韓國心理學會誌
Korean Journal of Psychology
1979, Vol. 2, No. 4, 273-280.

Effects of Brainstorming and Non-Brainstorming Instruction on Total Output and Creativeness of Ideas in Real Groups

Hyo-Suk Kang and Jae-Ho Cha

Department of Psychology
Seoul National University, Seoul

The usefulness of brainstorming as a group problem solving procedure was assessed by comparing the effects on performance of brainstorming instructions and non-brainstorming instructions in real groups. There were four independent groups of subjects, each group working on two problems, one under brainstorming instructions and another under nonbrainstorming instructions. The order of problems and instructions were varied from group to group. Sixty-four undergraduates worked in 16 groups of four. The study was essentially a replication of Parnes and Meadow (1959) except that (1) as a measure of quality, quality ratings of the best ideas rather than the number of good ideas were used, and (2) group means rather than the means of individual subjects were used as data points in order to provide for more appropriate error term in the analysis of variance. Results showed that more ideas were produced when working under brainstorming instructions relative to non-brainstorming instructions, but the quality of the best ideas produced by individuals was not significantly different between the two kinds of instructions. The results on total output of ideas are consistent with the findings of the earlier study, but the results on quality are not.

Brainstorming, which was originated and first used by Alex F. Osborn in 1939, has been subjected to experimental tests for its efficacy for a number of years. The methods used to test the technique, which allegedly promote creative thinking, varied from investigator to investigator. Hoffman (1965) and Zagona, Willis, and MacKinnon (1966) who reviewed experimental studies in this area identified three different categories of studies, namely (1) those studies which compare individual problem solving with group problem solving; (2) those studies which compare between different group problem solving situations, and (3) brainstorming in individuals. The basic features or rules of brainstroming, which consist of (1) ruling out criticism, (2) encouraging "free-wheeling," (3) an emphasis on quantity rather than quality, and finally (4) encouraging combination of and improvement over others' ideas (See Taylor, Berry, & Block, 1958), presuppose interaction among group members, and therefore the brainstorming in individuals does not represent a valid example of brainstorming technique.

The studies which compared individual problem solving with groups solving problems under the condition of brainstroming typically used one or more nominal groups which are contrasted with real groups working under brainstorming instructions (e.g., Taylor, Berry, & Block, 1958; Dunnette, Campbell, & Jaastad, 1963; Parnes & Meadow, 1963). A consistent finding seems to be that individual problem solving is superior to group problem solving when both are done under brainstorming instructions.

When the effect of brainstorming is assessed by comparing a nominal group and a real group working under brainstorming instructions, what is actually evaluated may be a function of the difference between individual work and group work rather than the effects of brainstorming itself since individual working condition as against group working condition is the dominant feature separating a nominal group and a real group. A more appropriate procedure for assessing the effects of brainstorming instructions would be to compare two real groups, one performing under brainstorming instructions and another under non-brainstorming instructions. There are two studies which studied brainstorming using the procedure recommended here. Meadow, Parnes, and Reese (1959) found that the group working under brainstorming instructions produced more ideas and more of better ideas. In this particular study, all subjects had previously received a semester of training in "creative problem solving methods." In a second study (Parnes & Meadow, 1959), the subjects did not receive this training prior to the experiment, but the study essentially duplicated the earlier study in its major findings.

The present study is basically a replication of the Parnes and Meadow study. The present study differs from the study by Parnes and Meadow in two respects. As a measure of quality of the products, Parnes and Meadow (1959) resorted to counting the number of "good" ideas, a good idea being defined as an idea which is up to or exceeds a given standard. As will be developed in greater detail later, the present writers are of the opinion that a more adequate measure of the quality is not the number of good ideas but the goodness of the very best or of a select few best ideas, for in practical situations only the best idea or ideas count and less good ideas, no matter how good they may be, are by and large ignored so long as there is a definitely better idea. The second difference has to do with statistical procedure. In the last mentioned two studies, the investigators used individual subject's score as the unit of analysis instead of using group mean as the unit. Such a statistical procedure is likely to underestimate the within-group variance and thus become a cause for a Type I error. In the present study, this oversight was corrected by using group means as data points.

