0129	1.0000

N = 59 1-tailed Signif: ** - .001

TABLE 26
Correlation Table for Process Variables at Time 3

Correlations	IDEAS AT TIME 3	PIGGY-BACKING	SPEAKING LENGTH	EVALUATION	INTERRUPTIONS
TIME3	1.0000	.0424	-.3335	.0228	.0804
PIGGYBACK	.0424	1.0000	-.0040	.2539	.0041
SPEAK	-.3335	-.0040	1.0000	.0355	-.4872
EVALUATION	.0228	.2539	.0355	1.0000	.2610
INTERRUPTION	.0804	.0041	-.4872	.2610	1.0000

N = 55 1-tailed Signif: ** - .001

TABLE 27
Correlation Table for the number of ideas generated at time 1, time 2 and time 3.

Correlations:	TIME1	TIME2	TIME3
TIME1	1.0000	.4984**	.5077**
TIME2	.4984**	1.0000	.5675**
TIME3	.5077**	.5675**	1.0000

N = 68 1-tailed Signif: ** - .001

Chapter 4

DISCUSSION

Introduction

Overall, the results of this study replicate the findings of earlier brainstorming experiments. Thus, hypotheses 1, 2, and 3 were inconsistent with the data. Further, there was no effect for time trends in these data. Nevertheless, this experiment has added new understanding of the brainstorming process, as well as a basis for future research.

Effect of Experience with Procedure through Training

Training the traditional brainstorming groups increased the production of creative ideas. Further, the process loss usually found in group creative idea generation was reduced in one condition, the trained traditional brainstorming groups generated as many ideas as the nominal groups. This result is noteworthy as the training induction was minimal, only a short training session each week. Therefore, training appears to be key in reducing process loss within brainstorming group, as the groups that received training performed substantially better than their untrained counterparts.

There was no effect for training in the nominal groups. The focus of the training induction hay have been geared

overly toward the process of idea generation within groups. Following Osborn's suggestions the training concentrated on teaching the participants not to evaluate others' ideas and the importance of piggybacking, neither of which can occur in nominal groups. It is possible that the individuals who received the training, but worked alone, felt that they were missing an exciting group experience and hence, did not generate as many ideas as they may have with an individual-based training program.

The failure of the subject-intact groups to outperform nominal groups may be due to the brevity of the experimental training inductions. Perhaps a more intense course which added a discussion about working with the same people over time would further reduce the process loss attributed to group interaction. Future research should examine the possibility that process gain could be achieved via better training.

Effect of Experience with Peers through Subject-Intact Groups.

The use of subject-intact groups in place of zero-history groups had a negative impact on the generation of creative ideas. The main effects for the group type induction also went in the opposite direction from the hypothesis, with subject-intact groups generating the fewest number of ideas over the three week period. It appears through observation that the members of the subject-intact groups became friendly. In so doing, they used the time

together in the later two sessions to discuss the causes behind the issues and to complain about them, rather than to generate creative ideas to remedy or solve the problems. From this finding, it can be suggested that without a proper focus, the presence of a brainstorming facilitator, or increased intrinsic motivation, groups that work together often may have increased process loss due to familiarity and friendship, rather than as a result of production blocking (Back, 1951).

Effect of Experience with the Problem through Priming

Priming had a negative effect on the generation of creative ideas. At week 1 priming occurred only a 5 minutes before the brainstorming session, while the priming induction for weeks two and three gave the participants the brainstorming question one full week in advance of the idea generation session. The results found that fewer ideas were generated by the primed groups than in the non-primed groups, suggesting the possibility of process loss due to self-evaluation. It is possible that if participants had generated ideas prior to each session, regardless of training in non-evaluation, they began to question the quality of the idea, and self-evaluated or self-censored themselves. However, primed subject-intact groups outperformed unprimed subject-intact groups. Perhaps working with the same group members enables the subjects to feel comfortable enough to present the ideas which they generated earlier.

The finding that primed subject-intact group produced fewer ideas than did the primed zero history\traditional groups has many implications. Organizations and social groups employing brainstorming typically give the problem out before the session begins. These organizations should try to mix the membership of these groups, getting the additional creativity that seems to be present when social-emotional conversation is unlikely to occur.

