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ABSTRACT

Noting that brainstorming remains a very popular means of idea generation despite considerable research evidence to the contrary, this paper attempts to debunk the brainstorming myth by first critically reviewing the claims advocating brainstorming and the data supporting these claims. The paper discusses the social science research relevant to brainstorming groups versus nominal groups (which are composed of individuals who do not interact), followed by a review of the explanations that have been developed to explain that literature. Since no single explanation appears to rectify the brainstorming literature, appropriate characteristics of future brainstorming explanations are discussed. Finally, a comparison is made between how brainstorming was initially conceptualized and how it has been operationalized in research. The paper concludes that many potential research avenues await the curious researcher. (Contains 22 references.) (RS)

The Brainstorming Myth

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Abstract

Brainstorming remains a very popular means of ideation (i.e., idea generation) despite considerable research evidence that brainstorming groups fail to generate as many ideas as nominal groups composed of individuals who do not interact. This paper attempts to debunk the brainstorming myth by first critically reviewing the claims advocating brainstorming and the data supporting these claims. The social science research relevant to brainstorming versus nominal groups is reviewed followed by a review of the explanations that have been developed to explain that literature. Since no single explanation appears to rectify the brainstorming literature, appropriate characteristics of future brainstorming explanations are discussed. Finally, a comparison is made between how brainstorming was initially conceptualized and how it has been has been operationalized in research. It is concluded that many potential research avenues await the curious researcher.

The Brainstorming Myth

This paper is designed to debunk the myth surrounding the group process called brainstorming. To debunk means "to expose the falseness or exaggerated claims of" (American Heritage Dictionary, 1980). Therefore, this paper will consist of several sections. First, the claims made by Osborn (1957), the father of the brainstorming technique, will be reviewed, followed by a critical discussion of the evidence he presented in support of brainstorming. Second, the social science research relevant to brainstorming (i.e., brainstorming versus nominal groups) will be discussed. Third, explanations that have been generated to explain the difference between brainstorming and nominal ideators will be reviewed and a summary of what future explanations should look like will be presented. Finally, the brainstorming claims developed by Osborn (1957) will be discussed in relation to the data reviewed. This final discussion will center upon the extent to which research have failed to investigate what Osborn originally formulated.

Brainstorming: The Procedure

The social science literature on 'brainstorming' has centered upon the relative effectiveness of interacting (i.e., brainstorming) and non-interacting (i.e., nominal) groups in the production of ideas. This varies somewhat from what Osborn (1957) originally described as brainstorming. Therefore, discussion of the original formulation of brainstorming is warranted.

Alex Osborn, founding partner of the Batten, Barton, Durstine, and Osborn advertising firm, was consistently frustrated by employees' lack of

creativity in problem solving or idea generation. In an effort to break mental blocks inhibiting creativity, Osborn (1957) developed an extensive set of procedures on freeing imagination. One central component of these procedures (which developed into an extensive training manual and two editions of a book) was the separation of judgemental from creative processes. Osborn (1957) argues that people engage in both judgemental and creative thought patterns and that individuals have a strong tendency to emphasize judgement over creativity. Finally, Osborn argues that the focus on judgement serves to inhibit the creative imagination. If one is concerned with potential negative evaluation, optimal creativity will not be reached.

The key to freeing one's imagination, according to Osborn (1957), is suspended judgement. Suspended judgement requires that creative processes be entirely separated from the judgemental ones. Only when the 'jamming' influence of judgemental thoughts are eliminated can creative juices flow optimally. Osborn says "When driving for ideas you can go further if you keep your foot off the brake" (1957, p. xx).

Brainstorming as an ideational technique depends on suspended judgement. The name arose according to Osborn (1957) because group members were ". . . using their brain to storm a problem" (p. 80; emphasis in original). According to Osborn (1957), in order to be maximally productive, brainstorming groups should follow four rules:

"(1) Criticism is ruled out. Adverse judgement of ideas must be withheld until later.

(2) "Free-wheeling" is welcomed. The wilder the idea, the better; it is easier to tame down than to think up.

(3) Quantity is wanted. The greater the number of ideas, the more the likelihood of winners.

