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Fluency, Flexibility, and Originality as a Function of Group Size

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Introduction

Research in the area of creativity training has generally shown that group productivity surpasses individual productivity (Owen, Renzulli, & Callahan, 1972; Taylor & Faust, 1952; Torrance, 1970, 1971). There seems to be some question, however, about the optimal size for groups who are engaged in brainstorming or creativity training sessions. Osborn (1963) has hypothesized that " ... as to the size of a brainstorming group, the ideal number is about a dozen," but this suggestion was not supported by any empirical evidence.

Research dealing with group productivity has centered around two major issues: (1) Does the mutual stimulation which results from group interaction bring about increased fluency (i.e., the generation of a greater number of ideas or responses to a given problem)? (2) Does the originality of responses improve with increased group size? Torrance's (1970, 1971) work tends to answer both questions in the affirmative, although he concentrated solely on students working in pairs as compared to working individually. Taylor, Berry, and Block (1958) found that while fluency increased in group situations, a larger number of unrepeated ideas were produced by individuals when working alone than by those working in groups. These researchers concluded that group conditions may have the effect of channeling thinking in similar directions and thereby reducing the flexibility and originality of response.

Several studies have attempted to investigate the function of group size in creative problem solving. South (1927) investigated some of the psychological aspects of committee work using groups of three and six. He found that groups of three were more efficient in dealing with abstract problems while groups of six performed more efficiently with concrete problems. In a study dealing with the effects of group size and threat reduction on creativity in a problem solving situation, Gibb (1951) reported that as group size increased, all group members reported a feeling of threat or inhibition of their impulses to participate. Taylor and Faust (1952) found that four-person groups correctly solved more problems than two-person groups; the problems put to them, however, appeared to be more convergent than divergent in nature. In a study dealing with the effects of large and small group participation on decision making, Fox, Lorge, Weltz, and Herrold (1953) found that groups consisting of 12 to 13 Air Force officers wrote decisions that were of "superior quality" to those written by smaller groups of six to eight members.

In a review of the literature on the effects of group size, Thomas and Fink (1963) found that under some conditions quality of performance and group productivity improved as group

size increased. They also reported that under no conditions were smaller groups superior. In contrast, Kidd (1958) reported that no significant differences were found in productivity among groups of two, four, and six members.

If the efficiency of the creative process is a function of group size, it would seem desirable to outline more closely the relationship between group size and such dimensions as fluency, flexibility, and originality. Whereas larger groups would appear to bring more minds to bear on a particular problem, however, smaller groups allow for more individual participation. Small groups may also provide an atmosphere that is less subject to peer pressure, while larger groups may stimulate more original responses as a function of increased group fluency. The major objective of the present study was to investigate the following questions with regard to group size:

1. What is the effect of group size on total fluency, flexibility, and originality of response to problem solving tasks?
2. What is the effect of group size on average per person fluency, flexibility, and originality or response to problem-solving tasks?

Procedures

Subjects

Subjects were 163 college juniors and seniors enrolled in an introductory educational psychology course. Since students were randomly assigned to treatment groups, it was assumed that problem solving capacity was equally distributed among the various groups.

Experimental Treatment

The subjects were assigned to comparison groups of one, three, six, or twelve members.[1] Following a short "warm-up" exercise, all groups were given identical instructions to respond aloud to three problem solving tasks. The tasks and instructions were as follows:

Task 1: *List all the possible uses that you can think of for a wire coat hanger.* Let your mind wander and try to think of uses that no one else has ever thought of. Tell the recorder all the ideas that come to mind, even if they seem silly or impractical. You will have five (5) minutes for this task.

Task 2: *Imagine that all the people in the world were suddenly reduced to 12 inches in height.* List all the possible consequences that might result. You will be given ten (10) minutes for this exercise. Think of both realistic and fanciful responses. For example,

1. There would be no need to list people's heights on drivers' licenses.
2. No one would have the nickname "Shorty."

[1] The authors acknowledge that a "group" consisting of one member is not consistent with the traditional definition of group.

Task 3: *List all the things you can think of that come in pairs.* In addition to such common things as a pair of socks, try to think of unusual pairings such as "one half of a quartet." You will have seven (7) minutes for this exercise.

Two recorders wrote down all responses generated by group members, and no evaluation of responses was made during the problem solving situation. Although the tasks were timed, the time limits were broad enough so that responses waned long before time ran out for each task.

