Effects of Creative Problem Solving Training on Communication Behaviors in Small Groups

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This study investigated the differences in communication behaviors in small groups trained in creative problem solving (CPS) with groups not trained in CPS. Forty groups of five members each were evaluated (22 trained groups and 18 untrained groups). Communication behaviors evaluated were amount of participation, evenness of participation, verbal indications of criticism, verbal indications of support, and verbal and nonverbal indications of humor. Groups were also evaluated on the quantity of ideas generated. Results indicated that groups trained in CPS participated more, criticized ideas less, supported ideas more, exhibited more verbal and nonverbal indications of humor, and produced more ideas than did untrained groups—all at a significant level. Groups trained in CPS did not participate evenly as compared to groups not trained in CPS. This finding is examined in light of the role of the idea recorder in the groups.

EFFECTS OF CREATIVE PROBLEM SOLVING TRAINING ON COMMUNICATION BEHAVIORS IN SMALL GROUPS

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Research in creativity and innovation has shown that, as a result of training in creative problem solving (CPS), individuals are able to perform better on a number of cognitive and affective evaluative measures. Torrance (1972) analyzed and evaluated the results of 142 studies that attempted to teach thinking skills. "When deliberate systematic problem solving skills were taught, the percentage of success was over ninety. Using all 142 studies and all of the criteria used to assess outcomes, the overall percentage of success was seventy-two" (Torrance, 1986, p. 633).

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Parnes (1987) reported that five major compilations in the U.S. literature of studies in creativity showed significant positive results when creative abilities were deliberately nurtured (Mansfield, Busse, & Krepelka, 1978; Parnes & Brunelle, 1967a, 1967b; Rose & Lin, 1984; Taylor, 1959; Torrance, 1972). Parnes (1987) reported over 12 studies (Basadur, Graen, & Green, 1982; Cohen, Whitmyre, & Funk, 1960; Ekvall & Parnes, 1984; Heppner, Baumgardner, Larson, & Petti, 1983; Heppner & Reeder, 1984; Jacobsen, 1977, 1978; Karol & Richards, 1981; Parnes & Noller, 1973; Richards & Perri, 1978; Simberg & Shannon, 1959; Sommers, 1962) that represented the positive effects of CPS training on "real-life criteria."

A great deal of investigation has been conducted on the effectiveness of CPS training on participants' cognitive and affective abilities and on real-life criteria. However, very little work has been done on the effects of CPS training on the communication behaviors that occur in small groups. One might ask: What impact does training in CPS have on the interactions that occur in problem-solving groups? The small group is in many cases the "place" where ideas are generated and developed. This study focused on the interactions that occur in the small group (five members) and used the small group as the unit of analysis.

Communication scholars are divided on the use of groups versus individuals for problem solving. A major aspect of this disparity has focused on the *assembly bonus effect.* The assembly bonus effect is an increase in group effectiveness resulting from efficient group interaction (Collins & Guetzkow, 1964). Hill (1982) reported that in "learning and concept-attainment tasks, group performance was usually superior to individual performance because of the group's ability to pool their resources, to correct errors, and to use qualitatively different learning strategies" (p. 522). In complex problem-solving tasks, the quality of group solutions was superior to that of individual solutions (Lorge, Tuckman, Aikman, Spiegel, & Moss, 1955).

Research conducted by Hall, Mouton, and Blake (1963) showed that final choices made by groups after interaction were better than statistical pooling of individual judgments without discussion.

Bouchard (1969, 1972) and Hart, Boroush, and Enk (1985) found that

> individual brainstorming was consistently superior to group brainstorming but that with the introduction of a minimum of structure, group brainstorming performance improved drastically. The study suggested that group procedures that force greater involvement of the participants in a systematic way might be even more productive. (p. 587)

Several other authors (Argyis & Schon, 1974; Hackman & Morris, 1976; Hoffman, 1965; Lamm & Trommsdorff, 1973; Osborn, 1963; Zagona, Willis, & MacKinnon, 1966) suggested that group process could lead to process gain. They suggested two potential sources of process gain. These sources were (a) member capacity to learn and (b) cognitive stimulation. Osborn (1963) believed that brainstorming groups could stimulate the production of ideas beyond the number that could have been produced by an individual.

However, Vroom, Grant, and Cotton (1969), found that

> groups in which members interacted with one another during generation produced a smaller number of different solutions, fewer high-quality solutions and a smaller number of different kinds of solutions than groups in which members were constrained from interacting during generation. (p. 77)

Hill (1982) reported that statistical pooling of individual responses frequently produced a greater number of unique ideas than did group interaction in brainstorming because of the ability of individuals to produce a greater number of ideas when working separately. Other studies (Dunnett, 1964; Fox & Lorge, 1962; Vroom et al., 1969) found that group performance was usually superior to individual performance but did not achieve the potential suggested by statistical pooling models, even though some group members were trained in group dynamics and problem solving. Miner (1984) contended that the literature seems to indicate that interaction during the idea-generation phase of problem solving is dysfunctional but interaction during the evaluation and synthesis phases is both desirable and necessary.