(4) Combination and improvement are sought. In addition to contributing ideas of their own, participants should suggest how ideas of others can be turned into better ideas; or how two or more ideas can be joined into still another idea." (p. 84; emphasis in original).

These rules are designed to generate a large number of ideas (rule 3) by sparking creativity (rules 2 and 4) through suspended judgement (rule 1).

It is the final rule which leads to a prediction that groups should generate more ideas than individuals. First, Osborn (1957) argues that the nature of group ideation allows for idea generation though the power of association (or what he calls 'sparking' or 'chain reactions'). Member A presents an idea to the group. The power of association might then 'spark' novel ideas both in the Member A him/herself and in other group members. Obviously, if ideas are not expressed verbally, they cannot create new ideas in other group members.

Osborn also argued that the "stimulative effect of rivalry" (p. 83) should provide groups with an ideational advantage. He claims that a spirit of friendly rivalry is important in brainstorming groups because it increases mental work and motivation. "Such motivation counts more in ideation than in almost any other mental function because true creativity more largely depends on application of effort" (p. 83).[1] Osborn refers to optimal brainstorming sessions as sort of a friendly game with rivalry where an effort is made to improve on old, and present new and better ideas (see rule four of brainstorming, above). Although rivalry is

produced, it is important that the group environment be relaxed, like a picnic as ". . . a relaxed mood is conducive to successful brainstorming" (Osborn, 1957, p. 240).

Brainstorming: The Claims [The Bunkum]

Throughout his book, Osborn (1957) consistently claimed that brainstorming groups, or the use of suspended judgement, is the most effective available means of idea generation. The most specific claim that Osborn (1957) makes in comparing groups to individuals is that

> "In the same length of time, under proper conditions, the average person can think up about twice as many ideas when working with a group than when working alone - unless the individual ideators adhere to the brainstorming principles of suspended judgement" (Osborn, 1957, p. 229-230).

In making this claim, however, the superiority of groups over individuals as ideators is equivocal when both use suspended judgement. Osborn does claim, however, that if group ideation creates rivalry and associations, groups should exceed individuals in the number of ideas created even though both use suspended judgement.

Osborn, as one might expect, is enthusiastic in his support for brainstorming, making several unsubstantiated claims regarding its benefits. "The quantitative results of joint ideation are beyond question" (Osborn, 1957, p. 82). "Countless group brainstorming sessions have been held from coast to coast, and nearly all have been worthwhile in terms of the ideas produced. Fiascoes are usually due to failures of leadership" (p. 80). "The very fact that a set of principles and procedures has been widely adopted might reasonably be acceptable as

partial proof of their validity" (p. 230).

Osborn's (1957) evidence supporting these claims is primarily anecdotal. There are many reports of brainstorming groups generating an impressive sounding number of ideas in a limited period of time. For example, "In 90 minutes, 10 people produced 87 ideas" (Osborn, 1957, p. 86). The other form of evidence supporting brainstorming came from brief descriptions of studies performed at the University of Buffalo (funded by the Creative Education Foundation, headed by Alex Osborn). Reporting of these experimental data is cryptic (not surprising, though, since the data did not appear in professional journals until 2 years after the publication of Osborn, 1957).

With Osborn's (1957) anecdotal evidence, however, comes the seeds of doubt as to group brainstorming's efficiency. Consider the example provided above where ten group members produced 87 ideas in 90 minutes. While 87 ideas (and a rate of 1 idea per minute across 90 minutes) sounds impressive, it represents only 9 ideas per group member or one idea per member every 10 minutes. When put in these terms, brainstorming generates what sounds like an impressive number of ideas, however, brainstorming's efficiency as an ideation technique becomes questionable.

In another example of brainstorming's potential inefficiency Osborn (1957) reports that one group of 200 training directors brainstormed "well over 100" promising ideas in less than 30 minutes. Here an average of less than one promising idea per group member was reached in a half-hour of ideation. Again, the efficiency of brainstorming groups appears questionable.

