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Michael W. Kramer, Chao Lan Kuo and John C. Dailey

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THE IMPACT OF BRAINSTORMING TECHNIQUES ON SUBSEQUENT GROUP PROCESSES

Beyond Generating Ideas

MICHAEL W. KRAMER

CHAO LAN KUO

University of Missouri–Columbia

JOHN C. DAILEY

Southwest Missouri State University

Previous research on brainstorming and nominal group techniques has focused primarily on their ability to generate ideas without examining the impact of these procedures on actual group decision making. This experimental study found no difference in the decision quality of untrained, brainstorming, and nominal groups. However, brainstorming and nominal group members were more satisfied, felt their groups used a more effective process, and felt they communicated more effectively than untrained groups. Such results suggest that the impact of these techniques goes beyond their ability to generate ideas by affecting group process and communication in positive ways.

Osborn (1957) proposed brainstorming as a technique for improving productivity and creativity during group decision making. Thousands of groups have been trained in the principles of brainstorming, which generally emphasize these axioms: (a) state as many ideas as possible, (b) the wilder or more creative the ideas the better, (c) improve or combine ideas, (d) accept without criticism all ideas, and (e) record all ideas for future consideration. Numerous other

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groups have been trained in a derivative of brainstorming called the nominal group technique (e.g., Delbecq, Van de Ven, & Gustafson, 1975). Nominal groups apply the same basic principles as brainstorming, except that the group members work independently and do not actually interact; they are groups "in name only." Nominal groups brainstorm individually, and then their nonredundant ideas are pooled by a moderator. In some cases, the idea-generating feature of the nominal group technique is combined with some decision-making procedure, typically a polling technique for reaching a decision (e.g., Gustafson, Shukla, Delbecq, & Walster, 1973; Hegedus & Rasmussen, 1986).

Previous research comparing brainstorming and nominal group techniques has focused almost exclusively on how these techniques increase the productivity and creativity of ideas without examining their impact on actual group decision making. This study's goal is to expand this body of research by exploring the impact of these techniques on group processes during subsequent group decision making. In particular, this research explores whether groups trained in brainstorming and nominal group techniques make higher-quality decisions than untrained groups and whether members of groups trained in brainstorming and nominal group techniques differ in their perceptions of the group communication and processes during subsequent decision making compared to members of untrained groups.

REVIEW OF LITERATURE

In a review of the previous research comparing brainstorming techniques, Diehl and Stroebe (1989) concluded that one of the most consistent findings in group research is that brainstorming groups generate more ideas than untrained groups but fewer ideas than nominal groups. In response to such findings, researchers have developed various techniques, such as synectics (e.g., Bouchard, 1972) or written feedback (e.g., Madsen & Finger, 1978), to increase the number of ideas generated and have proposed computer support systems to enable brainstorming groups to perform at the

level of nominal groups (Gallupe, Bastianutti, & Cooper, 1991). Only a few researchers have tested and compared various explanations or interpretive theories for these differences between brainstorming and nominal groups (e.g., Street, 1974). These explanations for the differences in the number of ideas generated include production blocking, in which ideas are lost because only one member can speak at a time; evaluation apprehension, in which members fear negative evaluation even though it is prohibited; and free riding, in which some members loaf while others actively generate ideas (Diehl & Stroebe, 1989). Researchers have not generated theories to explain the impact that these techniques may have on subsequent group decision making.

Osborn (1957) was not only concerned with generating more ideas but with how groups then screen the ideas and select the best choice. A major assumption in research concerning these techniques is that "the larger the number of ideas produced, the greater the probability of achieving an effective solution" (Taylor, Berry, & Block, 1958, p. 24). Rather than directly testing this assumption concerning decision quality, researchers have tended to test whether idea quality increases as the idea quantity increases. The results have been unequivocal: As the idea quantity increases, so does the idea quality (e.g., Diehl & Stroebe, 1989; Dunnette, Campbell, & Jaastad, 1963). However, this does not indicate whether groups with a higher quantity and quality of ideas actually make better decisions. Because groups must eliminate many suggestions in making decisions, a large quantity of ideas, even if of high quality, may not significantly increase the quality of the final decision, even though groups can combine ideas in creating solutions.

Previous research comparing brainstorming and nominal groups has failed to test empirically the direct impact of these approaches on decision making for two main reasons. First, some of the more frequently used topics do not allow for decision making. In the frequently used "thumbs exercise" (e.g., Bouchard & Hare, 1970), group members are asked to generate ideas for ways in which the world would be different if people had two thumbs on each hand. Although allowing for creativity, this topic lacks relevance and cannot be used to explore decision making. Second, even when the

studies have used topics that allow for decisions (e.g., how to increase European tourism to America; Jablin, 1981), the groups have been dismissed after generating ideas, without making any decisions.

