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# THE EFFECTS OF TRAINING ON BRAINSTORMING

By

Sally Ann Blomstrom

A DISSERTATION

Submitted to

Michigan State University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

Department of Communication

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## ABSTRACT

THE EFFECTS OF TRAINING ON BRAINSTORMING

By

Sally Ann Blomstrom

This study was conducted at a large midwestern university to examine the effects of short (approximately 7 minutes in length) and longer (approximately 15 minutes in length) training on the number of ideas generated by nominal and brainstorming groups. A main effect for group type was found such that nominal groups outperformed brainstorming groups. A main effect was found for training. Trained groups outperformed untrained groups. Longer training helped brainstorming groups more than short training. Quality of ideas was evaluated. Neither group type nor training had an impact on the quality of ideas.

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## DEDICATION

To my parents, Lloyd and Mary Blomstrom, who started me on the way.

## ACKNOWLEDGMENTS

I would like to thank:

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# CHAPTER 1

## Introduction

Today's business climate rewards adaptability, flexibility, and innovation in both companies and their employees. Rapid advances in communication, transportation, and production technologies have resulted in the need for organizations to solve problems faster and better than ever before. This accelerated rate of change requires organizations of various types to access individuals who can meet current challenges and use their skills to meet new ones as well.

Such an atmosphere places a premium on well-developed problem-solving skills. Certainly the need for problem-solving skills is not new. In *Applied Imagination* Osborn (1963) defined "the creative problem-solving process" as consisting of "(1) Fact-finding, (2) Idea-finding, (3) Solution-finding" (1963, p. 86.) Sidney Parnes worked with Osborn and further refined Creative Problem Solving (CPS.) CPS, according to Parnes, includes Objective-Finding (O-F), Fact-Finding (F-F), Problem-Finding (P-F), Idea-Finding (I-F), Solution-Finding (S-F) and Acceptance-Finding (A-F) (Parnes, 1992 p. 136.) The primary tool for idea finding is brainstorming, a group technique for generating a large number of potential solutions to a problem while emphasizing that evaluation of these solutions be withheld during the generation process. For the purposes of this study, brainstorming is defined as a group problem-solving process that segregates in time the formulation of ideas or solutions from judgments of their efficacy or value. (Paynes & Reese, 1959).

Since the introduction of brainstorming in the late 1930s, numerous studies have examined its utility as a tool for problem solving. The purpose of the present research is to extend these previous studies to determine the impact of brief training on brainstorming productivity.

Brainstorming is among the most popular tools used to promote creative problem solving by groups in formal organizations, particularly in business (Fernald & Nickolenko, 1993; Jablin & Sussman, 1978; Meadow & Parnes, 1959). This method was devised and introduced in 1939 by Osborn, an advertising executive. Fourteen years later, he published *Applied Imagination,* which codified basic rules for the process and made strong claims about the superiority of its effectiveness in comparison with other techniques for stimulating novel and better problem solutions in business, government, and educational settings.

From the perspective of the technique's creator, brainstorming is concerned solely with idea generation, not idea evaluation (Osborn, 1957). According to Osborn (1957), the absence of criticism or idea evaluation invariably results in an increase in the number of sound problem solutions generated. As Taylor, Berry, and Block (1958) noted, the assumption is that the larger the number of ideas produced, the greater is the probability of achieving an effective solution (p. 24).

In the nearly 50 years since Osborn's development and promotion of the brainstorming technique, the literature has not demonstrated that group brainstorming results in the generation of more ideas than are generated by individuals working alone. Many analyses (Bond & VanLeeuwen, 1991; Mullen, Johnson & Salas, 1991; Stroebe & Diehl, 1991) have been directed toward such a comparison, and have resulted in findings

that have been. at best. mixed. Brainstorming groups, defined as groups comprised of n subjects (in this study $n = 2$ to 4) who utilize brainstorming as the approach to generate solutions to a specific problem, rarely have outperformed individuals working alone, more often they have not. The question of what accounts for the discrepancy in the number of ideas generated by brainstorming groups and by nominal groups is in part addressed subsequently.

Studies of particular interest to the present project have focused on whether brainstorming skills can be improved by training. Brainstorming is a learned skill, so training in the technique should lead to improved results. Most studies' results show at least a modest positive training effect from brainstorming courses, most of them relatively formal educational efforts several weeks in duration (Blissett & McGrath, 1996; Cohen, Whitmyre & Funk, 1960; Meadow & Parnes, 1958). Paulus (1999) reports that conventional face-to-face groups can benefit significantly by receiving training in the efficient sharing of ideas. Training for facilitators is also an area under study. Paulus (1998) suggests groups should be aided by trained facilitators and that they should alternate between group and private ideation. Further evidence for the impact of training facilitators was reported by Oxley, Dzindolet, and Paulus (1996). Groups in the study which had highly trained facilitators and nominal groups produced significantly more ideas than the participants in other conditions. Additionally participants in the highly trained facilitator condition produced significantly more ideas than participants in other conditions during the last 15 to 20 minutes of brainstorming.

There have been few studies to date, however, which have incorporated an analysis of the impact of brief, highly focused training into a comparison of the

productivity of brainstorming groups and individual efforts. This research, therefore, examines whether brief training in brainstorming allows groups that received the training to outperform groups that did not receive the training. Additionally brainstorming groups will be compared with nominal groups in terms of the number of ideas generated.

This study was designed to answer several specific questions about the effect of training on creative problem solving. In particular, it sought to determine whether brief training in brainstorming techniques influences the productivity of brainstorming groups and whether it differentially impacts the productivity of brainstorming groups compared with the productivity of individuals working alone. Brief training, for the purposes of this study, is defined as training in brainstorming that is less than 20 minutes in duration.

The results of this study can provide insight into how to improve problem-solving ability with (1) additional comparative data on brainstorming and individual efforts, and (2) an analysis of the relationship of training in brainstorming with the amount and quality of solutions produced using both brainstorming and individual efforts. The study was designed to separate training effects from type of group effects on quantity and quality of solutions. For the purpose of this research, solutions are defined as subjects' brief (seven or fewer word) response to a problem; solutions are also referred to as creative ideas.

Findings will allow group leaders in various settings faced with problem situations to determine whether it is worthwhile to use brainstorming approaches to generate workable solutions, and whether brief training in brainstorming has the potential to improve problem-solving performance. For this reason, the research may have pragmatic as well as economic (cost-benefit) applications in the various settings.

## *Review of the Literature*

Brainstorming has been inextricably linked to creativity in the professional literature; arguably, it is one of the most, if not the most, widely known technique of creative problem solving (Fernald & Nickolenko, 1993; Leclef, 1993). This review of the literature on brainstorming examines this method (a) in the context of research on creativity and communication in general, and (b) more specifically in terms of brainstorming productivity research, particularly research on the impact of training on brainstorming productivity.

Many definitions exist for creativity and for the components that comprise creativity. In his 1950 Presidential Address to the American Psychological Association, Guilford described creativity as a multifaceted aspect of personality that went well beyond the simple dimension of intellectual competence, which previously had been the single element identified. By way of example, Christensen, Guilford, and Wilson (1957) examined two of the seven creative-thinking abilities identified by factor analysis. Fluency was the number of responses generated, and originality was a derivation of cleverness, remoteness of association, and uncommonness of association. (The four factors Guilford wrote of appear in much of the literature on creative thinking and include problem sensitivity, fluency, flexibility, and originality.) In this study researchers hypothesized that creative exercises requiring inventiveness compared with exercises requiring pure recall would have a relatively constant rate of idea production, that more original responses would come near the end of the production period, and pertinent to

this point, that instructions to write clever responses versus instructions to write appropriate responses would result in fewer total responses but raise the proportion of clever responses. They found that the same individuals tended to produce more clever responses regardless of the instructions they received, and that the kind of person who gives a larger number of uncommon or remotely associated responses was also likely to give more clever responses. Fluency is of primary concern in the present study and originality of chosen alternatives will be assessed as well. Guilford's conception of the multiple components of creativity has persisted for nearly 50 years and has influenced three generations of theorists.

Guilford's view of creativity, as a pattern of multiple personality traits, has been expanded by later theorists to consider the products, the contexts, and the processes of creativity as well. Of relevance to the present research is the emphasis on products (ideas generated) and processes–essentially elements of communication because participation in the creative process and expressing the product of creative processes must involve an exchange (communication) of ideas.