Brainstorming: The Experimental Evidence

The question at the heart of considerable research interest is the extent to which brainstorming groups are able to generate more ideas, and higher quality ideas, than nominal groups, i.e., than the same number of individuals working without interacting (presuming that both are using suspended judgement). The purpose of this section is not to comprehensively review the brainstorming versus nominal group literature because several excellent reviews exist including a recent meta-analysis (see Jablin & Seibold, 1978; Lamm & Trommsdorff, 1973; Mullen, Johnson, & Salas, 1991). These reviews will be relied upon heavily in discussing the brainstorming versus nominal group literature.

The initial brainstorming research (Meadow and Parnes, 1959) performed at the University of Buffalo focused on the effectiveness of a college course on creative problem solving (based on Osborn, 1957) rather than on the efficiency of brainstorming as an ideation technique. Other research in this same series (Meadow, Parnes, & Reese, 1959; Parnes & Meadow, 1959) investigated the effectiveness of brainstorming instructions, but did not delve into the question of brainstorming and nominal groups. Therefore, the "Buffalo data," though consistent with the Osborn's (1957) ideas and predictions, are not relevant to the present question, in large part because all these studies used individual rather than using both individual and group ideation (see also Parnes, 1961).

The first, now classic, study comparing group and individual ideation was performed by Taylor, Berry, & Block (1958). Taylor, et al., made an important methodological contribution when they contended that comparing group and individual ideators was not the right question to ask because

". . .the performance of a group should be superior to that of an individual, simply because in the group more individuals are working on the problem" (1958. p. 25). As a consequence, Taylor et al., created what they called nominal groups. In nominal groups, participants work individually and their efforts are pooled with other individual workers. These nominal groups create a performance baseline from which interacting (i.e., brainstorming) groups can be compared. Given Osborn's (1957) description of group ideation (i.e., power of association and friendly rivalry), one would expect brainstorming groups to produce significantly more and better ideas than nominal groups.

Taylor et al., (1958) compared the performance of 12 interacting, brainstorming, groups (each with four members) with 12 nominal groups randomly created from 48 participants who worked on the same problems while alone. Both brainstorming and nominal groups were given brainstorming instructions. Results indicated that nominal groups generated over 80% more ideas and more unique ideas than did brainstorming groups. This is quite inconsistent with Osborn's (1957) description of brainstorming groups.

Thirty-five years of subsequent research and three reviews of the brainstorming versus nominal group literature (Jablin & Seibold, 1978; Lamm & Trommsdorff, 1973; Mullen, et al., 1991) clearly indicate that the Taylor et al. (1958) data are not an anomaly. All three reviews conclude that a vast majority of published studies find that nominal groups exceed brainstorming groups in the number and quality of unique ideas generated.

Mullen et al., (1991) provide the most precise presentation of these data. Of the 34 studies included in the meta-analysis which investigated

the quantity of ideas 24 reported superior performance in nominal groups. More to the point, the average effect size (i.e., correlation) between group type (nominal or brainstorming) and the number of ideas generated was a robust .572 (significant to 50 decimal places) indicating a strong tendency for nominal groups to produce more ideas than brainstorming groups.

Across the nine studies included in Mullen et al.'s meta-analysis which assessed the quality of contributions, seven reported significantly greater performance in nominal groups (the remaining two studies reported no significant difference between group types). The average effect size between group type and the quality of contributions was an equally robust .558 (significant "only" to 33 decimal places), again indicating a strong performance advantage to nominal groups.

Beyond the simple magnitude of process losses in brainstorming groups, Mullen et al. (1991) also investigated the extent to which four moderator variables (i.e., group size, experimenter presence, response mode [written or oral], and type of nominal group [alone or together]) influenced the extent to which nominal groups exceed brainstorming groups in the quality and/or quantity of ideas generated. They conclude that all four variables moderate the impact of group type (nominal versus brainstorming) on the quality and/or quantity of contributions.

First, group size significantly influenced nominal group's performance advantage over brainstorming groups for both the quality and the quantity of ideas. Specifically, the performance advantage of nominal groups tended to increase strongly as groups increased in size (Mullen, et al., 1991). This is inconsistent with Osborn's (1957) claim that the

optimal size of a brainstorming group is about a dozen (though group size exceeded four in only three of the 34 meta-analyzed studies).