An interesting interaction between training and priming suggests that priming had a positive effect on idea generation for the traditional groups at time 1 when the groups were also trained. If the groups were untrained, the opposite effect occurred. The priming induction at time 1 was minimal, the subjects were only given 5 extra minutes to think about the problem than the unprimed subjects. It is possible that these negative effects of priming take longer than 5 minutes but less than 1 week to occur. Future research should examine what is the optimal time for priming.

The above findings may not have surprised Osborn. He stated in Applied Imagination that:

> One of the ablest [brainstorming group] members kept mum throughout one of our sessions. I button-holed him afterward and begged him to spout whatever ideas might come to his mind at our next meeting.
>
> "All right, I'll try," he said, "but here's

> what happened. *After* our last meeting I jotted down about 15 ideas, with the thought that I would bring them to our next session; but when I looked them over I decided that they were worthless, so I just tore up the list."
>
> It took quite a while to make him realize that one of his "worthless" ideas could be better than most of ours, or could be improved upon into one which might become the best of all ideas. (Osborn, 1963, p. 157, italics in the original)

While the training induction did stress the importance of non-evaluation and piggybacking, this above example suggests that getting the subject to both understand the concept of presenting all ideas to the group and the actual contribution of the earlier generated idea to the group to be a difficult, time-consuming and training intensive task. A more detailed training program with a specific focus on non-evaluation and the importance of contributing all ideas after priming may educate the brainstormers in the importance of each of their primed ideas, resulting in the success of the group over the individual.

In future studies in addition to using the priming induction, there needs to be a way to aid in the recall and contribution of the previously generated ideas. Perhaps group members could be permitted to bring notes of their primed ideas into the brainstorming session. None of Osborn's rules forbid either the priming or the pre-

formulation of ideas. If research finds that this tactic benefits the process, this type of behavior should be encouraged.

Process Variables

The process variables added interesting information to the analysis. The training, as designed for this study, decreased talk time and evaluations. Moreover, training in how to piggyback was particularly effective. On average, talk time had no relationship to group type, with the same length of time per speaker occurring in both the traditional and subject-intact groups at each time period. The group members spoke longer at time 3 than at time 1 or at time 2, regardless of group type conditions, possibly adding to the effects of production blocking The training not to engage in evaluative comments during the session did not work until time 3. It appears to take time for group members to understand how not to be evaluative.

Path Analysis

The path analysis performed for this study found a positive and statistically significant path model to exist from the training by group type interaction to piggybacking, and a positive relationship exists between piggybacking and the number of creative ideas generated at Time 1. However, since the best indicator of the number of ideas to be generated at the later time periods comes from the earlier time periods, this model is not significant at time 2 or time 3.

This model is important for it again demonstrates both the importance of training and that effectiveness of traditional brainstorming groups over subject-intact groups. As suggested above, within the organizational setting it would be productive, if possible, to assemble and train ad hoc brainstorming groups, as these groups should be most effective in generating creative ideas.

Limitations

This study is not without its limitations. Although the same results might have occurred with a non laboratory sample, organizational members engaged in brainstorming often are motivated both intrinsically and extrinsically. This motivation is difficult to recreate in the laboratory. This feature may also explain the lack of findings for time 3. It is quite possible that the subjects were simply tired of participating by time 3 and lost interest in the task.

As mentioned above the training induction was minimal, lasting only 10 minutes per session and followed by a debriefing. As this simple manipulation produced positive results, a more elaborate training process may see the type of result hypothesized.

The literature on brainstorming has often overlooked the manner in which brainstorming is utilized and has tested this process in the laboratory rather than around a conference table. This study attempted to recreate the subject-intact groups which are present in business. A concerted attempt to test brainstorming in a realistic

environment is encouraged.