Method

Subjects. Sixty-four undergraduates at Gwanak Campus of Seoul National University were used as subjects. These comprised 36 male and 28 female students.

Experimental design. There were three experimental variables, namely *working instruction* (brainstorming vs. non-brainstorming instructions), *problem* (Problem I vs. Problem II), and *order of problems* (Problem I-Problem II vs. Problem II - Problem I). There are two orders of receiving problems, and for each order the first problem can be solved under either brainstroming or non-brainstorming instructions. Thus, the combination of instructions and orders produce four experimental conditions. For each condition, the second problem was solved under instructions different from these under which the first problem was solved. The experimental design is summarized in Table 10 below.

Table 1. Design Outline of The Experiment

Condition	The first problem		The second problem	
	Instruction	Problem	Instruction	Problem
1	B*	Problem I	NB	Problem II
2	NB	Problem I	B	Problem II
3	B	Problem II	NB	Problem I
4	NB	Problem II	B	Problem I

* B= brainstorming instructions; NB=non-brainstorming instructions.

Four working groups were assigned to an experimental condition, with each group comprising four subjects. The four groups were tested on both the first problem and the second problem. There were a total of 16 groups of subjects.

Procedure. Each group of four was homogeneous with respect to sex. Subjects were set off according to the order of their arrival to the laboratory in groups of four. The first group formed this way became Group I. Other groups were given identifying numbers in the same manner. Each group was assigned to an experimental condition randomly following the prearranged assignment of group numbers to experimental conditions.

The two problems, which represent a selection from the original list of four through pretest, were (1) the problem of thinking up ad slogans (Problem I) and (2) the problem of suggesting solutions to some of the campus problems (Problem II).

When the four subjects are assembled, they were greeted by the first experimenter and seated around a table in the laboratory room. While distributing recording forms, the experimenter said: "You are not being tested for anything, and I want you to relax and think only of doing well what you are told to do." This was followed by an introductory remark about the experiment. All subjects were told the following:

Thank you for participating in the experiment even though I know you have many things to do. Now, I will tell you what the experiment is about and what you are supposed to do. In order to ensure uniformity in experimental conditions, I will read off instructions from my notes. This is an experiment on group problem solving. Probably you have had no experience in this kind of situation. This technique is used to help generate as many ideas as possible in a group problem solving situation by large business organizations. This technique is used especially when novel, extraordinary, and unique ideas are sought. Naturally, this method is rarely used in solving every-day problems. In this experiment, you will be solving problems under two different conditions, one after another. You will have 12 minutes to work on a problem as a group, during which time you are free to exchange ideas among you. Any idea that is produced in the group will be considered and counted as a product of the group rather than that of an individual member. Try to come up with as many ideas as possible for the group. In order to prevent recording the same ideas more than once, each of you are requested to write down your ideas on your individual recording sheet. Before you start, let me give you several pointers which will help you in your work.

From this point on, the instruction varied depending on the instruction condition.

(Brainstorming instructions) First, you should not criticize your own ideas or ideas others have come up with. No matter how improbable or implausible an idea may appear to you, it is not good to criticize it. Second, the more an idea seems deviant and extraordinary, the better it is for this experiment. For such an idea can be toned down later, and this way of approaching the problem is probably more realistic than trying to come up with perfect ideas from the beginning. Third, You should try to come up with as many ideas as possible instead of trying to come up with good ideas. Many ideas are likely to contain a few good ideas. Lastly, try to improve on ideas already suggested, or try to combine several ideas and come up with a new idea. Remember that you need not concern yourself for the quality of ideas. Only the quantity, or the number of ideas is what counts. It is important to keep in mind that you are requested to do is to express your ideas freely and without criticizing them. If you have questions, please put your questions to me now. If you don't, I will give you the problem to solve. (Problem I) A beverage company has come up with a new product called "Hais." His new beverage has a high degree of carbonation, and the company is mounting an ad campaign to promote the sale of the new product. Now, what you have to do is to devise ad slogans for the product which will appeal to the potential consumers. You have 12 minutes to work on this job.