In other studies, training has played a role in the experimental design. Colleros and Anderson (1969); Dillon, Graham, and Aidells (1972); Laughlin and Jaccard (1975); and Wenger and Zeaman (1965) found that group problem-solving proficiency "could be improved with training, and that practice effects varied with training and transfer conditions" (Hill, 1982). The evidence that groups benefited from training in group process and problem solving was seen in complex problem solving of Air Force field officers (Fox & Lorge, 1962) and in improvement of individual performance after group performance (Laughlin & Adamopoulous, 1980).

Communication research has provided mixed reviews on the use of groups for solving problems. Hackman and Morris (1976) reflected this concern when they stated:

> Indeed, the rather pessimistic conclusions of much psychological research on the role of group interaction process (e.g., that process may operate primarily to keep a group from achieving its potential productivity) may themselves have been predetermined in part by the methodologies used. (p. 61)

Hoffman (1965) noted the emphasis in small group research on identifying and studying "barriers" to group creativity. While acknowledging that such barriers must be overcome if CPS is to be promoted, he also argued for efforts directed to "inventing and testing new ways of encouraging creative group problem solving" (p. 127).

In reviewing the variability of findings on the use of groups in problem solving, one finds the results difficult to compare. Hill (1982) conjectured that it might be the type of problem used that lends itself to a particular technique. He reported that in several studies of brainstorming research, the type of problem affected the performance. Differences were found between "people problems" (Dunnett, Campbell, & Jaastad, 1963); socially relevant problems; and politically relevant problems (Dillon et al., 1972). However, some of these differences have been caused by inconsistencies due to differences in instructions (Dillon et al., 1972; Harari & Graham, 1975; Osborn, 1963).

To address some of the issues presented in the literature, several specific hypotheses were investigated in this study. Those hypotheses were the following:

1. Groups trained in CPS will exhibit more positive communication behaviors than groups not trained in CPS. This will be shown by
   a. greater participation,
   b. greater evenness of participation,
   c. fewer verbal indications of criticism of ideas,
   d. more verbal indications of support of ideas,
   e. more verbal indications of humor as evidenced by laughter, and
   f. more nonverbal indications of humor as evidenced by smiles.
2. Groups trained in CPS will generate a greater quantity of ideas than groups not trained in CPS.

METHOD

SUBJECTS

Twenty-two groups of five members each were obtained from the Introduction to Creative Studies undergraduate courses taught at the State University College at Buffalo (SUCB) during the spring semester of 1986. Eighteen 5-member groups of untrained subjects were obtained from undergraduate courses in the Business Department, Interdisciplinary Sciences Department, and the Consumer Studies and Home Economics Department at SUCB.

EXPERIMENTAL TREATMENT

Experimental subjects in this study were trained in a CPS process that emphasizes a balance between divergent and convergent thinking. These two thinking activities are integrated into a six-stage CPS model. The six stages of this model consist of the following:

1. *mess finding:* isolating a concern or problem on which to work

2. *data finding:* generating and selecting the most important data regarding the mess
3. *problem finding:* generating and selecting a statement that captures the "essence" of the situation
4. *idea finding:* generating and selecting the best available alternative(s) for solving the problem
5. *solution finding:* using criteria to screen, select, and support ideas selected in idea finding
6. *acceptance finding:* generating ways to implement the solution and developing a plan for action

The CPS process described above is based on the work of Parnes, Noller, and Biondi (1977), as well as that of Isaksen and Treffinger (1985), who added the mess-finding step and other refinements.

The divergent thinking used in this process is based on Osborn's (1963) guidelines for brainstorming:

1. Criticism is ruled out.
2. "Free-wheeling" is welcomed.
3. Quantity is wanted.
4. Combination and improvement are sought.

Osborn (1963) emphasized the importance of "deferring judgment" while generating ideas.

The convergent thinking used in this process is based on the concept of "affirmative judgment." In other words, the purpose of this convergent thinking is to screen, select, and support options instead of focusing on the weakness of ideas. Isaksen and Treffinger (1985) described affirmative judgment as looking for strengths or positive aspects of ideas. According to Isaksen and Treffinger (1985), affirmative judgment emphasizes the concept "that evaluation and decision making are constructive processes, not just destructive criticism" (p. Two-8).