Future Research

In addition to the ideas listed above, determining the most effective amount of advance time for priming and the need to enlarge the training program, future research into brainstorming should consider the addition of 3 additional rules to Osborn's original 4. The fifth rule would suggest that no idea generated during a brainstorming session could be longer than 7 words. Nominal group members simply jot down ideas, without regard to sentence structure, leaving more time to generate additional ideas. Observation of the groups demonstrated that group members usually attempt to form their ideas into complete sentences or paragraphs. As indicated by the average speaking length per talk time process variable, while there was no statistically significant group type main effect, talk time per speaker rose by nearly 50% in both the traditional and subject-intact groups between time 1 and time 2. As the research into production blocking suggests, if one person is speaking, the others will likely block the idea generation process. This rule would limit the speaking time per idea, leaving more time for idea generation.

The sixth rule would specifically eliminate all idea explanation from the brainstorming session. In the nominal groups, the brainstormer does not need to explain his or her idea, and rarely does. It was also observed that the interacting group members often elaborated on his or her

idea in order to insure that the fellow group members all fully understood it. As above, this explanation would limit the time available to generate additional suggestions. Ideas that were offered without explanation could be more fully explained and analyzed during decision-making, the process which should follow brainstorming, not be combined with it.

The seventh rule is simply a modification of Osborn's rule 1, which states that none of the ideas are to be evaluated during the idea generation session. Trainers need to instruct group participants that evaluative comments can be both positive and negative. A positive comment (e.g., "good idea" "I agree") can lead to production blocking to the same extent as negative comments. Thus, both types of evaluative comments should be avoided during brainstorming.

Conclusion

In sum, this study raises several issues. First, this study renews the idea of training as a method for improving group performance. Second, the composition of the group is important, with zero history groups outperforming history groups. Third, priming tends to be counter-productive. For groups that do give the problem out before the session begins, training should precede the actual idea generation session. Last, there are several process variables that can be examined to help understand the communication process within the brainstorming group. One process variable, piggybacking, is likely to be an important source of new

information. As such, continued research into brainstorming is warranted in order to fully understand and improve the idea generation process.

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APPENDICES

APPENDIX A

APPENDIX A

VERIFICATION OF INFORMED CONSENT

This series of exercises and questionnaires will measures how people react to creative problem solving situations. You will be asked to participate in a series of creative problem solving and answer questions about yourself and the situation presented in the exercise. Some questions will ask you to check the response that best represents your opinions, while other questions will ask you to write out your thoughts as completely as possible. The exercises will be performed 3 times over the course of 3 weeks, and each activity should take less than one-half hour to complete.

The experimental procedure in this study will expose each subject to a type of communication stimuli. There are no physical or psychological risks involved. Your participation is strictly voluntary. However, if you should feel uncomfortable for any reason, you may discontinue the experiment at any time without penalty.

This experiment is anonymous, no one will be able to associate responses or other data with individual subjects. Each participant will be given a number to track their involvement through the course of the study. **DO NOT WRITE YOUR NAME OR STUDENT NUMBER** on any page other than this one. This piece of paper will only be used to verify your consent to participate.

If you want more information or are interested in the results of this study, please contact:

Kenneth J. Levine
Department of Communication
444 Communication Arts and Sciences
Michigan State University
East Lansing, MI 48824
(517) 355-5190

Please indicate your consent to participate by signing below.

I _____(print your name)_____ voluntarily agree to participate in this research effort by taking part in this experiment.

_____(signature)_____ ___(date)___

_____(Communication Class)_____ ___(T.A.)___

APPENDIX B

APPENDIX B

PRETEST MEASURES

1. Have you ever participated in a formal creative idea generation or brainstorming session as part of any classroom instruction or exercise?

Yes _____ No _____

If yes, what is the number of times you have participated in this type of activity? _____

2. Have you ever participated in a formal creative idea generation or brainstorming session at work?

Yes _____ No _____

If yes, what is the number of times you have participated in this type of activity? _____

3. Have you ever participated in a formal creative idea generation or brainstorming session in a social or civic group?

Yes _____ No _____

If yes, what is the number of times you have participated in this type of activity? _____

Please list any other participants in this time-slot with whom you have worked in a group project prior to today.

1. 2.

3. 4.

_____ I have not worked with any member of the class in a group project before today.

Please answer the following questions about yourself.