Taylor (1972), for example, argued for the identification of multiple characteristics to account collectively for creativity, and he began during the late 1950s to measure communication as an integral component of this work. Csikszentmihalyi (1991) acknowledged communication as a critical part of creativity when discussing creativity as a process observed in the interrelations of three parts of a system: the domain, the field, and the person. The domain consists of a set of symbolic rules and procedures. For example mathematics is a domain, or more precisely algebra and number theory can be seen as a domain. The field consists of all people who act as gatekeepers

for the domain determining what constitutes a valuable contribution to the domain. The third component is the person, or actor in the process of creativity. According to Csikszentmihalyi (1996),

> Creativity occurs when a person, using the symbols of a given domain such as music, engineering, business, or mathematics, has a new idea or sees a new pattern, and when this novelty is selected by the appropriate field for inclusion into the relevant domain. (p. 28)

The product of creativity (the idea generated) must be communicated with others. If the product is known only to the creator, it cannot be considered creative according to the definition offered by Csikszentmihalyi. In the present study the written and spoken ideas are the outcomes and are evaluated in terms of quantity and quality. Ideas that were not spoken or written fall outside of the definition of creativity offered by Csikszentmihalyi. In line with Csikszentmihalyi's writing, ideas will be evaluated by an expert in the field to determine the degree of creativity.

Stein (1975) also integrated the aspect of communication in creativity, noting that creativity is "a process that results in a novel product or idea which is accepted as useful, tenable, or satisfying by a significant group of others at some point in time" (p. 253). Brainstorming is often employed when a novel idea is developed and expressed, which precedes the acceptance of an idea. The process of brainstorming falls within Stein's definition of creativity and the outcomes or products of brainstorming can be assessed using Stein's criteria for judging creative assessment. Stein (1975) provided these criteria: a) generally acknowledged creativity; b) representation in secondary sources; c)

expert judgment; d) quantity of products; e) psychometric tests; and f) the process. For purposes of the present paper, expert judgment and quantity of products are of central importance.

Building an even stronger case for the critical link between communication and creativity, Isaksen and Treffinger (1985) synthesized other definitions and suggested that creativity involves making and communicating meaningful new connections that help people to think of numerous possibilities, alter how people perceive their experiences such that they see other points of view, generate new and unusual ideas, and select alternatives to existing ways of thinking.

Torrance and Goff (1989) define creativity as follows:

> . . . the process of sensing problems or gaps in information, forming ideas or hypotheses, testing and modifying these hypotheses, and communicating the results. This process may lead to any one of many kinds of products–verbal and nonverbal, concrete and abstract. (p. 79)

In terms of the specific literature on brainstorming, the technique has been found to be one of the most prominent methods used in problem solving and creativity over the past several decades. Brainstorming has been widely employed in group contexts for making and communicating meaningful new connections (Fernald & Nickolenko, 1993; Jablin & Sussman, 1978; Meadow & Parnes, 1959). As earlier mentioned, brainstorming was introduced by Osborn in 1939, who later elaborated on the approach in various formats–publications, lectures, and interviews published in the popular press. Osborn

made strong claims about the superiority of brainstorming's effectiveness vis-à-vis other techniques for generating ideas in such real-life group settings as factories and offices.

Osborn was convinced that the creativity of groups was negatively impacted by the tendency of group members to evaluate solutions as they were generated in the group context. He often described this tendency as "driving with the brakes on," meaning that evaluative comments by self or others tended to limit the production of creative ideas within group meetings. To override this dynamic, and to improve group problem-solving techniques, Osborn designed the brainstorming session–a time-limited conference period whose single purpose was that group members could produce as many ideas as possible without evaluating any of them.

A major principle underlying this approach was what Osborn termed deferment of judgment, that is, purposefully delaying judgment about an idea's quality during a specified period during which ideas were being generated. This principle does not suggest that Osborn intended that the ideas generated should never be evaluated. Quite the contrary: What Osborn's method of brainstorming did do was purposively separate the idea generation phase of the problem-solving process from the idea evaluation phase. In fact, deferring judgment was one of four major guidelines for the brainstorming process Osborn (1953) detailed, as follows:

> 1. Criticism is ruled out. Adverse judgment of ideas must be withheld until later. The purpose of the brainstorming session is the generation of many, varied and unusual ideas.
>
> 2. Freewheeling is welcomed. The wilder the idea, the better; it is easier to tame down than to think up. Because criticism is temporarily

ruled out, it is acceptable and desired that really wild and unusual ideas are shared.

3. Quantity is wanted. The greater the number of ideas, the greater the likelihood of useful ideas.

4. Combination and improvement are sought. In addition to contributing ideas of their own, participants should suggest how the ideas of others can be turned into better ideas; or how two or more ideas can be joined into still another idea. (pp. 300-301). (This guide presumes evaluation and as such appears to conflict with the first guide.)

In this initial conceptualization, Osborn (1957) described brainstorming as only one technique for generating ideas. Moreover, generating ideas was described as only one part of the total process of creative problem solving.

From the very beginning, however, there were those who were unconvinced about the outcomes claimed. Osborn was criticized for attempting to create a methodology to replace individual creativity when, according to his writings and those of his later supporters, replacing individual efforts with group efforts was not his intention. Osborn also received criticism for promoting or overselling brainstorming–an activity he was considered well equipped to do considering that he was successful advertising executive. Indeed, some suggested that the continued popularity of brainstorming is more a testament to Osborn's salesmanship than to the technique's genuine utility.

Osborn's case study reports (1963) offer strong support for brainstorming as a group conference technique for generating ideas. Yet, social scientists in years

subsequent seldom have found support for brainstorming in a group to be equal to, much less superior to, individual idea generation.

Creative Problem Solving literature continues to offer support for brainstorming as a viable technique. Often brainstorming is examined as part of the creative problem-solving process. Torrance (1987) reviewed studies that examined training for creativity. Of these experimental studies conducted between 1972 and 1983, 166 were conducted at the elementary and secondary levels and 76 at the college and adult level. Of the 13 types of intervention mentioned, 11 resulted in success rates of 54 percent or higher. The Osborn-Parnes CPS intervention (or modification of same) yielded a success rate of 88 percent. Success was defined for the types of intervention by the percentage of dependent measured objectives that resulted from the intervention, for example, fluency, originality, flexibility. In an earlier article, Torrance (1972) reviewed 142 studies conducted before 1972, which involved teaching creativity to children. Success was again defined for these studies by the percentage of measured objectives attained. Of the 142 studies, 103 used the Torrance Tests of Creative Thinking (TTCT) as criteria. TTCT measures quantity of ideas (referred to as fluency) and originality, in addition to other measures. The training intervention type of Osborn-Parnes CPS and/or modifications resulted in a 91 percent success rate, the highest percentage of success reported.

How brainstorming as a group technique compared to idea generation on an individual basis was not of primary importance to CPS researchers, because the group is of primary interest to them when studying creative problem solving. Researchers studying group dynamics, however, are interested in comparing the outcomes of groups with individuals acting alone. Those who examined brainstorming in isolation repeatedly

found strong support for individual brainstorming over group brainstorming with the dependent variable being the number of ideas generated. Both sets of literature offer sound thinking but report conclusions that are at odds with one other.

Much of the literature on brainstorming is comparative in nature, that is, the research reported compares outcomes achieved by brainstorming groups with outcomes achieved using the pooled products of individuals working alone. Almost without exception, brainstorming has been compared with nominal groups–comprised of n subjects (in this research $n$ = 2 to 4) who work individually under brainstorming instructions to generate solutions to a specific problem (Diehl & Stroebe, 1991). Essentially, these comparative studies examined whether a group of individuals who work together using Osborn's brainstorming rules outperform individuals who work individually using the same rules. They compared the nonredundant ideas of n subjects ($n$ = brainstorming group size) working individually to the ideas generated by brainstorming groups.

Many analyses (Bouchard, 1969; Bouchard & Gare, 1970; Campbell, 1968; Dunette, Campbell & Jaastad, 1963; Taylor, Berry & Block, 1958), including the relatively recent work of Bond and VanLeeuwen (1991), Mullen, Johnson and Salas (1991) and Stroebe and Diehl (1991), have made such comparisons. Their findings were generally consistent: nominal groups generally outperformed brainstorming groups in generating ideas (Dillon, Graham & Aidells, 1972, p. 487). As Diehl and Stroebe (1991) noted:

> In a recent review of this [brainstorming] research, we reported that 18 of 22 published experiments found that nominal groups produced a

> greater number of ideas than brainstorming groups. Only four experiments, all involving two-person groups, reported no difference. None of these studies found brainstorming groups superior to nominal groups. (p. 392)

Delving into possible explanations for the apparent superiority of nominal groups, Isaksen and Beaton (1991) suggested that all of the previous (comparative) studies underestimated the effectiveness of brainstorming because they relied on what is described as a relatively confined paradigm within which brainstorming productivity was compared to the productivity of individuals working alone. Isaksen and Beaton proposed that brainstorming productivity could be analyzed more accurately in terms of the methodology's original characteristics and within the specific organizational contexts described by Osborn. The basis for their conclusion about the inconsistency of most of the previous work that compared brainstorming productivity to the productivity of nominal groups was a meta-analysis of 50 studies of brainstorming conducted between 1959 and 1989. They framed six specific parameters for analyzing each study's results: (a) was brainstorming used as a group technique? (b) were the brainstorming groups facilitated? (c) were the subjects trained in the technique? (d) what types of problems were generally used? (e) what types of samples were utilized in the research? and (f) how were outcomes evaluated?