Second, Mullen et al., found that the presence of the experimenter influenced the extent to which nominal groups exceed brainstorming groups in the quantity, but not the quality of ideas generated. Nominal group's advantage over brainstorming groups in the number of ideas generated was larger when the experimenter was not present in the room when ideation took place than when the experimenter was present (Mullen, et al., 1991). This is inconsistent with the social loafing literature (Harkins & Jackson, 1985; Latane', Williams, & Harkins, 1979) that predicts that group members will exert greater effort when their contributions can be identified.

Third, studies varied in whether ideas were recorded by means of a tape recorder or written down by each participant. For both quality and quantity of ideas, nominal groups exceeded brainstorming groups to a greater extent when ideas were tape-recorded than written (Mullen, et al., 1991). One implication of having brainstorming group members write ideas down is that there may be some cases where group member might write an idea down without presenting it verbally. To the extent that 'chain reactions' occur in groups the reduction of verbal output could attenuate the number of ideas created in interacting groups.

Finally, studies varied in how the nominal group data were collected. Some studies had nominal group members work alone while other studies had nominal groups ideate individually but in the same room as their fellow nominal group members. Mullen et al. (1991) report that for both the quality and quantity of ideas, the superiority of nominal groups

was greater when nominal group members worked individually.[2]

In summary, to quote Osborn (1957) "the quantitative results of joint ideation are beyond question" (p. 82), however, unlike Osborn, Mullen et al.'s (1991) conclusion best fits the data: "It appears to be particularly difficult to justify brainstorming techniques in terms of any performance outcomes, and the long-lived popularity of brainstorming techniques is unequivocally and substantively misguided" (1991, p. 18).

Brainstorming: The Explanations

The case against brainstorming is clear. Brainstorming groups fail to generate the number or quality of ideas generated by the same number of individuals working alone but using the same set of rules. The only current (and enduring) controversy in this literature is why brainstorming doesn't work (see Bond & Van Leeuwen, 1991; Mullen et al., 1991, and Stroebe & Diehl, 1991 for a recent exchange on this issue). Many explanations have been generated, however, none have been able to adequately explain all the experimental data (see Jablin & Seibold, 1978 for the most cogent enumeration of these explanations and the data [not] supporting each).

In an effort to explain their experimental data, Taylor et al. (1958) presented two hypotheses for the lack of productivity in brainstorming groups. First, they posited that despite instructions prohibiting explicit criticism, members of brainstorming groups may feel less free from criticism than members in nominal groups. Criticism in brainstorming groups could be implicit or explicit. As a consequence, brainstorming group members may withhold ideas that might be considered strange or bizarre (Lamm & Trommsdorff, 1973). This "social inhibition" (Jablin and

Seibold, 1978) may well serve to inhibit both the quality and quantity of ideas, because the initially bizarre idea may actually be the creative 'spark' the group has been looking for.

Taylor et al.'s, (1958) second explanation for their data is that group interaction may generate fewer different ideas. Group members are thought to be more likely to follow the same "train of thought." Time spent on one type or category of ideas creates "cognitive inertia" and socially validates the presentation of more ideas in that same area (Jablin & Seibold, 1978, p. 348). Nominal group members' thoughts and ideas, on the other hand, are thought to be free to roam randomly from idea to idea, concept to concept.

Lamm and Trommsdorff (1973), after reviewing the nominal versus brainstorming group literatures, concluded that ". . .the most important source of the inferiority of groups. . . is the operation of the implicit rule that only one group member speaks at a time" (p. 380). Thus, the "production blocking" explanation presumes that while one member speaks, the others must remain silent. That only 1/n group members (where n is group size) can speak at a time inhibits the total number of ideas that can be presented by those n group members.

Jablin & Seibold (1978) present a number of other explanations for the superiority of nominal groups. For example, the social facilitation explanation (see Cottrell, 1972; Zajonc, 1965 for the original formulations of the social facilitation effect) predicts that the presence of others leads to a drive (i.e., arousal) which, in turn, leads to an increased emission of the dominant response (i.e., that response with the greatest probability of occurring). Within the brainstorming context,

Street (1974) argued that the dominant response was to present well-learned (i.e., not terribly creative) ideas. Therefore, the presence of others in brainstorming groups may well inhibit the production of creative responses.