Analysis

Responses for each group were scored according to three criteria: fluency, flexibility, and originality. The fluency criterion was established by taking a simple frequency count of recorded responses, with repeated answers omitted. The responses were scored for flexibility by first grouping answers into rational categories (arrived at by a consensus of four judges). The flexibility score was the total number of *different* categories produced. Originality was determined by asking two judges to rate each response on a scale of 1 (low originality; mundane) to 3 (high originality; unique). Thus, a mean originality score was computed for each task.

lnterrater reliability for the originality judgments was found to be .79 and was judged to be the most appropriate estimate of reliability for the originality measures used in this research. A stability estimate was impossible because the semester had ended before a test-retest format could be accomplished. An internal consistency estimate was not used because of an incomplete data matrix (internal consistency estimates can be derived only when all subjects give an equal number of responses.) Thus, the major focus for reliability was the extent to which judges agreed on the originality of responses.

Finally, fluency, flexibility, and originality scores were summed for each group across the three problem solving tasks. In addition, mean per person scores on each criterion were found by dividing the group sum by the number of group members. Thus, there were six independent variables: group scores on fluency, flexibility, and originality; and average per person scores on the same three variables. One-way analyses of variance were performed on the six criteria, with the independent variable being group size.

Results

Results of the analyses of variance are shown in Table 1.

Table 1. Summary of f-values for analysis of variance comparisons.

Variable	Group F-Ratio	Per Person F-Ratio
Fluency	22.31*	13.56*
Flexibility	13.56*	209.76*
Originality	22.33*	15.208

*P < .05 df = 3,27 for all comparisons

Overall F ratios for each criterion measure were all significant at the .05 level. In other words, group size had a powerful effect on the total group output. To determine which groups were statistically different from the others, *a posteriori* comparisons were made by means of Tukey's H.S.D. (Honestly Significant Difference) technique (Kirk, 1968). A distinct trend was seen with respect to the *a posteriori* tests. A progression of scores was found across the three groups; i.e., as group size increased, so did the group's fluency, flexibility, and originality. On each of the three criteria, however, groups with three members were statistically indistinguishable from groups with six members. That is, groups of three produced about the same number of responses and showed the same amount of originality and flexibility as groups of six. In addition, it was found that in terms of flexibility, six member groups generated no more categories of responses than did twelve member groups. Thus, while adjacent groups were sometimes statistically equal, the general trend is clear: the larger the group, the larger the output.

The second research question dealt with average per person scores within the various group sizes. Again, analyses of variance produced significant overall F ratios for each of the three criteria. These results are also presented in Table 1. *A posteriori* tests revealed results that were generally opposite from the results of total group output[2]. It was found that as group size increased, the *per person* contribution tended to diminish. Exceptions to this tendency were found with respect to six- and twelve-member groups. There were no differences in average per-person, fluency, or originality scores between these two groups. Also, the difference in per person flexibility scores between six- and twelve-member groups was barely significant at the .05 level. Thus, groups of six or twelve members appear to inhibit per-person contributions equally.

Discussion and Conclusions

The results of this research are perhaps best understood if the *purposes* of group problem solving are outlined. From one viewpoint, groups are used to solve problems quickly and efficiently. If the results of this study can be extended to practical applications, it appears that the larger the group (up to twelve members), the greater the *total* productivity in terms of the number of responses, originality of answers, and capability of generating new categories of responses. This outcome appears to corroborate Torrance's (1971) thinking about the mutual stimulation and added productivity possible when an individual is permitted to work with others.

If the primary purpose of the group exercise is to get problems solved, two additional implications can be drawn. First, groups of three, six or twelve are generally more productive than individuals. Second, if groups of twelve are impractical (say, within a classroom), it makes little difference whether the group has three or six members. In fact, if there are several problems which need to be solved under this circumstance, it would seem judicious to use groups of three so that more groups could work on more problems.

On the other hand, some researchers (*cf.* Osborn, 1963) have asserted that one of the major functions of group problem solving or brainstorming is to stimulate ideas rather than to provide solutions to specific problems. Essentially, then, it is possible to view group activities as

[2] Tables that contain all *a posteriori* analyses are available from the senior author.

a procedure for *training* members to be more creative. From this standpoint, the results of the present study are not encouraging. It was seen that as group size increased, per-person productivity generally decreased. The implication here is that the effect of increased group size may be to delimit opportunities for individual productivity in solving problems.

While it should be stressed that the present findings depend upon how one views the *purpose* of problem-solving activities, perhaps the most sensible approach is that a variety of experiences in groups of varied sizes will help individuals to determine under which conditions *they* operate most effectively. Also, certain types of problems undoubtedly lend themselves to different group conditions. For example, a complex social problem that may require input from persons representing many disciplines (psychology, sociology, economics, city planning, etc.) may very well dictate group size according to the types of representation necessary. Finally, it seems clear that the value of group problem-solving sessions depends to some degree on how the sessions are conducted, the nature of the topic under consideration, the amount of prior practice in problem solving, and the age and educational background of the participants.

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