Isaksen and Beaton (1991) noted that the first requirement of a consistent comparison is a comparison of brainstorming with other group techniques. Nominal groups, they argued, are an individual technique rather than a group technique and,

therefore, an inappropriate comparison set. They assert that Osborn's intention was to promote group problem-solving skills–namely, to improve these skills, not to replace individual problem-solving skills. Osborn wrote,

> Despite the many virtues of group brainstorming, individual ideation is usually more usable and can be just as productive. In fact, the ideal methodology for idea-finding is a triple attack: (1) Individual ideation. (2) Group brainstorming. (3) Individual ideation (Osborn, 1963, p. 191).

Osborn never intended the method of brainstorming to replace individual problem-solving efforts. Therefore, they argue it is inappropriate to compare the two types of methods. This perspective is also taken by Smith (1998), who reviewed 172 idea generation techniques. Brainstorming was one of the techniques, which was categorized as an "interpersonal strategy."

Certainly group dynamics scholars would take issue with this point of view. If group problem solving were inferior to individual problem solving, it would not warrant investigation.

A more substantive point is that although strong evidence exists to the contrary, many believe groups are more effective than individuals working alone. The illusion of group productivity appears strong (Paulus, Dzindolet, Poletes & Camacho, 1993). Perhaps popular belief in the efficacy of brainstorming explains why the method continues to enjoy support. Rowatt, Nesselroade, Beggan, and Allison (1997) conducted four studies that examined participants' beliefs about brainstorming. Participants concluded that brainstorming was more important to generate creative ideas, original

ideas, and high-quality ideas than it was to generate as many ideas as possible. This finding suggests that brainstorming may be perceived to be an optimizing task, despite instructions specifying a maximizing task if the respondents did focus on creative ideas that were original and of high quality. Participants reported they would generate more ideas working in a group than working alone, and that they would generate more creative ideas when working in a group than when working alone. Further, participants reported others would benefit more than they would from brainstorming. These findings offer support for the popular belief that brainstorming is an effective group technique.

The second criticism cited by Isaksen and Beaton of brainstorming research involves facilitation. All of the groups Osborn cited had a designated leader. The leader or facilitator functions to keep the group generating ideas. For example, a person can only express one idea during a turn at speaking, so that hitchhiking can occur. Also, the facilitator sets short-term goals, such as "Let's get 10 more ideas," or "Let's break 100." When brainstorming is compared with other (group) problem-solving methods, therefore, the brainstorming group should be one that is facilitated.

Third, they raise the issue of training for brainstorming. Isaksen and Beaton (1991) suggested that brainstorming must be learned before it can be employed, noting that Osborn incorporated training for the problem-solving process that included 30 minutes of training specific to brainstorming. Brainstorming is sufficiently complex to require training.

A fourth area of comparison has to do with the types of problems typically utilized in research studies. Unlike Osborn's real problems encountered in business organizations, Isaksen and Benson found the problems typically used in studies were

generally unreal, poorly presented, and ones for which the group had no ownership, that is the group was not involved in the problem (p. 4). They suggest a valid study of brainstorming would utilize realistic problems.

Sample populations were also discussed in the comparison. College students constitute the sample populations of 45 of the 50 studies Isaksen and Beaton reviewed. Brainstorming, according to Osborn, was designed primarily for adults in real situations. The groups Osborn used may differ from groups of college students because Osborn's groups often had extensive subject knowledge and significant rewards dependent on the outcomes. These differences may call into question the generalizability of the findings from studies conducted with college students to non-college student populations.

Another problem for Isaksen and Benson relative to the studies they examined was the evaluation of outcomes. The authors observed that most frequently the dependent measure was the number of ideas generated–seldom, if ever, a consideration outside laboratory settings. Quality of ideas was only occasionally assessed. Isaksen and Beaton noted that in organizational practice, selection of one alternative solution typically takes place, and that alternative is chosen in large part on the basis of its quality. They also point out that if an overall measure of quality were taken for brainstorming and nominal groups, the overall quality for the brainstorming groups would be lower. This prediction is due to the fact that brainstorming groups are encouraged to generate wild ideas, and the silly or wild ideas would adversely affect the overall quality ratings for the brainstorming group.

Quality was measured in a study by Parnes and Meadow (1959) which assessed the number of "good" ideas generated. In this instance good was computed using a

measure of the uniqueness and value of each idea generated. They reported students who had taken a semester long course in creative problem solving generated a higher number of good ideas than students who had not taken the course. They also found significant correlations between quantity and quality.

Taylor, Berry, and Block (1958) found that higher quality (defined as feasibility, generalizability, and effectiveness) correlated with higher quantity. It bears noting that in this study nominal groups outperformed brainstorming groups. In sum, quality as a dependent measure deserves more study.

### *Training*

There is a limited amount of literature on the effect of training on brainstorming productivity, and most of it focused on the number of ideas (solutions) produced under various training conditions. Isaksen and Beaton considered subjects trained if they received a minimum of 30 minutes or more of direct instruction. Only 7 of the 50 studies included in the review of literature by Isaksen and Beaton (1991) met that standard for training. Levine's (1996) study also meets this standard. Although duration is often mentioned in the studies, content is certainly important.

Meadow and Parnes (1958) reported that subjects who had taken a one-semester course in creative problem solving generated significantly more ideas than those in a control group. Parnes and Meadow (1959) found trained subjects, those who had taken a semester long course, produced more good ideas, regardless of whether the instructions specified quantity of ideas or quality of ideas. Firestien and McCowan (1988) compared

groups composed of students from an Introduction to Creative Studies course with students who had not taken the course. They examined the number of ideas generated and several communication assessments. The trained groups, who had received 32.5 hours of training, generated significantly more ideas than the untrained groups. The trained groups had a mean of over 27 ideas compared to a mean of 14 for the untrained groups. Additionally, the trained groups exhibited more participation, less verbal criticism, more verbal indicators of support, more verbal indications of laughter, and more smiles.

In 1960 Cohen, Whitmyre and Funk explored the relationship between training, group cohesion, and problem type. Training consisted of a 10-hour course in creative thinking. Other independent variables were cohesiveness and ego involvement. All of the participants ranked all other participants within their training groups in terms of partner preference for brainstorming. Cohesive groups were formed by pairing participants who chose each other within the top six of their preferred brainstorming partners. For ego-involving problems, trained cohesive and trained nominal groups produced significantly more unique ideas than untrained counterparts. Training did not have an impact on results of the noncohesive groups. They reported an interaction effect such that in the number of ideas generated for ego-involving problems, cohesive, trained groups significantly outperformed all other groups. In conditions using non-ego–involving problems, trained groups generated more ideas than nontrained groups, but the results were not statistically significant.

Dillon, Graham, and Aidells (1972) were among the first to demonstrate that not all types of training have positive effects on the mean number of responses. Factors in this study were videotape training, brainstorming practice, and type of group (nominal or

brainstorming). All participants viewed a 4-minute videotape that contained either individual or group brainstorming instructions. Those in the individual condition heard, "the following rules are for groups. You will be working alone. However, I want you to apply these rules as best you can while working on the problem. What we are interested in is whether or not an individual can brainstorm and how he/she does it." The instructional tape for the group condition was worded appropriately for groups.

Then the subjects in the trained condition saw a 10-minute videotape of a "smoothly functioning, rapidly idea-generating, four-man brainstorming group" working on the "people" problem. Those in the untrained condition did not see the tape, but rather received written instructions and began brainstorming.

The participants in the practice condition worked on the problem 10 minutes, after which their papers were collected. They then worked on the same problem an additional 15 minutes, during which they could use the responses generated during the 10-minute practice session.

The problem for brainstorming was, "Given the current situation of an escalation of this war and the widespread intense reactions across this country, what can you as an individual do to effect change, and what things would you change?" The authors' findings revealed a significant main effect for videotape training, but not in the predicted direction. The videotape training inhibited performance. One explanation offered was that individuals may have been overwhelmed by watching a proficient group. The suggestion was made that videotape training in future studies focus on errors and common violations of brainstorming rules, which the present study does incorporate. A significant main effect for individual versus group brainstorming was obtained. Two

significant interactions occurred, one between videotape training and practice (practice without videotape training before was helpful), and the other between videotape training and type of group (videotape training helped individuals more than it did groups).

More recently, Smith (1993) reported on the positive impact of brief training in brainstorming. Following only 5 minutes of specific training on verbal and nonverbal criticism, trained brainstorming groups outperformed untrained brainstorming groups in terms of the number of ideas produced. Moreover, they had more positive perceptions about the group climate than individuals who were members of untrained groups.

Even more recently, a study by Levine (1996) provided some clues about the relationship between training and the type of group. Levine compared the number of ideas generated by nominal groups, brainstorming groups, and subject-intact groups. Group members were either trained or untrained and were either given the problem in advance (priming condition) or not. All groups met once a week for three weeks. The training was conducted during each of the three weeks. In the first week a script was used for training, and during the second and third weeks videos were played. The content of the first training script is as follows:

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 or off-the-wall. In fact, the wilder the better. Remember, a wild idea isn't necessarily a wrong idea. Just think of some of your favorite commercials and you'll see that wild ideas can work.