Jablin and Seibold's (1978) "oral communication" explanation predicts that differences in speaking time/participation rates within interacting groups covary with perceptions of group member status (Jablin & Sussman, 1978). Moreover, as the size of perceived status differences increases, members tend to feel that it is more likely that their participation is being evaluated by other group members (Collaros & Anderson, 1969).

Jablin & Seibold (1978) also posit that personality differences may influence the productivity of brainstorming groups. Specifically, individuals low in communication apprehension (Jablin, Seibold, and Sorenson, 1977) and high in sociability (Bouchard, 1969) have been found to create significantly more ideas in brainstorming that in nominal groups.

Finally, In lieu of specific explanations, Mullen et al. (1991) present three major categories; Procedural mechanisms, social psychological mechanisms, and economic mechanisms. First, procedural mechanisms "derive from the mundane concerns of parsing up a given amount of task performance time amongst a certain number of performers (p. 4). This is consistent with Lamm and Trommsdorff's (1973) concept of production blocking.

Mullen et al.'s (1991) second category, social psychological mechanisms are "basic underlying processes engaged by the presence of others people, and by the individual's membership in the group" (Mullen et

al., 1991, pp. 4-5). Explanations falling in this category would include social facilitation, self-attention, and deindividuation effects.

The final category of explanations, economic mechanisms (Mullen et al., 1991) "represent a motivated, intellectual withdrawal of effort" (Mullen et al., p. 5). Social loafing is the prototypical economic mechanism inhibiting brainstorming group performance.

Working from data on the moderating effects of group size, experimenter presence, response mode, and group type, Mullen et al. (1991) attempted to differentiate between these three categories of explanations. Predictions made by each category of explanation as to the relationship between group type, moderator variables, and outcome variables were compared to the meta-analytic data. Mullen et al., concluded from these comparisons that "the social psychological mechanisms provide the most accurate predictions, that the procedural mechanisms provide marginally accurate predictions, and that economic mechanisms generally yield erroneous predictions" (1991, p. 17; though see Bond & Van Leeuwen, 1991; Stroebe & Diehl, 1991; for alternative interpretations of these data).

Mullen et al.'s meta-analytic data provide a precise picture of the difference between brainstorming and nominal group performance across a number of conditions. The relative ability of the theoretical explanations to account for these differences, however, is not as well established as it should be. There are several reasons to make such a claim. First, Mullen et al., (1991), Bond & Van Leeuwen (1991), and Stroebe & Diehl (1991) provide three alternative interpretations of the meta-analytic data. Clearly, the development of the categories, or the

link between the categories and the data was not clearly established. Second, it is not clear how previous explanations (see especially Jablin & Seibold, 1978) fit into Mullen et al.'s category scheme. For example, are fear of social chastisement, oral communication, and personality characteristics social psychological mechanisms, economic mechanisms, or production mechanisms? Third, the strength of the four moderator variables varies. Group size acts as a strong moderator, while the type of nominal group is a weaker, though statistically significant moderator variable. In drawing conclusions, Mullen et al., act as though the four moderator variables are equally strong moderators. Finally, it is not clear why all the specific explanations which fall into a particular category (e.g., social psychological explanations) necessarily make identical sets of predictions.

As a consequence, although there is consensus that nominal groups produce more and higher quality ideas than do brainstorming groups, there is anything but consensus on the issue of why this is the case. Rather than muddying the theoretical waters further by suggesting a new explanation, the characteristics of future brainstorming explanations will be briefly discussed.

Brainstorming: Toward New Explanatory Formulations

The initial goal of this section was to present an entirely new, radical, simple yet far-reaching, all-encompassing explanation of brainstorming and nominal groups which would serve to explain all inconsistencies in the literature and refocus research in this area. As even the causal reader of this literature surely knows, such an explanation has eluded small group researchers for over three decades and

no such explanation has emerged in the present piece. Therefore, rather than developing an original formulation, the characteristics of an effective theoretical explanation of the brainstorming versus nominal group literature will be discussed.