Roth (1994) cited a number of studies as evidence that the nominal group technique improves group decision quality when compared with that of untrained groups and other techniques, such as the Delphi method. However, these studies also fail to determine the impact of these idea-generating techniques on group decision making for two reasons. First, most of these studies use intellectual tasks that have correct answers because "idea generation tasks unfortunately do not allow for objective criteria" (Roth, 1994, p. 431). Because the group tasks involved making estimates and predicting probabilities, the studies could not examine the merits of these approaches as creative, idea-generating techniques. Given this limitation, it is not surprising that these studies do not compare nominal groups with brainstorming groups. Second, most of these studies have not actually compared the quality of group decisions. In most cases, group members make independent predictions or decisions, meet to share and discuss their choices, and then make a second set of independent decisions (estimate, talk, estimate). Group members' average or aggregate scores are then compared without the groups reaching mutual decisions (e.g., Fischer, 1981; Gustafson et al., 1973; Nemiroff, Pasmore, & Ford, 1976). In another variation, a composite score of the quantity of ideas and group satisfaction is used as an effectiveness measure, without examining the decisions made by the groups (Van de Ven & Delbecq, 1974). One study does have group members reach decisions after working independently but omits the round-robin idea sharing typical of the nominal group technique, again posing a problem with objective (true or false) answers (Hegedus & Rasmussen, 1986).

In sum, research directly comparing brainstorming and the nominal group technique frequently fails to use decision-making topics and, when using such topics, does not allow group members to make decisions. Research comparing the nominal group technique with other decision-making approaches fails to use topics that allow for creative thinking and generally substitutes aggregate or

average scores for group decisions. Therefore, this research explores the underlying assumption that the higher quantity and quality of ideas generated through brainstorming and nominal groups result in better group decisions by testing the following hypothesis:

H1: Decision-making groups trained in brainstorming and nominal group techniques make higher-quality decisions than untrained groups.

Another omission in previous research comparing brainstorming and nominal group techniques is its failure to examine whether the training has an impact on group communication and processes during any subsequent decision making. A few studies have shown that compared with untrained, interacting groups, nominal groups are more satisfied (e.g., Hegedus & Rasmussen, 1986) and interact differently (Delbecq et al., 1975), but these studies do not involve idea-generating tasks or comparisons with brainstorming groups. In direct comparisons of brainstorming and nominal groups, there has been no attempt to explore the impact of these techniques on group communication and processes after the idea-generating periods because groups have not been allowed to continue until they reach decisions.

Structuration theory (e.g., Giddens, 1979) provides a theoretical explanation for expecting these techniques to affect group interactions after the idea-generating periods. As applied to groups, structuration theory indicates that group members use the rules and resources of the group to produce and reproduce the social system (Poole, Seibold, & McPhee, 1985). This suggests that groups trained in these idea-generating techniques would have different rules and resources from those in untrained groups. The use of these available resources should affect group processes and communication during subsequent decision making.

In the case of brainstorming groups, an extended period of no criticism and free-wheeling participation could establish a strong norm that would be followed after the brainstorming period. Groups follow very casually created norms for long periods of time (Gersick, 1988). If brainstorming groups use the norms established by the

process once those rules are no longer in force, they could continue to reproduce a system with relatively equal participation and acceptance of various viewpoints. If this were the case, brainstorming may encourage more democratic processes through equal participation (Gastil, 1993) and may have implications for team building in groups, a current concern in business and industry.

The impact of the nominal group technique on group communication and processes during decision making would be more subtle. Nominal groups have no interaction as they generate ideas but individually follow the brainstorming rules. Members then take turns sharing ideas. When they begin making decisions, few interaction norms have been established, except for this turn-taking norm for sharing ideas. Previous research has shown that the nominal group technique promotes more equitable participation compared with untrained groups (Delbecq et al., 1975). This suggests that the groups use this turn-taking norm as a resource to reproduce a more equitable system.

Unlike brainstorming and nominal groups, untrained groups do not have the norms or resources that promote equitable participation or positive interaction. Typically, in untrained decision-making groups without those resources, criticism is common and inequality in participation is frequently the norm (Delbecq et al., 1975). This indicates that untrained groups should perceive their interactions differently than brainstorming or nominal groups. This suggests the following hypothesis:

- H2: Members of brainstorming groups and nominal groups report experiencing more positive communication and group processes during subsequent decision making than untrained groups.