What is your sex? _____
What is your age? _____
What is your major? _____
What year of college are you in? (circle the correct response)

Freshman Sophomore Junior Senior
Graduate Student Lifelong Student

APPENDIX C

APPENDIX C

INSTRUCTIONS FOR FACILITATORS
PRIMING AND TRAINING GROUPS - TIME 1

The facilitator will present the following information to the groups in the priming and training condition at time 1 and time 2.

This is a exercise in creative idea generation, commonly referred to as "brainstorming." Brainstorming is a technique to assist group in generating proposals for alternative courses of action. From these alternatives, a final decision on how best to resolve a problem can be made with confidence.

There are four (4) rules to be followed in this, and any brainstorming session:

(point to poster)

1. Generate as many ideas as possible during the session. Don't worry about the quality of ideas. Quantity is valued more-so than quality.

2. Do not evaluate any ideas during the session. This means that you need to refrain from stating your opinion, *positive or negative*, about either your own or someone else's idea.

3. Include all ideas, even those which you might consider wild of off-the-wall. In fact, the wilder the better. Remember, a wild idea isn't necessary a wrong idea, just think of some of your favorite commercials and you'll see that wild ideas can work.

4. Feel free to "piggy-back" by using one idea as a springboard for additional suggestions.

The rules are posted so that you can refer to them at anytime during the brainstorming session.

As an example, I will demonstrate how a successful brainstorming session might. Consider the following problem:

APPENDIX C

INSTRUCTIONS FOR FACILITATOR
PRIMING AND TRAINING GROUPS - TIME 1

We don't think that it is very likely, but imagine for a moment what would happen if everyone born after 1995 had an extra thumb on each hand. This extra thumb would be built just as the present one, but located on the other side on the hand. The new thumb faces inward, so that it can press against the fingers, just as the regular thumb does now.

Some of the ideas generated were:

easier to throw a ball
higher incidence of jammed thumbs on the basketball court
can't show someone where in Michigan you're from
better hand/eye coordination
easier to count to twelve
could wear more rings
better finger painting

some of the ideas that were "piggy-backed" were:

better with the TV remote
faster typing
glove factories will have to change their designs
could speak in sign language faster

Some of the wild/off the wall ideas were:

new nasty hand gestures
new shadow puppets
in the future, bouncers will know how old you are

APPENDIX C

INSTRUCTIONS FOR FACILITATOR
PRIMING AND TRAINING GROUPS - TIME 1

When you entered the room today, you should have found the problem for today'ssession on your desk. (ask if everyone did). You have been provided with a tape recorder to record all of your ideas. Please try to speak loud and clear in order that the tape can pick up your ideas. (to insure that the recorder is working, turn it on and give the day and time, then replay it to the audience.)

Are there any questions?

You will have ten (10) minutes to complete this portion of the exercise. I (we) will be back when the 10 minutes are over.

(set timer and leave)

APPENDIX D

APPENDIX D

INSTRUCTIONS FOR FACILITATOR
PRIMING AND TRAINING GROUPS - TIME 2

There is a videotape to be used at this session. After all subjects have arrived in the laboratory, start the videotape.

The training tape begins with the same discussion of Osborn's four brainstorming rules as during week 1, however, a different problem is use for purposes of instruction.

Question for Time 2:

Each year a great many more European tourists visit other part of Europe rather than the United States. Suppose that our country wished to get many more European tourists to visit the United States during their vacations. What steps can you suggest that would get more Europeans tourists to come to this country?

1. tours to sporting events

2. Monet exhibit in Chicago
   other unique exhibits that will not travel to Europe

3. Decent train service
   clean train station
   clean bus stations
   a Ameri-rail pass to be like Euro-rail pass

4. Advertise National parks
   tours to national parks

5. find some icon that cries to get pilgrimages

6. find Elvis

7. lottery to meet the president
   lottery to meet Hillary
   spend a day at the White House
   spend a day with Michael Jordon
   spend a day with Oprah
   spend a day with Michael Jackson

APPENDIX D

INSTRUCTIONS FOR FACILITATOR
PRIMING AND TRAINING GROUPS - TIME 2

8. educational scholarships

9. eat a meal in every state tour
   contest to travel to every state

10. contest to star in Hollywood movie
    with Arnold

11. see what is uniquely American like Las Vegas
    like Branson, MO.