The primary characteristic of an effective explanation would be consistency with the results of the Mullen et al., meta-analysis, including the moderating impact of group size, experimenter presence, response mode, and type of nominal group. An explanation would be most useful in its ability to explain the inconsistencies in the literature. For example, why do brainstorming groups sometimes outperform nominal groups? Why are the data inconsistent with any single explanation?

The second characteristic of a good theoretical explanation of the brainstorming literature would be that it include several of the previously developed interpretations. It is clear from the reviews of the literature that no single explanation is adequate to explain the production differences between brainstorming and nominal groups. In addition, current explanations are not mutually exclusive. Fear of social chastisement may be related to oral communication, personality differences, and social facilitation. Combining these factors into a single explanatory mechanism would seem optimal. At the same time, however, the explanation should be relatively simple in nature (see, e.g., Zajonc's, 1965, initial theoretical integration of the social facilitation literature).

Third and finally, the explanation should be consistent with, and take into account other group phenomena. For example, a full explanation of brainstorming should be consistent with both the social facilitation

(Cottrell, 1972; Zajonc, 1965) and social loafing (Harkins & Jackson, 1985; Latane' et al., 1979) phenomena. This may well require differentiating between concepts such as evaluation apprehension, the evaluative presence of others, identifiable responses, and evaluated responses, and so on. In addition, other phenomena and data from other group literatures would need to be considered. For example, as group size increases, a small number of group members tend to dominate the discussion that goes on in the group (Bales, Strodtbeck, Mills, & Roseborough, 1951). How participation differences might influence perceptions and performance in brainstorming groups (e.g., Jablin & Seibold's oral communication explanation) should be considered.

Brainstorming: What Has Been Tested?

The empirical literature comparing brainstorming and nominal groups, presuming that both use rules governing brainstorming, indicates that groups are a particularly inefficient means of generating ideas. There is one important point, however, that must be made in drawing this conclusion. It is important to remember that the empirical question of brainstorming versus nominal groups which has been extensively researched deviated in important ways from the procedures for brainstorming groups discussed by Osborn.[3]

The typical brainstorming session involves bringing a number of strangers into the laboratory. They are provided with the four rules governing brainstorming and are told to generate as many ideas as is possible in a specified period of time. Some warm-up exercise is often provided before the topic of interest is discussed.

It is not difficult to find inconsistencies between Osborn's (1957)

conceptualization of brainstorming groups and their operationalization in the literature. One obvious difference is in the size and composition of the brainstorming group. In discussing the size of the ideal brainstorming group, Osborn (1957) claims that "Based on hundreds of experiences, the optimal size is indicated as being about a dozen" (p. 234). This stands in sharp contrast to studies that rarely use group sizes of greater than four.[4]

The composition of groups also differs between Osborn (1957) and research studies. Osborn describes the ideal group as being comprised of ". . . a leader, an associate leader, about five regular or 'core' members and about five guests" (p. 235). The core members are described as having demonstrated their ability in creative problem solving who should serve as the group's "pace-setters" (Osborn, 1957, p. 235). The guests should be chosen, according to Osborn, with an eye toward those who have had experience with the issue or topic under consideration (e.g., hunters about shotguns, sales representatives who travel if the topic were hotels). In contrast, brainstorming groups in the literature tend to be zero-history (and zero-future as well) groups where members are strangers. Members are not chosen with any concern for their problem solving ability or experience with the topic under discussion.

Another important difference between brainstorming procedures described by Osborn (1957) and as operationalized in much of the research is in the role of the group leader. Osborn claims that although the leader should stay out of the way and let the group develop their own ideas, the leader should help the group by suggesting ideas that he/she have brought with him/her to the session when the group's 'well' begins to

run dry. Osborn also suggests that the leader is encouraged to point the group in a new direction or potentially move the group to a previously considered, but not fully explored, category of ideas when the group seems to be spending too great a time discussing one particular category of ideas.

Given this view of the leader's role in a brainstorming group, when Taylor et al., (1958), report that "Actually, for both individuals and groups, appreciable periods of silence appeared between responses near the end of the twelve minutes" (p. 30) it is clear that the role of the leader is not being followed as Osborn suggests. The leader (if there is one) is not keeping the group going nor are they suggesting new ideas and/or the reconsideration of old ideas. An important component of Osborn's (1957) view of brainstorming is missing.