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

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

As an example, I will demonstrate how a successful brainstorming session might work. 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.

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 12
- could wear more rings
- better finger painting

Some of the ideas that were "piggybacked" 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 or off-the-wall ideas were:

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

In analyzing Levine's results it is useful to compare the findings between training and no-training conditions for brainstorming and nominal groups. At time one Levine reported an effect for training that approached significance ($p < .10$). Training did improve brainstorming group performance. Training had no impact on performance in nominal groups or on subject-intact groups. Thus, support was found for training, yet questions remained.

The present study in part replicated Levine's design and data analysis, and sought to find greater significance for training effects overall and for training effects in nominal as well as brainstorming groups. In this regard, the present study evaluated three

hypotheses and two research questions. The first hypothesis relates to expected differences in quantity of solutions generated between brainstorming and nominal groups. The related research question is related to the quality of responses between brainstorming and nominal groups. The second hypothesis relates to expected differences in the quantity of solutions generated by individuals who had been trained in brainstorming techniques and those who had not been trained. The final hypothesis relates to the duration of training. The second research question asks if the duration of training affects quality of outcomes. The hypotheses and questions follow:

$H_1$: Subjects brainstorming alone generate more solutions than subjects working in groups.

$Q_1$: Will the solutions generated by brainstorming groups be of higher quality than the solutions generated by subjects who work alone?

$H_2$: Trained subjects generate more solutions than untrained individuals.

$H_3$: Training will be cumulative such that subjects receiving the longest training will generate more ideas than those receiving shorter training who will generate more ideas than those receiving no training.

$Q_2$: Will trained subjects generate solutions of higher quality than individuals who have not been trained?

# CHAPTER 2
# Methodology

This present study was designed to compare the effects of group type and training on the productivity of subjects working on a common problem. The problem posed was how to increase university students' use of a specific airline.

## *Subjects*

Subjects ($n$ = 207) were volunteers enrolled in communication courses at Illinois State University. They were randomly assigned to one of six experimental conditions based on the type of group (brainstorming or nominal) and the training type (no training, 7-minute training, and 15-minute training).

## *Design*

The subjects were randomly assigned to one of six experimental conditions illustrated in Table 1. They comprised 34 brainstorming groups, with a mean of three subjects each; and 34 nominal groups, each comprised of a mean of three subjects who completed problem-solving tasks independently. Of the 34 brainstorming groups, 11 were assigned to the no-training condition, 11 to the 7-minute training condition, and 12 to the 15-minute training condition. Of the 34 nominal groups, 12 were assigned to the no-training condition, 10 to the 7-minute training condition, and 12 to the 15-minute

training condition. The combination of the group types and the three training conditions resulted in a 2 X 3 independent groups design.

Table 1

*Subject Subsamples by Group Type and Training Condition*

| Training Condition | Problem-Solving Approach | |
|---|---|---|
| | Brainstorming | Individual |
| No Training | Subsample A | Subsample B |
| 7-Minute Training | Subsample C | Subsample D |
| 15-Minute Training | Subsample E | Subsample F |

### *Training Conditions*

As is evident from Table 1, subjects were exposed to one of three training conditions. One was a no-training condition, one of the brief training periods was seven minutes in length, and the other was 15 minutes in length.

Subjects assigned to the training conditions watched one of two training videos before undertaking the brainstorming task. Those in the no-training condition proceeded

to the brainstorming tasks after receiving brainstorming instructions (see Appendix C for Brainstorming Instructions).

The shorter training session consisted of a videotape, and included a presentation of brainstorming guidelines, followed by elaboration on each rule through explanations and examples. The examples were demonstrated by an individual working alone on a computer. This feature of the tape was designed to see if training would impact nominal group performance as well as brainstorming group performance. The guidelines emphasized were Osborn's (1957) four rules, which had been employed in most previous studies with one modification, and two additions recommended by Levine (1996). The modification was an amendment to the defer judgment guide adding the statement– "Positive comments are also evaluative." The two additional rules were stated as: "Keep comments brief. No idea should be longer than seven words," and "Do not explain your ideas."

In addition to the full content of the short training videotape, the longer training sessions included a videotape of examples of a group actually brainstorming. Graphics appeared on the screen highlighting when group members followed or violated brainstorming guidelines. Following this group discussion, the videotape presented Osborn's checklist, with elaboration, in the same way the guidelines initially had been stated and elaborated. Osborn's checklist included what could be substituted, combined, adapted, modified (magnified, minimized), to what other uses something can be put, what can be eliminated, and what can be reversed or rearranged.

The problems used in the individual brainstorming examples in both videotapes were excerpted from Fogler and LeBlanc's (1995) *Strategies for Creative Problem*

*Solving* software. The experimenters moderated both training sessions during which the videotapes were presented. (See Appendix J for a more detailed description of the tapes.)

The two group types to which subjects were assigned were (a) individual and (a) brainstorming. In the individual condition each subject worked alone on the problem-solving tasks, and unique ideas for three individuals were pooled; in the brainstorming condition subjects worked on the tasks in groups with (typically) two other subjects.

### *Procedures*

First, subjects were recruited, informed about the project, and asked for their voluntary consent to participate. They completed the Informed Consent Form (see Appendix A). They then completed the study questionnaire (see Appendix B) and received one of three sets of instructions (see Appendix C).

Virtually identical instructions were given orally to subjects in all subsamples, except that the two subsamples in the no-training condition were not told about a training videotape. The brainstorming subsamples receiving training, whether 7 or 15 minutes in length, were given the same instructions having to do with the training tape.

As part of the instruction phase, all six subsamples were read the six guidelines to be followed in brainstorming. After these guidelines were read aloud, subjects in all subsamples were allowed to ask questions. These questions were answered by the investigator before subjects proceeded to a subsequent problem solution phase of the study.

Also during the instructions phase of the study, subjects in all six subsamples were instructed to create a written record of the solutions they themselves generated for the problem of finding other uses for a cardboard box and to record these solutions (or ideas) on the form provided by the investigator (a sample of which appears in Appendix D). Forms were identical for all subsamples. Subjects in brainstorming groups were instructed both orally and in writing that they were to record only the ideas that they themselves spoke in the group and all the ideas they themselves spoke in the group, that is, each person was to record the ideas he or she spoke, not all ideas spoken. Members of brainstorming groups were also informed that their sessions would be tape recorded, and the recorder was visible during the group session.

Those subjects assigned to a training condition received training of either 7 or 15 minutes in length. Subjects then completed two problem-solving tasks to generate solutions. In brainstorming groups, all subjects kept a written record of all ideas personally contributed. The practice problem-solving task presented–to generate uses for a cardboard box–served only as a practice exercise, and the solutions generated were neither coded nor analyzed. Participants were informed that this task was a practice effort, and they were given 1 minute to work on this task and to record their solutions.

The problem used for the study was to generate ideas for how an airline could effectively increase college students' ticket purchases. A brief written description of the problem (which appears in Appendix E along with the instrument participants used for recording their ideas and solutions) was distributed. Subjects were given 10 minutes to generate and record their solutions to the second problem.

Subjects who had worked alone then came together to create a nominal group. Members of nominal groups were instructed to pool their solutions (ideas) without discussing them and to select the best solution in this solution pool. This instruction replicated the experimental procedure employed by Graham (1977). Subjects in brainstorming groups were asked to select the best solution the group had generated by using their written records of solutions to refresh their memories. Subjects in both nominal and brainstorming groups evaluated the best idea or solution generated by their group members during the problem-solving task component of the study, and then individually wrote responses to several additional items (see Appendix F). Participants were then asked to write down the guides for brainstorming (see Appendix G). In conclusion, a debriefing statement was read (see Appendix H).

### *Instrumentation*

The dependent variables of greatest interest in this study were the number of unique, unduplicated ideas generated, the number of piggybacked and judgmental statements made, and the quality of these ideas as rated by the participants and an expert outsider (see Appendix I). Two trained coders counted the number of unique ideas generated by all groups. Coding was accomplished blind; that is, the coders did not know what type of group (brainstorming or nominal) generated the set of ideas being coded. The number of piggybacked statements and judgmental statements was done in a similar manner. The number of piggybacked statements was determined using the written reports. The number of judgmental statements was determined by listening to taped

discussions of the brainstorming groups. Technical difficulties with the taped recordings resulted in a considerable amount of missing data for the assessment of judgmental statements made.

A qualitative assessment of the best ideas selected by each of the 60 groups was made by the head of marketing for a major national airline on five point scales for usefulness, originality, and overall quality. These were the same quality dimensions used by study participants to evaluate their own ideas.