Students practiced the CPS process on a number of problems that they identified as personally relevant. They also practiced on situations that were presented to them by the instructor. Students were exposed to current issues, theories, and philosophical aspects of

creativity in various class sessions. Additionally, they were administered an instrument designed to determine their cognitive style and told its implications for problem solving.

When students practiced the CPS process, they worked individually, in dyads and in small groups (five to seven members). Although students did work in groups, the focus of the course was to practice CPS techniques, such as brainstorming, attribute listing, problem redefinition, criteria selection, and action-plan development. No emphasis was placed on teaching specific interpersonal communication techniques, that is, active listening, paraphrasing, or group-interaction analysis. (A syllabus of the creative studies classes and all activities conducted in them is available from the author.)

The untrained, or control, subjects in this experiment attended classes that emphasized a traditional lecture-discussion format with a small amount of group work that was assigned by their instructors.

MATERIALS

To evaluate the interactions in this experiment, groups were videotaped. When group members entered the television studio, they were seated around a circular table. Pencils, pads of paper, and a written copy of the case problem were provided for all subjects. A numbered pad of paper was provided to record the group's list of ideas. Three television cameras mixed into a single image were used for recording the interactions that occurred in the groups.

PROCEDURE

Subjects were randomly assigned to groups within intact classes, resulting in 40 groups of five members each: 22 trained groups and 18 untrained groups.

Group members were presented with a case problem on which they were instructed to generate possible solutions. Groups had 5

min in which to generate those solutions. The case problem involved getting groups and large professional organizations to stay at a seasonal resort hotel on a year-around basis (i.e., not just during the peak season).

When the case problem was presented to each group, a volunteer in the group was solicited to record the group's ideas on a numbered pad of paper that was on the table in the observation area. The individual who gave the instructions and read the case did not know if the groups she was presenting the case to were trained or untrained. This individual introduced the problem and solicited a recorder for all 40 groups in the study. She informed the groups that they had 5 min to work on the problem and then left the room.

To evaluate communication behaviors, the tapes of the groups at work were analyzed by trained raters.

Raters scored the behaviors exhibited by the subjects, but not how the behaviors affected other group members. The raters did not know if the groups they were viewing were trained or untrained.

Communication behaviors investigated were (a) amount of participation, (b) evenness of participation, (c) verbal indications of criticism, (d) verbal indications of support, (e) verbal indications of humor, and (f) nonverbal indications of humor. The quantity score on number of ideas generated was obtained from the list of ideas written down by the group recorder.

Participation was measured by counting the number of times subjects spoke. Evenness of participation was determined by calculating the standard deviation of the total subject responses. Raters also counted the number of times subjects criticized ideas. Responses like "no, that won't work" and "that's a silly idea" were counted as criticisms. Verbal indications of support were also counted by raters. An example of a verbal indication of support would be "good idea" or "I like that." The times subjects laughed were counted as verbal indications of humor, and the times subjects smiled were counted as nonverbal indications of humor.

Data collection for both the trained and untrained groups occurred near the end of the semester in the fourteenth week of classes in a 16-week semester in the spring of 1986. Trained subjects had

TABLE 1: Two-Tailed *t* Test on Communication Behaviors and Quantity of Ideas Generated

	Means		
Communication Behaviors	*Untrained*	*Trained*	*t*
Total responses	26.28[a]	38.82	5.23**
Evenness of responses	.73[b]	1.19	3.30*
Verbal criticism	2.22	.09	3.69**
Verbal support	1.39	3.68	4.15**
Laughter	2.11	6.00	4.45**
Smiles	2.67	6.77	5.28**
Ideas generated	13.17	27.09	8.28**

a. Control (untrained), $n = 18$ groups of five members each; treatment (trained), $n = 22$ groups of five members each.
b. Standard deviation score.
*$p \leq .01$; **$p \leq .001$.

attended 26 classes of 1 hour 15 min in duration, or 32½ hours of instruction.

For each variable investigated, a Pearson's product-moment correlation (Pearson's r) was calculated to determine interrater reliability on the ratings of each communication behavior. Interrater reliability scores were quite high with a range of $r = .95$ to $r = .99$ across the communication variables; thus the means of the two raters' scores were combined to create a single score for that communication variable.

RESULTS

As shown in Table 1, on five of the six communication behaviors evaluated, the groups trained in CPS surpassed the control groups. The variables on which the CPS groups outperformed the control groups were total responses ($t = 5.23$, $p \leq .001$); fewer verbal indications of criticism of ideas ($t = 3.69$, $p \leq .001$); more verbal support of ideas ($t = 4.15$, $p \leq .001$); and more nonverbal indications of humor as evidenced by smiles ($t = 5.28$, $p \leq .001$).