12. race up the statue of liberty
    race up the Washington monument
    race up the Arch in St. Louis
    race up the Sear Tower
    create tour-de-America - like Tour-de-France

13. bungee jump at the Grand Canyon

14. participate in a cattle drive in Texas
    meet a real cowboy

15. Trips to see space stuff at Cape Canaveral
    NASA museum in Houston
    Air and Space Museum at the Smithsonian
    meet Astronauts

16. Visit Rock and Roll Hall of Fame

When you entered the room today, you should have found the problem for today's session on your desk. (ask if everyone did). You have been provided with a tape recorder to record all of your ideas. Please try to speak loud and clear in order that the tape can pick up your ideas. (to insure that the recorder is working, turn it on and give the day and time, then replay it to the audience.)

Are there any questions?

APPENDIX D

INSTRUCTIONS FOR FACILITATOR
PRIMING AND TRAINING GROUPS - TIME 2

You will have ten (10) minutes to complete this portion of the exercise. I (we) will be back when the 10 minutes are over.

(set timer and leave)

APPENDIX E

APPENDIX E

INSTRUCTIONS FOR FACILITATOR
PRIMING ONLY GROUPS - ALL THREE WEEKS

This is a exercise in creative idea generation, commonly referred to as "brainstorming." There are four (4) rules to be followed in this, and any brainstorming session:

(point to poster)

1. Generate as many ideas as possible during the session. Don't worry about the quality of ideas. Quantity is all that matters.

2. Do not evaluate any ideas during the session.

3. Include all ideas, even those which you might consider wild of off-the-wall. In fact, the wilder the better.

4. Feel free to "piggy-back" by using one idea as a springboard for additional suggestions.

When you entered the room today, you should have found the problem for today's session on your desk. (ask if everyone did). You have been provided with a tape recorder to record all of your ideas. Please try to speak loud and clear in order that the tape can pick up your ideas. (to insure that the recorder is working, turn it on and give the day and time, then replay it to the audience.)

Are there any questions?

You will have ten (10) minutes to complete this portion of the exercise. I (we) will be back when the 10 minutes are over.

(set timer and leave)

APPENDIX F

APPENDIX F

INSTRUCTIONS FOR FACILITATOR TRAINING ONLY GROUPS - WEEK 1

This is a exercise in creative idea generation, commonly referred to as "brainstorming." Brainstorming is a technique to assist group in generating proposals for alternative courses of action. From these alternatives, a final decision on how best to resolve a problem can be made with confidence.

There are four (4) rules to be followed in this, and any brainstorming session:

(point to poster)

1. Generate as many ideas as possible during the session. Don't worry about the quality of ideas. Quantity is valued more-so than quality.

2. Do not evaluate any ideas during the session. This means that you need to refrain from stating your opinion, *positive or negative*, about either your own or someone else's idea.

3. Include all ideas, even those which you might consider wild of off-the-wall. In fact, the wilder the better. Remember, a wild idea isn't necessary a wrong idea, just think of some of your favorite commercials and you'll see that wild ideas can work.

4. Feel free to "piggy-back" by using one idea as a springboard for additional suggestions.

The rules are posted so that you can refer to them at anytime during the brainstorming session.

As an example, I will demonstrate how a successful brainstorming session might. Consider the following problem:

We don't think that it is very likely, but imagine for a moment what would happen if everyone born after 1995 had an extra thumb on each hand. This extra thumb would be built just as the present one, but located on the other side on the hand. The new thumb faces inward, so that it can press against the fingers, just as the regular thumb does now.

APPENDIX F

INSTRUCTIONS FOR FACILITATOR
TRAINING ONLY GROUPS - WEEK 1

Some of the ideas generated were:

easier to throw a ball
higher incidence of jammed thumbs on the basketball court
can't show someone where in Michigan you're from
better hand/eye coordination
easier to count to twelve
could wear more rings
better finger painting

some of the ideas that were "piggy-backed" were:

better with the TV remote
faster typing
glove factories will have to change their designs
could speak in sign language faster

Some of the wild/off the wall ideas were:

new nasty hand gestures
new shadow puppets
in the future, bouncers will know how old you are

You have been provided with a tape recorder to record all of your ideas. Please try to speak loud and clear in order that the tape can pick up your ideas. (to insure that the recorder is working, turn it on and give the day and time, then replay it to the audience.)