# CHAPTER 3

## Results

The subjects collectively generated 3,790 ideas or solutions to the experimental problem: How can airlines increase ticket purchases by college students? These ideas included duplicated ideas generated independently by members of nominal groups. Of these ideas, 2,568 (67.75%) were considered by the experimenter and the second rater to be unduplicated ideas within each group. Inter-rater reliability on this issue was assessed by correlating raters' scores, and was found to be .91

The mean number of unduplicated solutions generated per group for the 68 groups across all six experimental conditions was 37.21, with a range of 14 to 96 solutions per group. Table 2 shows the mean number of solutions generated by groups exposed to each experimental condition.

Table 2

*Mean Number and Standard Deviation* of Ideas Generated in Each Experimental Condition With (N = 68 groups)*

| Training Condition | Brainstorming | Nominal | Overall |
|---|---|---|---|
| No Training | 24.83 | 38.58 | 31.70 |
| | (8.71) | (6.87) | (10.40) |
| 7-Minute Training | 28.91 | 53.20 | 41.15 |
| | (4.81) | (21.46) | (19.32) |
| 15-Minute Training | 38.45 | 49.83 | 43.69 |
| | (14.00) | (23.68) | (20.08) |
| Overall | 30.73 | 47.26 | 37.21 |
| | (11.19) | (19.198) | (17.62) |

*Standard Deviations in parentheses.

A two-way analysis of variance (ANOVA) for independent groups was performed on these data, with group type (nominal, brainstorming) and training (none, 7 min, 15 min) as the independent variables and quantity of ideation as the dependent variable. A summary of this ANOVA is shown in Table 3. A statistically significant main effect was found for group type [$F(1, 62) = 19.94$, $p < .05$) and for training condition ($F(2, 62) =$

4.31, $p < .05$). The group type X training interaction effect was neither substantial nor statistically significant.

These results were used to evaluate Hypotheses 1 and 2, relating to the influence of group type and the training condition on number of ideas produced. The main effect of the group type indicated a statistically significant difference in the quantity of ideas produced by nominal and brainstorming groups. Nominal groups generated significantly more ideas than brainstorming groups. Thus, the data were consistent with Hypothesis 1. This effect was in the predicted direction, and replicates the findings of previous studies that demonstrated, in general, the superior performance of nominal groups compared to brainstorming groups.

Table 3

*ANOVA for Group Type by Training Condition*

| Source | Sum of Squares | DF | Mean Square | F | Significance |
|---|---|---|---|---|---|
| Group Type | 4455.872 | 1 | 4455.872 | 19.939 | .000 |
| Training | 1926.844 | 2 | 963.422 | 4.311 | .018 |
| Group Type X Training | 512.316 | 2 | 256.158 | 1.146 | .324 |
| Residual | 13855.486 | 62 | 233.476 | | |
| Total | 20808.118 | 67 | 310.569 | | |

The second significant main effect noted was for training. This effect was in the predicted direction, with trained groups producing, on average, more ideas than untrained groups. Thus, the data were consistent with Hypothesis 2.

Hypothesis 3 was tested by examining the linear trend for training. Although this trend was substantial ($r = .30$) and statistically significant [$F(1, 62) = 6.98, p < .05$], observing the means in Table 2 indicates that the difference between the number of ideas generated in the 7-minute and 15-minute conditions did not differ substantially. The

results of a subsequent *t* test on these data is consistent with this observation [$t(45) = .44$, $p > .05$). Therefore, the overall trend indicates that training facilitates performance, although the difference between 7 and 15 minutes of training is not substantial.

Although the interaction effect was not statistically significant, it is known that the analysis of variance is relatively ineffective at detecting interactions, particularly when there is more than one degree of freedom associated with the interaction (Rosenthal & Rosnow, 1985). Moreover, examining the data in Table 2 suggests the possibility that group type and training combine nonadditively to affect the quantity of ideation, thus qualifying the conclusions drawn in the preceding paragraphs.

The first notable feature in Table 2 is the substantial difference in within condition variances [$F(5, 62) = 6.93$, $p < .05$, Levene's test], with the larger variances found in the training conditions, that is, those conditions with the larger means (the correlation between mean and variance being .88, $p < .05$. Thus, although mean differences between nominal and brainstorming groups in the no-training and the 15-minute training conditions were nearly identical, because of the vast differences in variances, different substantive conclusions are plausible. In the former instance, and in the 7-minute training condition, nominal groups were much more effective than brainstorming groups [$t(22) = 4.30$, $p < .05$ and $t(19) = 3.66$, $p < .05$, respectively], but in the 15-minute training condition the mean number of ideas generated by nominal and brainstorming groups were within sampling error of one another [$t(21) = 1.39$, $p > .05$].[1] Therefore, it is plausible that 15-minute training improves the performance of brainstorming groups, relative to nominal groups, to the extent that they are equally effective at ideating.

Probing mean differences in training indicates different mean difference patterns for brainstorming and nominal groups. For nominal groups 7-min training groups are more effective than no-training groups [$t(20) = 2.24, p < .05$][2], but the no-training–15 min training and 7-min–15-min training comparisons produce substantially smaller differences [$t(22) = 1.58, p > .05$ and $t(20) = .35, p > .05$, respectively]. In sum, training has relatively modest effects on the performance of nominal groups.

On the other hand, for brainstorming groups, although the difference between no-training and 7-min training is trivial [$t(21) = 1.37, p > .05$], the differences between 15-min training and no-training [$t(21) = 2.83, p < .05$] and between 15-min training and 7-min training [$t(20) = 2.14, p < .05$][3] are more substantial. Therefore, the data are consistent with the proposition that 15-min training improves the performance of brainstorming groups.

The two research questions dealt with the quality of solutions. Quality was evaluated using an airline executive's blind ratings of each group's self-selected "best" idea. Each of the 68 best ideas was rated for overall quality on a scale of 1 to 5, with 5 representing the highest possible quality. Table 4 shows the results of this assessment.

As these results show, the overall quality of the ideas produced for every experimental condition was ranked as generally poor, with a grand mean of 2.36. The results of a two-way analysis of variance for independent groups indicate no evidence of a group type main effect [$F(1,62) = .00, p > .05$], no evidence of a training main effect [$F(2,62) = 1.93, p > .05$], and no evidence of a group type X training interaction effect [$F(2,62) = .133, p > .05$]. Therefore, pertinent to the first two research questions there is no evidence that training or type of group affect the quality of the group's best idea.

Table 4

*Mean Rating of Solution Quality by Experimental Condition*

| | No Training | Short Training | Long Training | Overall |
|---|---|---|---|---|
| Nominal | 2.58 | 2.20 | 2.25 | 2.35 |
| | 0.79 | 1.14 | 0.97 | 0.95 |
| | (12) | (10) | (12) | (34) |
| Brainstorming | 2.75 | 2.09 | 2.18 | 2.35 |
| | 0.97 | 1.04 | 0.98 | 1.01 |
| | (12) | (11) | (11) | (34) |
| Overall | 2.67 | 2.14 | 2.22 | 2.35 |
| | 0.87 | 1.06 | 0.95 | 0.97 |

Finally, an analysis of the effects of group type and training on the number of piggybacked statements was performed. These data are broken down by experimental conditions, and presented in Table 5. Neither training [$F(2, 62)<1$, ns], group type [$F(1,$

62)<1, ns], nor the training X group type interaction [$F(2, 62) = 1.36$, ns] had a significant impact on the number of piggybacked statements.

Table 5.

*Mean Number of Piggybacked Statements Per Condition (Standard Deviations in Parentheses)*

| | No Training | Short Training | Long Training | Overall |
|---|---|---|---|---|
| Nominal | .92 | 1.00 | 2.33 | 1.44 |
| | (1.44) | (1.15) | (2.31) | (1.81) |
| Brainstorming | 1.75 | 1.82 | 1.45 | 1.68 |
| | (1.76) | (2.82) | (2.11) | (2.20) |
| Overall | 1.33 | 1.43 | 1.91 | 1.56 |
| | (1.63) | (2.18) | (2.21) | (2.00) |

Group sizes varied from two to four participants with 4 two-person groups, 59 three-person groups, and 5 four-person groups. Two of the two-person groups were in the

nominal short training condition and two were in the brainstorming no-training condition. Of the 5 four-person groups two were in the nominal short training condition, one was in the nominal long training condition, one was in the brainstorming no-training condition, and one was in the brainstorming, long training condition. These frequencies are shown in Table 6.

Table 6

*Frequencies of Two- and Four-Person Groups by Condition*

| Group Size | Nominal | Brainstorming | No Training | Short Training | Long Training |
|---|---|---|---|---|---|
| 4 | 3 | 2 | 1 | 2 | 2 |
| 2 | 2 | 2 | 2 | 2 | 0 |

The means for number of ideas generated are shown in Table 7.

Table 7

*Mean Number of Ideas Generated by Size of Group*

| Group Size | Frequency | Mean Number of Ideas |
|---|---|---|
| 2 | 4 | 19.75 |
| 3 | 59 | 38.00 |
| 4 | 5 | 62.20 |

An effect for group size was evidenced in the data with an $F(2,65) = 8.24$, $p < .01$. Relatively few groups of two and four person groups existed, and they were distributed relatively evenly across conditions, so this effect did not impact the results substantially.