After the 12 minute interval is over, the subject is told: "The second task that you will be working on is under a different condition. So, please not to think of the first task."

(Non-brainstorming instructions) When you feel that the ideas you have just come up with are good, announce them and record them on your sheet. A good idea is an idea which is unique, useful, and meaningful. We would like to see how many good ideas you can think up in the allotted time. Later, I will evaluate your performance. When I do, a better idea will receive a higher score than a common idea. The evaluation is done for the group and not for the individual member. Therefore, in order to get a good idea, it is entirely permissible if criticized the ideas thought up by other members. In other words, you are free to criticize any unseeming ideas or ideas which are almost identical to those already presented. Remember that it is the quality of idea that matters. If you have no questions to ask, I will now give you the problem to solve. (Problem II) "We have already spent a semester since moving to this new campus at Gwanak. While living on this new campus, we bet you have found many advantages and disadvantages of this new campus. I want you to think up defects or things that need to be improved of this campus and suggest solutions to these problems. The problems may have to do with physical facilities, school administration, and other aspects of the campus life."

After the group has completed both the two problems, a set of post-experiment questions were asked: (1) Now that the the experiment is over, do you have any thing to say about the experiment in which you took part? (2) Of the two problems which one do you feel you have done better? (3) Did you have any idea as to what we are expecting about the relative efficacy of the two instructions? (4) Did you ever think that there was not enough time to solve the problems? After these questions, the experimenter thanked and asked the subject not to divulge the nature of the experiment for the next two weeks.

The above sequence of events (brainstorming instructions, Problem I, non-brainstorming instructions, Problem II) was for Condition 1. For the other conditions, the order of these events of course was varied according to the plan outlined in Table 1.

Evaluation of ideas. Two judges independently evaluated the quality of each idea produced. Two judges were given a description of standards on which an idea is to be evaluated and a familiarity training with the judging procedure until the intercorrelations of the two judges' judgments reached a satisfactory level. In order to prevent the judge from knowing the experimental condition under which an idea was produced, the first experimenter read off the ideas and the judges rated each idea on a 7-point scale. For the ideas produced in connection with Problem I, the subjects judged the quality on three different dimensions, namely uniqueness, readability (similar to codability), and likableness. The ideas produced in connection to Problem II were judged on only one dimension, importance of the problem. The inter-judge reliability coefficients (r) for uniqueness, readability, and likableness were .69, .73, and .64, respectively. The interjudge reliability coefficient for importance was .67. An idea's quality score on any of these dimensions was the average of the ratings of the two judges. Each 7-point rating scale had a score range of 0 to 6.

Results

Idea productivity. The results of analysis of variance based on the average number of non-overlapping ideas produced by each group are presented in Table 2. Of the seven components of comparison, only the effect of instruction was statisfically significant ($F=25.6$, $df=1/12$, $p < 01$). Table 3 shows the mean output scores for each of the four experimental conditions formed by the intersections of instruction and problem. The level of idea output was about twice as high in the brainstorming instructions condition than in the non-brainstorming instructions condition (see Table 3). This finding clearly confirms the findings reported by Meadow, Parnes, and Reese (1959) and Parnes and Meadow (1959).