Here is the problem for today (pass out problem). Are there any questions?

You will have ten (10) minutes to complete this portion of the exercise. I (we) will be back when the 10 minutes are over.

(set timer and leave)

APPENDIX G

APPENDIX G

INSTRUCTIONS FOR FACILITATOR
TRAINING GROUPS - TIME 2

There is a videotape to be used at this session. After all subjects have arrived in the laboratory, start the videotape.

The training tape begins with the same discussion of Osborn's four brainstorming rules as during week 1, however, a different problem is use for purposes of instruction.

Question for Time 2:

Each year a great many more European tourists visit other part of Europe rather than the United States. Suppose that our country wished to get many more European tourists to visit the United States during their vacations. What steps can you suggest that would get more Europeans tourists to come to this country?

1. tours to sporting events

2. Monet exhibit in Chicago
   other unique exhibits that will not travel to Europe

3. Decent train service
   clean train station
   clean bus stations
   a Ameri-rail pass to be like Euro-rail pass

4. Advertise National parks
   tours to national parks

5. find some icon that cries to get pilgrimages

6. find Elvis

7. lottery to meet the president
   lottery to meet Hillary
   spend a day at the White House
      spend a day with Michael Jordon
      spend a day with Oprah
      spend a day with Michael Jackson

APPENDIX G

INSTRUCTIONS FOR FACILITATOR TRAINING GROUPS - TIME 2

8. educational scholarships

9. eat a meal in every state tour
   contest to travel to every state

10. contest to star in Hollywood movie
    with Arnold

11. see what is uniquely American like Las Vegas
    like Branson, MO.

12. race up the statue of liberty
    race up the Washington monument
    race up the Arch in St. Louis
    race up the Sear Tower
    create tour-de-America - like Tour-de-France

13. bungee jump at the Grand Canyon

14. participate in a cattle drive in Texas
    meet a real cowboy

15. Trips to see space stuff at Cape Canaveral
    NASA museum in Houston
    Air and Space Museum at the Smithsonian
    meet Astronauts

16. Visit Rock and Roll Hall of Fame

You have been provided with a tape recorder to record all of your ideas. Please try to speak loud and clear in order that the tape can pick up your ideas. (to insure that the recorder is working, turn it on and give the day and time, then replay it to the audience.)

Here is the problem for today (pass out problem). Are there any questions? You will have ten (10) minutes to complete this portion of the exercise. I (we) will be back when the 10 minutes are over. (set timer and leave)

APPENDIX G

INSTRUCTIONS FOR FACILITATOR
TRAINING GROUPS - TIME 2

FOR TRAINING AND PRIMING GROUPS:

You already know the problem for today. (review problem). Are there any questions? You will have ten (10) minutes to complete this portion of the exercise. I (we) will be back when the 10 minutes are over. (set timer and leave)

APPENDIX H

APPENDIX H

INSTRUCTIONS FOR FACILITATOR
NO PRIMING OR TRAINING GROUPS - ALL THREE WEEKS

This is a exercise in creative idea generation, commonly referred to as "brainstorming." There are four (4) rules to be followed in this, and any brainstorming session:

(point to poster)

1. Generate as many ideas as possible during the session. Don't worry about the quality of ideas. Quantity is all that matters.

2. Do not evaluate any ideas during the session.

3. Include all ideas, even those which you might consider wild of off-the-wall. In fact, the wilder the better.

4. Feel free to "piggy-back" by using one idea as a springboard for additional suggestions.

You have been provided with a tape recorder to record all of your ideas. Please try to speak loud and clear in order that the tape can pick up your ideas. (to insure that the recorder is working, turn it on and give the day and time, then replay it to the audience.)

Here is the problem for today (pass out problem). Are there any questions?

You will have ten (10) minutes to complete this portion of the exercise. I (we) will be back when the 10 minutes are over.