Short and long training were collapsed to examine the data further. The results are shown in Table 8. An ANOVA was performed on this breakdown and the results were consistent with the analysis performed on the data with the short and long training groups separated. A statistically significant main effect was found for group type $F(1,64) = 17.03$, $p < .05$, and for training condition $F(1,64) = 8.06$, $p < .05$. No interaction effect was evident in the analysis $F(1,64)<1$, ns.

Table 8

*Means and Standard Deviations for No-training Conditions and Combined Training Conditions*

| | No Training | Training |
|---|---|---|
| Brainstorming | 24.83 | 33.68 |
| | (8.71) | (11.32) |
| | $n = 12$ | $n = 22$ |
| Nominal | 38.58 | 51.36 |
| | (6.87) | (22.23) |
| | $n = 12$ | $n = 22$ |

# CHAPTER FOUR

## Discussion

The present study found some data consistent with the hypothesis that relatively brief training is an effective means of increasing the number of ideas generated by both nominal and brainstorming groups. Overall, nominal groups outperformed brainstorming groups, but the difference between untrained nominal groups and brainstorming groups in the 15-minute training condition was not significant. No evidence was presented that training affected the quality of ideas generated. The explanation that accounts for this finding is explored in greater detail below, but first limitations of the study are discussed.

The limitations of the study include its available subject pool, the inability of the research design to track (or follow up) whether training effects persist over time, and the necessity for providing all subjects with a period of instructions making a true no-training condition impossible.

The subjects in the study were college students who comprise a specialized subpopulation, not necessarily representative of the population as a whole. The college student population as a whole is relatively homogeneous with respect to educational attainment, age, and other sociocultural variables (such as race and class). These sample limitations underscore the need for caution in generalizing the results of the study to other populations which do not have similar features.

The inability to retest subjects at a later point in time is another cause for caution. Even if brief training is demonstrated to have an effect on the problem-solving skills demonstrated in this study, no assumption should be made that a single brief training

session is sufficient to promote long-term, permanent mastery of brainstorming skills. Contributing to this limitation of the study is that training in every instance immediately preceded immersion in problem-solving tasks. The extent to which brief training may be more easily forgotten has not been measured in this study.

The third limitation is that all subjects received a short period of instruction in how to perform the problem-solving activities, including a description of the task and the guides for brainstorming. The extent to which these instructions were training has not been measured in the present effort. Additionally in the more than 40 years since its introduction, brainstorming has entered into common usage, so it is possible that some of the subjects–especially relevant are the subjects in the no-training condition–had previous knowledge of or experience with the technique.

The findings of this research were generally consistent with recent findings by Levine (1996) and others. Its most significant result had to do with the positive impact of brief training on the performance of brainstorming groups, specifically on the number of ideas produced.

The training used in this study employed repetition in that the guides for brainstorming were displayed graphically, spoken, demonstrated, and summarized. The tapes had a very narrow focus with clear examples that had previously been used in brainstorming training. Simply reading the instructions was ineffective because people may not have paid attention. Participants in the no-training, instruction-only condition generated the lowest number of ideas whether in brainstorming or nominal groups. It may be the case that they expect important information to be repeated and, therefore, do not need to attend the first time they hear something. Repeating the guides for brainstorming

in different ways seemed to make them clearer. Even with this focus and repetition in the tapes, the average number of guides or rules that participants were able to recall at the study's completion was less than three, that is, less than one-half. More precise and better developed training likely can make a difference.

As these results demonstrated, although trained brainstorming groups did not generate more ideas than nominal groups, training did increase the idea production level of brainstorming groups so that it almost exactly equaled that of untrained nominal groups. In this research, untrained individuals who later pooled their unduplicated ideas to form a nominal group created an average of 38.58 solutions to the hypothetical problem of the experiment. Brainstorming groups who received 15-minutes of training before addressing the hypothetical problem created an average of 38.45 solutions to the same hypothetical problem–virtually an identical result.

This finding can be of practical significance in business and professional organizations, especially because the training effect was achieved in this study with a minimum investment of time and resources. While it appears that training individuals to brainstorm may be the method by which most ideas are generated, brainstorming remains a popular technique in many business settings. Isaksen and Beaton's (1991) work provided the best framework for understanding why this outcome is relevant in today's culture.

As Isaksen and Beaton, Katzenback and Smith (1992), McGovern (1991), and others point out, working in groups has become an important organizational reality in many occupational settings in the past two decades. Most large corporations and many small ones have now organized their workforces into teams, committees, or task forces to

accomplish their organizational goals. Organizational success–however it is defined–frequently demands reliance on group processes rather than strictly on individual effort and initiative. As a consequence, methods that improve the performance of groups have value for organizations that have determined that much of their work will be done collectively. In such settings, the demonstrated superiority of nominal groups may be put into practice in some contexts while also implementing brainstorming or other group techniques to recognize that team efforts are valued and supported. Often teams are assumed to contribute to the organizational climate in (sometimes unspecified) ways that the organization intrinsically values; this contribution is seen as reason enough to promote group problem-solving efforts.

In these contexts, techniques that can improve the ability of groups to solve problems have merit because they allow an organization to be more productive compared to its recent past. Information that leads to a more effective distribution of tasks between individuals and groups would benefit organizations as well.

The present research provides evidence that training in brainstorming techniques of no more than 15-minute duration can positively affect a group's ability to use brainstorming to generate significantly more potential solutions to a problem than the group would generate if brainstorming with no training. Training also was demonstrated to improve the number of ideas generated by nominal groups. The present research also demonstrates that this training alone does not markedly impact the quality of ideas generated. The direction of change (toward a positive impact on quality of solutions) after training suggested that modifications in a brief training program could result in the generation of better ideas as well. This area is ripe for future study.

Further examination of quality in the present study was warranted. The quality measure had limitations for both the expert and the participants. The expert would have possibly had better ideas to evaluate if he had been asked to give an overview of the problem to the participants who would be generating ideas. Had the participants been presented with more information and criteria for evaluating ideas from the airline's perspective, the ideas generated may have been of a higher quality. The problem overview could have set the stage for seeking quality. The emphasis in the tape and in the instructions was on quantity, not on quality. Quality was not asked for in the instructions in any way. Quantity was clearly the objective sought by the experimenters. The participants were not introduced to the idea that quality was a component of the study until they were asked to select their best idea. This lack of communication regarding quality created a situation in which the participants could not reasonable be expected to state ideas of high quality. Criteria for what constituted a quality idea were needed if participants were expected to select a high quality idea. In sum, quality was never introduced as a desired outcome for participants and the resulting low scores on the quality measure are not surprising in such a circumstance. Future research might provide a broader overview of the problem, specifically request responses of high quality, and state clearly what the criteria for evaluating quality would be.

In a general sense and given the situation just explained, the findings related to idea quality were the most difficult to interpret. The major reason for this difficulty was the very minimal overall variation in quality across the six experimental conditions. Several possible explanations come to mind.

One of these was discussed earlier in terms of the relationship between the relevance of the problem situation and subjects' interest in and ability to engage in generating solutions. The problem selected was assumed by the experimenter to be one of interest to the college students who were the proposed subjects for the research. The low quality of solutions, however, may be a reflection that the topic was one that did not engage the subjects or that determining what constituted "the best" idea was outside their realm of expertise. Although they collectively generated more than 3,000 solutions in a single problem-solving session, the expert airline executive who rated the solutions for quality judged most to be only between *poor* and *fair* on the 5-point rating scale. Many were rated as *very poor* and only a very few as *very good.*

Another possible explanation for the lack of training effect on quality ratings may lie with the expectations on the rater's part, which may have been too high for the subject pool. The airline executive was essentially applying an evaluative criterion of "quality" from the perspective of an airline–and the subjects had been instructed to ignore evaluative criteria and attempt to be wild and uninhibited in their responses. Perhaps a gap between the college campus and the world of airline ticket promotion (or a generation gap between young students of 19 or 20 and an adult of 50) was principally responsible for the generally depressed quality scores of groups across all experimental conditions in this project. Whatever the reason for the present results related to quality, future research is needed to further examine the impact of training on idea quality.

The airline executive would be considered creative using Csikszentmihaly's (1996) definition, because he has considerable knowledge in the domain and his work has been accepted by the field. Study participants lack knowledge of the domain.

Interestingly several of the "wild" ideas generated by the subjects in this study are being incorporated by airlines currently. None of these suggestions were selected as "best" by the groups.

The method employed in this study to limit the number of ideas rated by an expert failed in its attempt to identify the best ideas. Future research could incorporate a better means of selecting ideas to be rated for quality by an expert, or better yet, include all ideas for expert evaluation. Idea generation principally focuses on the number of ideas that can be generated in a given period or quantity; idea evaluation is focused on how good those ideas are or quality. Future research is needed to investigate how quality can be enhanced.