It is also unclear the extent to which this lack of leadership allowed groups to break the rules governing brainstorming (most importantly, the lack of criticism rule). Osborn (1957) suggests that whenever a rule is broken that the leader or associate leader ring an old-fashioned school teacher's bell. It is not clear from research reports, whether or how such rule violations are identified and dealt with (particularly in studies where the experimenter is absent). Presuming that fear of negative evaluation inhibits group ideation (Jablin & Seibold, 1978; Mullen, et al., 1991) the extent to which explicit criticism intercedes into discussion could have a drastic negative impact on group productivity.

Perhaps the most important missing ingredient in brainstorming groups in the literature is the training of the leader and/or group members.

Osborn (1957) spends a great deal of time discussing the need for, and how to achieve, suspended judgement. It is not presented as something that one can achieved by the simple listing of four rules. The elimination of explicit criticism and the singular concentration on idea generation are not concepts that Osborn claims come easily. They take time and effort to achieve. This is time not taken and effort not exerted in the social science literature on brainstorming.

Brainstorming groups in the literature meet once without training, generate ideas, and then never meet again (i.e., they are both zero-history and zero-future groups). Osborn (1957) recommends, on the other hand, that the ideal brainstorming format involves three sessions; individual-group-individual brainstorming session. In particular, group members are provided with the topic a few days before the brainstorming session. Members are told to consider the issue on their own before meeting with the group. After the group meets, members should be sent a copy of the ideas that the group developed so that any ideas that might come to them over the next few days could be sent to the leader.

Brainstorming: The Conclusions and Suggestions for Future Research

There are two important conclusions that should be drawn from this review. First and foremost, considerable research clearly and consistently shows that brainstorming groups, without the aid of extensive training in suspended judgement, are inferior to nominal groups in the production of the quantity and quality of ideas. Explanations generated to account for these differences have been inadequate. Research, therefore, could be performed in an effort to clarify and test the predictions made by the various explanations for brainstorming groups'

inadequacy. For example, most of the research that has tested the social facilitation explanation has centered upon Zajonc' (1965) original formulation. Cottrell's (1972) social facilitation explanation based on the evaluative presence of others seems both more relevant to the brainstorming context (see, e.g., Street, 1974) as well as clearly related to other explanations of the brainstorming (e.g., oral communication, social inhibition).

The second conclusion to be drawn from this review is, to a large extent, the research performed on brainstorming has little to do with what Osborn (1957) called suspended judgement and/or brainstorming. There are many important differences between Osborn's description of the spirit, structure, and functioning of brainstorming groups and the way in which groups were formed, trained, and expected to generate ideas. In short, although considerable research has been performed on brainstorming little of this research is a valid test of Osborn's ideas.

Future research, then, should more closely follow Osborn's description of the brainstorming group in an effort to determine how effective an ideational technique it can be. This is certainly a daunting experimental task because it would require training group members, allowing group bonds to form, and letting the group develop over time. This sort of longitudinal has several important practical problems associated with it. The quality of the data generated from such studies, however, would be worth the effort.

Notes

[1] Osborn (1957) mentions social facilitation in making this point noting the impact of pacing on individual performance (e.g., Triplett, 1897). This is a curious choice because in the 1950's social facilitation had fallen out of favor because the data were very inconsistent and difficult to interpret. In some social facilitation studies groups outperformed individuals while in other studies individual outperformed groups. It was not until a decade later that any theoretical formulation came along that explained these inconsistencies (Zajonc, 1965; see also Cottrell, 1972).

[2] Mullen also broke these analyses down by whether brainstorming groups used the four rules outlined by Osborn (1957) or some variant set of rules or procedures. Only the data for the typical brainstorming groups are reported here.

[3] Several of these points are made more eloquently by Jablin and Seibold (1978). The author is indebted to this earlier review.

[4] It could be validly argued that the results of the Mullen et al., meta-analysis, particularly the moderating impact of groups size, would indicate that increasing group size will lead to nothing but worse performance in groups. It should be kept in mind, however, that relatively few data points exist for groups sizes above four.

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