Table 2. Summary of Analysis of Variance of the Total Number of Ideas Produced per Group

Source of Variation	df	MS	F	p
Total	31			
Between subjects	15			
Instruction (I) x Problem (P)	1	38.28	---	n.s.
Instruction (I) x Order (O)	1	270.28	---	n.s.
Problem (P) x Order (O)	1	11.28	---	n.s.
Error (a)	12	193.87		
Within subjects	16			
I	1	2032.60	25.2	.01
P	1	166.53	2.06	n.s.
O	1	26.28	---	n.s.
I x P x O	1	100.97	---	n.s.
Error (b)	12	80.70		

Table 3. Mean Number of Different Ideas Produced Under the Brainstorming and the Non-brainstorming Instructions on Problems I and II

Problem	Brainstorming (N=16)[1]	Non-Brainstorming (N=16)	Total (N=32)
I	32.62	18.87	25.75
II	39.37	21.25	30.31
Total	36.00	20.06	28.03

1 Number of groups.

Quality of ideas. Scores on each of the three quality or creativeness dimensions (uniqueness, readability, and likeableness) of ideas from Problem I and scores on importance of ideas from Problem II were subjected to analysis of variance together. The ANOVA plan was identical to that shown in Table 2. There were no significant main effect of instruction on any of the combinations, uniqueness-importance, readability-importance, and likeableness-importance ($F=.86$, $F=2.33$, $F=.23$ for the three combinations, respectively. $df=1/12$). Since there was no statistically significant Instruction x Problem interaction, with the mean square for this interaction close to nil in each combination, the lack of the effect of instruction is presumably not confined to any one problem or any one dimension. Neither were the other interactions involving instruction (instruction x order, instruction x problem x order) statistically significant. Thus there is no evidence that a real group working under brainstorming instructions produces overall better quality ideas than a real group working under non-brainstorming instructions.

Typical distributions of ideas produced in terms of rated quality are shown in Fig. 1. The quality dimension shown is the uniqueness dimension for Problem I. It is clear that the brainstorming instructions produces not only more of better quality ideas but also more of lower quality ideas. The mean uniqueness score for the brainstorming group was 2.53 while that of the non-brainstorming group was 2.56.

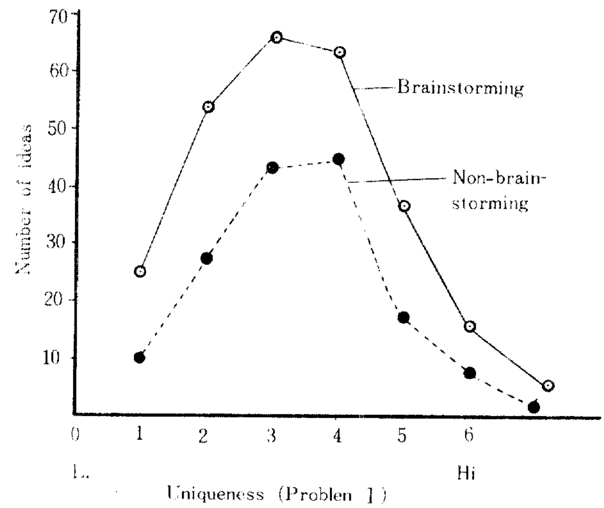

Fig. 1. Frequency Distributions of Ideas Produced Under Brainstorming and Non-Brainstorming Instructions in Terms of Mean Uniqueness of Idea.

Obviously, comparisons of the two instruction conditions in terms of a mean quality score are not adequate tests of the efficacy of the instructions in group problem solving. For in such a situation, what counts is a small number of best ideas rather than the overall quality level of many ideas. One way of comparing the two instructions for good ideas is to set an arbitrary standard of a good idea and compare the instructions in terms of the number of ideas that are up to or exceed the stardard of quality. If a group problem solving technique is to be judged solely in terms of its ability to generate good ideas, a more stringent, and perhaps more reasonable, way of comparing the techniques would be to contrast the technique in terms of the quality of the best idea produced by an individual or a group.