An aspect of the study deserving further comment is the fit between the task and the participants. The task chosen was thought to be relevant to the participants, and was rated by many of them as relevant. In spite of the reported relevance, the participants demonstrated relatively little knowledge of what would constitute a good idea for the topic. Specifically, the participants did not demonstrate sufficient knowledge to select the "best" ideas from their combined lists. Future research could better insure the participants would have adequate subject expertise by pretesting various problems with the target audience. In the present instance, few, if any, of the participants were likely to know what an airline would consider as usable or original, so they were not in a position of being able to generate high quality ideas. Research would be better served by employing a problem for which the audience had substantial knowledge and for which they could evaluate higher from less high quality responses. Familiarity with the subject matter in a

general sense is insufficient. Thorough knowledge and, ideally, strong interest or involvement with the problem would likely make for a higher quality of responses.

The six questions put forth by Isaksen and Beaton (1991) as criteria for evaluating studies on brainstorming will be employed to summarize the discussion section. The first question is whether brainstorming is used as a group technique. This study used brainstorming as a technique for groups and for nominal groups. Therefore, this study did not completely satisfy the first question. The second question is whether the groups are facilitated. None of the groups in the present study were facilitated. The third question is whether participants are trained in brainstorming. This study did incorporate training. The fourth question deals with the types of problems used. The problem in the present study was rated as relevant by most of the participants. The fifth question asks about the type of sample used in the study. In this study the sample was the target sample of the problem. The sixth question asks how outcomes are evaluated. The present study sought to evaluate the solutions generated by the participants as well as by an outside expert. In sum, the present study addresses four of the six questions. Problem type and evaluation of quality could both be better addressed with the benefit of hindsight. These questions form a useful foundation for constructing studies on the topic of brainstorming.

### *Recommendations*

Little research has been done to date to test the basic assumptions of the brainstorming method as outlined in Osborn's four rules, the primary one of which is that the generation of large number of ideas is inextricably linked to an increased likelihood that better ideas will be generated. Now that the present research and other recent works

have found a main effect of training on the number of ideas produced using brainstorming techniques, it is time to design studies that will examine the conditions associated with the production of better ideas–and the conditions that are not.

This task will require, among other things, the creation of a clear definition of quality ideas or solutions, a determination which to date seems to be conspicuously absent in the professional literature. Nearly 15 years ago, Gryskiewicz (1984) noted, in a remark as apt today as then:

> I believe additional qualitative variables are necessary to clearly identify and evaluate the assets of the creative problem solving technologies (p. 7).

These qualitative variables must include some means of determining the "betterness" of one idea over another, as well as the benefits derived by group members as they utilize the brainstorming process. As Isaksen and Beaton (1991) note, sometimes the outcome being sought when using brainstorming is the benefit to team-building and group involvement. This is another qualitative consideration.

An additional recommendation is to use a sample with mastery of a domain and a problem specific to that domain. The airline problem was considered fairly relevant by the participants in this study. Future research could use domain-specific, relevant problems.

The goal of generating as many ideas as possible is to involve the participant in the activity. This involvement or mindfulness is an effort of will which when tapped in a sustained fashion leads to greater creativity. Involvement also leads to greater

satisfaction. This study did not measure how involved participants were in the process. The results indicate that the reported measure of problem relevance is probably not an adequate measure of involvement. The measure of quantity, while inadequate for assessing solutions, may provide a measure of involvement. When involvement is achieved in brainstorming and better methods are found for measuring it, the research on brainstorming will be able to make a greater contribution to the creativity literature and possibly to working in general as well.

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# APPENDICES

## APPENDIX A

### Verification of Informed Consent

This series of exercises and questionnaires will measure how people react to creative problem-solving situations. You will be asked to participate in two creative problem exercises, and to answer questions about yourself and the group. Some questions will ask you to check the response that best represents your options, while other questions will ask you to write out your thoughts as completely as possible. The exercises will be performed in one session and the session will take less than one and one-half hours.

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 his or her involvement through the course of this 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:

Sally Blomstrom

2484 Shattuck Avenue

Suite 225

Berkeley, CA 94704-2029

Phone: 510-548-6200

E-Mail: sally@fea.com

Please indicate your consent to participate by signing below.

I _____ voluntarily agree to participate in this research effort by taking part in this experiment.

_____ _____

Signature Date

_____ _____

Communication Course T. A.

## APPENDIX B

### Study Questionnaire

Please answer the following questions.

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 kind 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 kind 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 kind of activity?

_____

4. 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 now? *(Please circle one.)*

Freshman Sophomore Junior Senior Graduate Lifelong Learner

## APPENDIX C

### Instructions for Facilitators

### Training, Nominal

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

There are six guides to be followed in this brainstorming session:

**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. This means that you need to refrain from stating your opinion about either your own or someone else's idea.

**2a.** Avoid positive opinions as well as negative opinions.

**3.** Include all ideas, even those which you might consider to be wild or off-the-wall. In fact, the wilder the better. Wild ideas may either eventually be or lead to a chosen solution.

**4.** Feel free to "piggyback" by using one idea as a springboard for additional suggestions.

**5.** Keep your comments brief. Ideas should be expressed in five or fewer words.

**6.** Do not explain your ideas.

Are there any questions? *(Questions will be answered.)*

The rules will be posted so that you can refer to them at any time.

Now you will view a video that reviews these rules in detail, suggests ways to continue generating ideas if you get stuck, and shows an individual and groups brainstorming.

Are there any questions? *(Questions will be answered.)*

We ask you to brainstorm on other uses for a cardboard box. You will have 5 minutes to brainstorm. Please write all your ideas on the sheet of paper provided. Any questions? *(Sheet is distributed. Timer is set for 5 minutes.)*

Now we ask you to brainstorm in the same fashion for the next 10 minutes on a new problem. A start-up airline is seeking to increase their passengers of college students. The airline believes that as a college student, you have unique insight for how they can effectively appeal to you and other college students to fly with them. Brainstorm ways for the airline to have more college student passengers. Again, please write your responses on the sheet of paper provided. Any questions?

Thank you. Now we ask that you meet with two other people who have been working alone.

*(When the three are together)* Please select the best idea from the ideas individually generated by each of you.

*(When the best alternative is selected)* Now please answer the following questions. *(Distribute questionnaires.)*

*(When finished)* Thank you very much for participating. *(Debrief)*

**Instructions for Facilitators**

**No-Training, Nominal**

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

There are six guides to be followed in this brainstorming session:

**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. This means that you need to refrain from stating your opinion about either your own or someone else's idea.

**2a.** Avoid positive opinions as well as negative opinions.

**3.** Include all ideas, even those which you might consider to be wild or off-the-wall. In fact, the wilder the better. Wild ideas may either eventually be or lead to a chosen solution.

**4.** Feel free to "piggyback" by using one idea as a springboard for additional suggestions.

**5.** Keep your comments brief. Ideas should be expressed in five or fewer words.

**6.** Do not explain your ideas.

Are there any questions? *(Questions will be answered.)*

The rules will be posted so that you can refer to them at any time.

We ask you to brainstorm on other uses for a cardboard box. You will have 5 minutes to brainstorm. Please write all your ideas on the sheet of paper provided. Any questions? *(Sheet is distributed. Timer is set for 5 minutes.)*

Now we ask you to brainstorm in the same fashion for the next 10 minutes on a new problem. A start-up airline is seeking to increase their passengers of college students. The airline believes that as a college student, you have unique insight for how they can effectively appeal to you and other college students to fly with them. Brainstorm ways for the airline to have more college student passengers. Again, please write your responses on the sheet of paper provided. Any questions?

Thank you. Now we ask that you meet with two other people who have been working alone.

*(When the three are together)* Please select the best idea from the ideas individually generated by each of you.

*(When the best alternative is selected)* Now please answer the following questions. *(Distribute questionnaires.)*

*(When finished)* Thank you very much for participating. *(Debrief)*

**Instructions for Facilitators**

**Training, Brainstorming Groups**

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

There are six guides to be followed in this brainstorming session:

**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. This means that you need to refrain from stating your opinion about either your own or someone else's idea.

**2a.** Avoid positive opinions as well as negative opinions.

**3.** Include all ideas, even those which you might consider to be wild or off-the-wall. In fact, the wilder the better. Wild ideas may either eventually be or lead to a chosen solution.

**4.** Feel free to "piggyback" by using one idea as a springboard for additional suggestions.

**5.** Keep your comments brief. Ideas should be expressed in five or fewer words.

**6.** Do not explain your ideas.

Are there any questions? *(Questions will be answered.)*

The rules will be posted so that you can refer to them at any time.

Now you will view a video that reviews these rules in detail, suggests ways to continue generating ideas if you get stuck, and shows an individual and groups brainstorming.