METHOD

SAMPLE

A total of 200 students enrolled in a multisection basic communication course selected the option to participate in this experiment

to meet a course requirement. Students divided themselves into groups of five and then signed up to participate at a specific time. In this respect, they were not strictly zero-history groups because they had agreed to participate together at a certain time. However, because results from previous research on brainstorming groups with a history have not differed significantly from results involving those without a history (e.g., Dunnette et al., 1963), this limited history was not considered a problem.

Participants in the study were 57% female. Most were of European ancestry, with 7% Asian and 4% African ancestry. Their average age was 22. They included freshman (2%), sophomores (15%), juniors (33%), seniors (46%), and graduate students (4%). Of the 59 different majors listed, the ones most frequently listed were education (13.5%), human resource management (8.5%), engineering (7%), and finance (5%).

PROCEDURES

This research used an experimental design. Groups were randomly assigned to one of three conditions prior to their arrival at the experimental room. This seminar room had a rectangular table with a pad of paper and a pencil at each seat. In the first condition, the untrained groups ($n = 13$) were simply told that their task was to reach a decision for the assigned topic, and no further directions were given. As is typical of previous research in this area using untrained or traditional interacting groups, no training was given because this would provide a confound in interpreting results (e.g., Nemiroff et al., 1976; Sniezek, 1990). The procedures for the other two groups also followed those typical of this research (e.g., Gallupe et al., 1991). In the second condition, brainstorming groups ($n = 14$) were instructed in the brainstorming principles and were given a brief 5-minute practice session on a topic (how to improve food service on campus) different from the experimental one. After the practice session, they were told to brainstorm for 10 minutes on the assigned topic, after which they were to reach a decision. In the third condition, nominal groups ($n = 13$) were instructed in the

principles of the nominal group technique and given a brief 5-minute practice session on the same alternative topic. Then they were instructed to brainstorm individually for 10 minutes on the assigned topic, after which they were to take turns sharing their ideas and then reach a decision.

In addition to these specific directions, all groups were instructed to write down their final decision on a designated form. In the second and third conditions, a timer was set to beep after 10 minutes to inform the groups when to begin the decision-making process. The researcher then turned on an audiotape, left the room, and closed the door. When the groups finished, a member opened the door and the researcher reentered the room. The participants were told not to discuss the activity with any students in their communication classes because other groups had not yet completed the activity. Then all participants filled out a brief questionnaire. They were debriefed by their course instructors after all the data were collected.

To allow for relevant decision making in which creativity would be an important element, the group task was to develop a 2-hour Saturday afternoon program for 200 high school juniors and seniors coming to visit the university during a fall weekend on which there was no football game. Pretests of this topic showed that students were able to generate numerous ideas in short periods of time. Students recognized the topic's potential relevance because colleges and universities face this situation annually. As is often the case in organizational decision-making settings, some group members were already experienced with the topic, having been involved as participants in such events prior to entering college.

QUANTITATIVE MEASURES

To measure group processes and communication, a number of established scales were used on the questionnaire, and other scales were developed through exploratory factor analysis. Items included positively and negatively worded items to reduce response bias. All scale items required responses on a 5-point Likert-type scale and

were coded so that high scores indicated high levels of the variables. Results are reported as the average per item on the scale rather than as sums.

Group satisfaction was measured using a five-item scale developed by Valacich, Dennis, and Nunamaker (1992). Participants indicated the degree to which they were satisfied with the group process, the outcome, group members, overall quality of effort, and their willingness to work with the group again. For this study, the internal reliability of the scale was $\alpha = .81$.

The effectiveness of the process was measured using three items from the effectiveness scale by Valacich et al. (1992), along with an additional process item added for this study. Participants indicated the degree to which they thought their group made effective use of group members' skills, generated good ideas, evaluated the ideas effectively, and developed positive interactions during the process. The internal reliability of this four-item scale was $\alpha = .76$.