(set timer and leave)

APPENDIX I

APPENDIX I

INSTRUCTIONS FOR FACILITATOR
NOMINAL GROUPS

Go through the same instructions for the proper group condition, except once the instructions have been completed, disburse the individuals so that no two people are within hearing (interruption) distance from one another.

Give them a tape recorder and a timer, and instruct them to return to the lab in 10 minutes. Test the tape recorder to insure that it works, and tell them to start the tape there, do not rewind.

APPENDIX J

APPENDIX J

DEBRIEFING THE TRAINING CONDITIONS
WEEKS 1, 2, AND 3

If there have been two groups going simultaneously or any individuals brainstorming alone, bring everyone together into one of the larger lab rooms.

If not already done, turn off the tape recorder, and ask for each group\individual to remember some of the ideas that were generated. Then ask for ideas that were "piggy-backed" from any of them.

Ask if anyone felt uneasy about sharing ideas, and repeat how important all the rules are, particularly that ideas are not evaluated in future sessions.

If also priming group: Give them the idea for the next week and instruct them to not to share the problem (or potential solutions) with other students participating in the study.

Tell them to think of ideas over the coming week.

Thank them and remind them to show up the next week.

APPENDIX K

APPENDIX K

DEBRIEFING THE PRIMING SESSIONS
WEEKS 1, 2, AND 3

Before the participants leave the lab, give them the idea for the next session.

Instruct them not to share the problem (or potential solutions) with other students participating in the study.

Tell them to think of ideas over the course of the coming week.

Thank them and remind them to show up the next week.

APPENDIX L

APPENDIX L

POST TEST - WEEK 3

Do you currently live in a residence hall?

Yes _____ No _____

If NO, have you ever lived in a residence hall at Michigan State University?

Yes _____ No _____

Do you currently have a car here at college?

Yes _____ No _____

If NO, have you ever had a car here at Michigan State University?

Yes _____ No _____

Have you ever received a parking ticket?

Yes _____ No _____

APPENDIX M

APPENDIX M

FINAL DEBRIEFING

Thank you for your participation in this brainstorming study.

This experiment was designed to test the effect that a history of group interaction, training in the process and\or prior knowledge of the problem would have on the number of ideas generated by groups\individuals over a three week period of time.

To test the effect of group interactions, research subjects were in one of three group types:

1. working alone
2. working with a different group each week
3. working with the same group each week.

To test the prior knowledge of the problem, half of the participants received the problem before the session began, and the other half received the problem immediately before the session began.

To test the effect of training, half of the participants were instructed in the 4 rules of brainstorming, and received a demonstration before each session began (ie: the thumbs problem) while the other half only were instructed in the 4 rules of brainstorming.

If you have any questions about the study or its results, please contact Kenneth J. Levine in Room 444 of the Communication Arts and Sciences Building.

APPENDIX N

APPENDIX N

BRAINSTORMING PROBLEMS

Fame and Immortality

How can the average person achieve fame and immortality in his/her own lifetime?

Parking

A committee has formed to discuss ways to revamp the parking regulations here on campus. What ideas would you suggest to D.P.S. on this subject?

Dorms

Michigan State University is looking for ways to persuade students to remain in the residence halls for their junior and senior years. What ideas can you suggest to the Administration to accomplish this task?

Election

In the upcoming election for city council positions in East Lansing, what are the important issues between the students and the City?

APPENDIX O

APPENDIX O

CODING OF THE VIDEOTAPES

The behavioral issues to be coded off the audio and\or videotape recordings of the brainstorming sessions are:

1. Number of ideas generated by each participant.

2. Number of times that each participant "piggy-backed."

3. Response, if any, from the creator of the original idea.

4. Number of interruptions by each participant.

5. Number of false starts by each participant (where someone begins a statement, but fails to complete a thought).

6. Looks of disapproval by a listener to the speaker, and the resulting behavior of the speaker, including completion of started statement and any additional statements.

7. Briefness of the message (number of words per utterance).

ENDNOTES

1.In the third revised edition of Applied Imagination in 1957, Osborn discusses his own studies of brainstorming undertaken since the text's original publication, however, no cite is given. These examples document increases in the levels of group output after learning the proper brainstorming methods.