However, the participation in the control groups was more even than the participation in the groups trained in CPS ($t = 3.30$, $p \leq .01$). The data presented do not support the hypothesis that groups trained in CPS exhibit greater evenness of participation than groups not trained in CPS.

Table 1 also indicates that groups trained in CPS generated significantly more ideas than the control groups ($t = 8.28$, $p \leq .001$). The data presented support the hypothesis that groups trained in CPS generate more ideas than groups not trained in CPS.

DISCUSSION

In summary, this study found that groups trained in CPS participated significantly more than groups not trained in CPS. Groups trained in CPS did not exhibit greater evenness of participation than groups not trained in CPS. Additionally, groups trained in CPS criticized ideas less, verbally supported ideas more, laughed more, smiled more, and generated significantly more ideas than groups not trained in CPS.

The results of this study indicate that training in CPS has a significant impact on the communication behaviors that occur in small groups. It also indicates that groups trained in CPS produce significantly more ideas than groups not trained in CPS.

Moreover, subjects in this study worked on a "real" problem. Much of the earlier related research in this area has used "unreal" problems to test the effects of training in CPS. Harari and Graham (1975) concluded that the tasks in most studies represent little more than innocuous puzzles or games. Bouchard (1971) found that more responses were given to unreal problems than to real problems, and Dillon et al. (1972) found that group members had difficulty adhering to the rules of brainstorming on problems they were interested in and cared about.

The only area in which the treatment group did not surpass the control group was in evenness of participation. An explanation for this phenomenon can be found by viewing the videotapes of the

problem-solving groups in action. In each of the groups, an individual in the group volunteered to record the ideas generated. In groups where fewer ideas were generated (i.e., most of the untrained groups), the recorders had sufficient time to make their own contributions, and the communication behavior raters scored these contributions as responses. However, in the treatment groups, other members of the group were generating ideas at such a high rate that the recorder was kept busy recording all the ideas generated. As a result, recorders in the trained groups were unable to contribute as many ideas as recorders in the untrained groups.

Based on the results and discussion, a course in CPS has a strong positive effect on communication behaviors that occur in small groups. However, the limitations of the research indicated areas in which further study is needed. Because of logistical constraints, there was an element of familiarity in the treatment groups. Subjects had worked together in various small group situations in class. Thus one could question the degree to which this influenced the results of the study. This might have added to the increased incidences of overall responses, humor, and laughter. However, the group interactions in class were designed to help students solve specific problems following a prescribed methodology. The course was not designed to teach the benefits of positive group interaction or methods for developing or structuring a group. To further validate the findings of this study, additional research should be conducted by assembling groups of subjects trained in CPS that had no prior interaction with each other.

This research used students from one course in CPS at the State University College, Buffalo; therefore, there is difficulty generalizing the findings to a broader population. Further studies need to be conducted with other populations, perhaps managers in business and industry and other working professionals to further validate these results. Other training programs designed to teach CPS might also be investigated. Will other courses in creativity have an impact on communication behaviors in groups as this CPS course did?

Additional studies could examine the length of the CPS course. An entire semester might not be necessary. Perhaps a series of two-

or three-day programs would be sufficient to introduce participants to these methodologies and obtain similar positive results.

As mentioned earlier, the use of real or unreal problems seems to have an effect on subjects' motivation and their willingness to adhere to the rules of brainstorming. However, the use of real problems in the Introduction to Creative Studies course may have had a positive effect on subjects' motivation to contribute ideas. In the creative studies course, students practiced CPS techniques on some problems that were of direct concern to them. By developing solutions to their own problems, and implementing those solutions, students might have realized the value of using CPS methods. This recognition of usefulness could have contributed to increased performance motivation and carried over to the case problem. Bouchard (1971) supported this position when he stated, "Real groups in applied settings are highly motivated because there is a real payoff for successful performance. This could lead to more effective management of the group's time and resources" (p. 184).

This study found that not only is the introductory course in CPS as taught at SUCB beneficial in helping participants on a number of cognitive and affective measures, as reported in Parnes and Noller (1973) and Parnes (1987), but the course makes a significant impact on the positive communication behaviors exhibited in problem-solving groups. There are a number of programs on the market today—that is, Training Resources (1979), Pfeiffer and Jones (1980), and Xerox Learning Systems (1982)—and countless courses in organizational and educational settings that profess to teach small group communication skills, increase team involvement, and enhance participants' satisfaction with group experiences. Perhaps it would now be appropriate to add a course in CPS to those programs.

Finally, the results of this study indicate that there is a strong synergistic effect occurring between the field of CPS and communication. Perhaps combined studies might be undertaken to clarify some of the inconsistent findings, reported in the introduction to this article, regarding the use of problem-solving agendas and the efficacy of individuals versus small groups in problem solving.

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