Are there any questions? *(Questions will be answered.)*

We ask you to brainstorm on other uses for a cardboard box. You will have 5 minutes to brainstorm. In addition to speaking your ideas, please write each idea you speak on the sheet of paper provided. Remember not to judge your own ideas or those of others. Write all the ideas you speak, and only the ideas you speak on the paper. Any questions? *(Sheet is distributed. Timer is set for 5 minutes.)*

Now we ask you to brainstorm in the same fashion for the next 10 minutes on a new problem. A start-up airline is seeking to increase their passengers of college students. The airline believes that as a college student, you have unique insight for how they can effectively appeal to you and other college students to fly with them. Brainstorm ways for the airline to have more college student passengers. Again, please speak your responses and write your spoken responses on the sheet of paper provided. Any questions?

Thank you. Please select the best idea from the ideas generated by the group. You can refer to your sheets.

*(When the best alternative is selected)* Now please answer the following questions. *(Distribute questionnaires.)*

*(When finished)* Thank you very much for participating. *(Debrief)*

**Instructions For Facilitators**

**No-Training, Brainstorming Groups**

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

There are six guides to be followed in this brainstorming session:

**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. This means that you need to refrain from stating your opinion about either your own or someone else's idea.

**2a.** Avoid positive opinions as well as negative opinions.

**3.** Include all ideas, even those which you might consider to be wild or off-the-wall. In fact, the wilder the better. Wild ideas may either eventually be or lead to a chosen solution.

**4.** Feel free to "piggyback" by using one idea as a springboard for additional suggestions.

**5.** Keep your comments brief. Ideas should be expressed in five or fewer words.

**6.** Do not explain your ideas.

Are there any questions. *(Questions will be answered.)*

The rules will be posted so that you can refer to them at any time.

We ask you to brainstorm on other uses for a cardboard box. You will have 5 minutes to brainstorm. In addition to speaking your ideas, please write each idea you speak on the sheet of paper provided. Remember not to judge your own ideas or those of others. Write all the ideas you speak, and only the ideas you speak on the paper. Any questions? *(Sheet is distributed. Timer is set for 5 minutes.)*

Now we ask you to brainstorm in the same fashion for the next 10 minutes on a new problem. A start-up airline is seeking to increase their passengers of college students. The airline believes that as a college student, you have unique insight for how they can effectively appeal to you and other college students to fly with them. Brainstorm ways for the airline to have more college student passengers. Again, please speak your responses and write your spoken responses on the sheet of paper provided. Any questions?

Thank you. Please select the best idea from the ideas generated by the group. You can refer to your sheets.

*(When the best alternative is selected)* Now please answer the following questions. *(Distribute questionnaires.)*

*(When finished)* Thank you very much for participating. *(Debrief)*

## APPENDIX D

### Practice Problem Recording Form

*On this sheet please write out your ideas for possible other uses for a cardboard box. PLEASE WRITE LEGIBLY.*

## APPENDIX E

### Study Problem Recording Form: The Airline Goes to College

Now we ask you to brainstorm in the same fashion for the next 10 minutes on a new problem. After brainstorming you will select the best idea.

An airline is seeking to increase their business with college students. The airline believes that as a college student, you have unique insight for how they can effectively appeal to you and other college students around the country to fly with them.

Brainstorm ways for the airline to have more college student passengers.

## APPENDIX F

### Selected Alternative Evaluation Form

Please write down the best idea selected by your group.

_____

Please rate the chosen idea in terms of uniqueness.

Very Unoriginal ___ ___ ___ ___ ___ Very Original

Please rate the chosen idea in terms of usefulness.

Not At All Useful ___ ___ ___ ___ ___ Very Useful

Please rate the chosen idea for overall quality.

Very Low Quality ___ ___ ___ ___ ___ Very High Quality

Do you agree that the chosen alternative is best?

_____ Yes _____ No

Which alternative would you choose?

_____

Please rate the idea you would choose in terms of uniqueness.

Very Unoriginal ___ ___ ___ ___ ___ Very Original

Please rate the idea you would choose in terms of usefulness.

Not At All Useful ___ ___ ___ ___ ___ Very Useful

Please rate the idea you would choose for overall quality.

Very Low Quality ___ ___ ___ ___ ___ Very High Quality

Please rate how relevant this problem is for you.

Not At All Relevant ___ ___ ___ ___ ___ Very Relevant

## APPENDIX G

### Recall of Brainstorming Guides

List the guides for brainstorming stated in the instructions.

## APPENDIX H

### Debriefing Statement

Thank you very much for participating in this study. We appreciate your contribution. Here is the basic overview of what we were investigating. In 1952 Alex Osborn, an advertising executive wrote a book called *Applied Imagination* in which he presented the concept of brainstorming. He reported great success with the technique in terms of number of ideas generated and the quality of those ideas. Since that time numerous studies have been conducted to study brainstorming and many found that more and better ideas were generated by individuals whose efforts were pooled together than were generated by brainstorming groups. We wanted to see if training made a difference, thinking that most people are not trained in brainstorming, and that if they were they would be better able to generate many ideas and ideas of higher quality. Approximately half of the participants were trained. It seems that with training, brainstorming groups should be able to perform at a level comparable to or better than individuals whose efforts are pooled. We also wanted to investigate what would happen with a problem that was relevant to the audience, since much of the previous research dealt with problems that were not realistic or relevant to the audience. The final aspect we are investigating is the quality of ideas. In most situations the number of ideas generated is not what matters. Typically the quality of the chosen alternative is important. For that reason we asked you to rate the quality of ideas. The ideas will also be rated by an airline executive.

If you did not see the training tape, it reviewed the guides for effective brainstorming, demonstrated a woman at a computer speaking and typing ideas generated

for problems presented, and Osborn's checklist was presented. This is typically referred to as SCAMPER:

S = what can I substitute?

C = what can I combine?

A = what can I adapt?

M = what can I modify, magnify, or minify?

P = what other uses can I put this to?

E = what can I eliminate?

R = what can I rearrange or reverse?

Results of the study are available from Sally Blomstrom. You can email her at *<sally@fea.com>* to get the results.

Please do not speak about this study to anyone for the next week, as students from other classes will be participating and we want everyone who participates to have the same information about the study when they take part.

Again, thank you.

## APPENDIX I

### Directions for Coding Data

**For the sheets:**

Use the sheets written out by the group members. The total number of ideas for the group is the total number of unique ideas generated by the three participants.

Code the number of ideas written by each individual. Sum the ideas for each group by counting the nonduplicated ideas of the individual members.

From the sheets, count the number of wild ideas. These are ideas you consider unusual.

Count the number of piggybacked ideas, that is, an idea that builds directly and clearly on the idea preceding it.

**Using the tapes:**

Code the total number of judgment statements made in the group.

## APPENDIX J

### Description of Training Tapes

The brief training tape consisted of two experimenters introducing brainstorming by stating the guides for brainstorming. These included (a) generating as many ideas as possible, (b) not evaluating any ideas during the session and reminding viewers that positive statements are also evaluative, (c) including all ideas stating that the wilder the idea the better, (d) feeling free to piggyback using one idea as a springboard for others, (e) keeping ideas brief, and (f) not explaining ideas. Each rule was read and displayed on the screen. A brief explanation of each guide was given. Then one of the experimenters sat at a computer screen and demonstrated each rule by typing solutions to problems taken from Fogler and LeBlanc (1995.) The demonstration for generating as many ideas as possible was shown by typing several ideas at a relatively quick and constant pace and stating what the experimenter was doing. The problem used in this example was imagine Michigan State University and the University of Michigan merged into one entity, Michigan University. What are some of the consequences that result from such a merger? A wild idea was demonstrated by typing several responses to the posed problem and then typing what could be considered an off-the-wall response. The statement of guides for brainstorming, briefly explaining each, and demonstrating each was the content for the short training tape.

The longer training tape consisted of everything in the first tape along with a demonstration of a group brainstorming and the introduction of Osborn's checklist, which are ideas for generating more ideas. The group that was modeling brainstorming

had received about 15 minutes of training and had some practice at brainstorming. They were slightly better skilled at the task than the viewers were assumed to be. They had explicitly been instructed to demonstrate each of the rules. During the course of the footage a graphic appeared on the screen stating a rule and whether it was being applied or ignored. Both applications and violation of guides were demonstrated and the corresponding graphic displayed. Following the modeling portion, Osborn's checklist was presented. These ideas include what can be substituted, combined, adapted, modified, eliminated, reversed or rearranged, and to what other uses can you put something. A summary was provided in conclusion.

## ENDNOTES

[1]Normally, a correction would be made for the number of tests performed, but because of the small number of observations and the substantive nature of what is being tested, the more pressing concern is Type II, not Type I, error. Hence, these *t* tests do not employ the Bonferroni Correction. Moreover, the same inference would be made in each case regardless of whether the test was one-tailed or two-tailed.

[2]These two variances are heterogeneous, and if the assumption of homogeneity of variance is relaxed, this difference does not quite reach conventional levels of statistical significance, that is, $p < .07$.

[3]The comment made in Note 2 applies to this test as well.


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