As a first step toward this direction, the scores on uniqueness, readability, and likeability of the ideas produced in Problem I were pooled, and the mean of the pooled scores of the ten highest scoring ideas in one instruction condition was compared with the comparable mean from the other condition. The difference wás not statistically significant (M_b=13.21 and M_{nb}=13.17. t=1.29, df=18, $p>.1$).For a further comparison, the over all best-rated idea from each subject was identified and the means of the pooled (over creativeness dimensions) scores of these best ideas were compared between the instruction conditions, with the working groups as the unit of analysis. The mean difference was not significant statistically.

Discussion

The results from the present study confirmed the findings of earlier experiments by Meadow and Parnes (1959) with respect to the total number of non-overlapping ideas but not with respect to the quality of productions. In the present experiment, brainstorming instructions significantly increased the total output as compared to non-brainstorming instruction, but brainstorming instructions did not pro- better ideas. The last finding is at variance with those from the studies by Meadow and Parnes, and probably this discrepancy is due to the latter investigators' failure to use adequate error term in evaluating the effect of brainstorming instructions. That is, their findings might have been a Type I error.

In evaluating the efficacy of brainstorming instructions, it is perhaps misleading to compare the means of quality ratings of the comparison groups. When there is an overall increase in the total output of ideas, the increase in absolute number may contain both the better ideas and the poorer ideas, as in the present study. If this were true, the overall quality ratings of all different ideas will not differ between the instruction conditions even though one condition would have produced more ideas at the better end of the quality dimension. A fairer test of a group problem solving technique would be to evaluate it in terms of the quality of ideas judged good or the quality of the very best idea produced by an individual or group.

Parnes and Meadow (1959) compared the number of ideas receiving 5 or more points in the composite rating of quality (out of a maximum score of 6 points) and found that the brainstorming instructions produced more of these ideas. Bouchard (1969) compared between the brainstorming and non-brainstorming instructions for both the number of good ideas and the mean quality ratings of all different ideas. As would be expected from the above analysis, the brainstorming instructions produced more of "good" ideas (and more of all ideas) than the non-brainstorming instruction in real groups. But the mean quality rating was lower in the brainstorming instructions than in the non-brainstorming instructions conditions. The last finding suggests that the brainstorming instructions, which normally increase the overall number of ideas, generated more of good ideas but at the same time even more of inferior ideas, thus lowering the mean of the quality ratings of all ideas.

As suggested earlier, the number of good idea is a less than ideal criterion for evaluating a group problem solving technique. The last mentioned two studies indicate that brainstorming instructions are superior to non-brainstorming instructions when judged on this criterion. But a more useful and reasonable criterion, as explained earlier, is the quality of the best idea or ideas. The present study indicates that according to this criterion, brainstorming instructions are no more effective in elevating the quality of better ideas than non-brainstorming instructions.

References

Bouchard, T. J. Personality, problem-solving procedure, and performance in small groups. *Journal of Applied Psychology Monograph*, 1969, *53*, 1-29.

Bouchard, T. J., & Haire, M. Size, performance, and potential brainstorming groups. *Journal of Applied Psychology*, 1970, *54*, 51-55. 51-55.

Dunnette, M. D., Campbell, J., & Jaastad, K. The effects of group participation on brainstorming effectiveness for two industrial samples. *Journal of Applied Psychology*, 1963, *47*, 30-37.

Hoffman, L. R. Group problem solving. In Berkowitz (Ed.), *Advances in Esperimental Social Psychology*. Vol. 2. New York: Academic Press, 1965. pp. 99-132.

Meadow, A., Parnes, S. J., & Reese, H. Influence of brainstorming instructions and problem sequence on a creative problem solving test. *Journal of Applied Psychology*, 1959, *43*, 413-416.

Parnes, S. J., & Meadow, A. Effects of brainstorming instructions on creative problem solving by trained and untrained subjects. *Journal of Educational Psychology*, 1959, *50*, 141-176.

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

Zagona, S. U., Willis, J. E., & MacKinnon, W. J. Group effectiveness in creative problem-solving tasks: An examination of relevant variables. *Journal of Psychology*, 1966, *62*,