To measure the impact of these techniques on the group communication and decision-making processes, items were generated to measure communication processes and outcomes identified in previous research. These included seven items based on Gastil's (1993) concept of democratic group processes; four items concerning the quality of the decision, based on research by Hirokawa and Rost (1992), Watson, Kumar, and Michaelson (1993), and Taylor et al., (1958); and eight items concerning communication. Using the data collected in this study ($n = 200$), these 19 items were factor analyzed (principal components, varimax rotation, eigenvalues > 1) to develop individual scales. To be retained, an item had to load at greater than .60 on one factor and less than .40 on other factors. Three items were dropped from the analysis for failing to meet these criteria. The remaining 16 items indicated three factors (see Table 1): (a) communication (10 items, $\alpha = .92$), on which participants indicated the degree to which they felt satisfied with the communication, felt that there was an equal opportunity to participate, felt that members listened, felt that they could speak, felt that conflict was managed well, felt satisfied with their participation, gave everyone's ideas fair consideration, accepted differences in members, and commu-

nicated respect and consideration; (b) quality of decision (3 items, $\alpha = .78$), on which participants indicated the degree to which they felt the decision was feasible, effective, and likely to be rated negatively (reverse coded); and (c) dominance (3 items, $\alpha = .70$), on which participants indicated the degree to which some people dominated the communication, one person was an obvious leader, and everyone in the group had the same amount of influence or power (reverse coded).

OUTSIDE RATING OF QUALITY OF DECISION

To evaluate the decision quality more objectively, two outside judges active in recruiting high school students, but unfamiliar with the experimental conditions, evaluated the groups' final decisions. The judges were given a typed version of the groups' decisions and rated the quality of the decision on a four-item Likert scale based on research by Hirokawa and Rost (1992), Watson et al. (1993), and Taylor et al. (1958). They indicated the degree to which they thought the decision was effective, feasible, creative, and would be interesting to high school students. The scale had an internal reliability of $\alpha = .86$ for the two judges. Because the interjudge correlation for this scale was $r = .77, p < .001$, the judges' average was used as the judges' multiple-item scale. In addition, the judges gave an overall program rating on a 7-point scale (*superior* to *very poor* program idea). With the interjudge correlation for this overall evaluation being $r = .69, p < .001$, the judges' average rating was used as the judges' overall rating. Correlations between all the quantitative measures are reported in Table 2.

STATISTICAL ANALYSES

Results are reported at the group level rather than at the individual level of analysis. This was accomplished by averaging individuals' scores for a particular scale (e.g., satisfaction) within each group. This resulted in a sample of 40 for all correlations and analyses of variance. It should be noted that the pattern of signifi-

TABLE 1: Factor Loadings

<i>Items^a</i>	<i>Communication</i>	<i>Decision Quality</i>	<i>Dominance</i>
As a group, we communicated respect and consideration to each member.	.83	.03	-.16
As a group, we gave everyone's ideas fair consideration.	.79	-.03	-.21
I felt other members of the group listened to me.	.77	.13	-.16
I felt I could speak up whenever I had something to say.	.77	.17	-.15
As a group, we accepted differences in members' styles of interacting.	.72	.04	-.16
As a group, we listened to everyone's ideas.	.71	.15	-.20
Everyone had an equal opportunity to participate in the group.	.69	-.09	-.17
As a group we managed any conflicts or disagreements in a way that made it easy to continue working together.	.68	.25	-.07
I felt satisfied with my participation in the group.	.67	.26	-.13
Overall, I was satisfied with how we communicated as a group.	.65	.27	-.29
The final decision we made would probably be rated poorly. (reverse coded)	.05	.84	-.05
The final decision we made would be feasible for the university to adopt.	.07	.83	-.03
The final decision we made would make an effective program.	.25	.78	.04
There was an obvious leader of this group.	-.09	-.03	.80
One or two people tended to dominate the communication.	-.25	.00	.79
Everyone in the group had about the same amount of influence or power. (reverse coded)	-.39	-.01	.66
Eigenvalue	6.71	2.00	1.28
% of variance	42.0	12.5	8.0
Reliability	.91	.78	.70

NOTE: Italicized numbers indicate which factor the items loaded on for subsequent analyses.

a. Items appeared in random order on the questionnaire.

TABLE 2: Correlations Matrix

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
1 Group satisfaction	4.26	.31	—						
2 Effective process	4.02	.38	.87**	—					
3 Communication	4.28	.28	.87**	.80**	—				
4 Dominance	2.68	.58	-.59**	-.52**	-.63**	—			
5 Self-rating quality	4.17	.51	.20	.26	.01	.05	—		
6 Judges' multiple item	3.84	.61	-.26	-.17	-.40*	.18	.66**	—	
7 Judges' overall rating	4.94	1.18	-.27	-.22	-.43*	.23	.51*	.91**	—

* $p < .05$. ** $p < .001$.

cant results was identical whether the unit of analysis was the individual or the group because the means remained the same; however, changes in the degrees of freedom did result in changes in the F ratios and effect sizes when comparing group and the individual level of analysis.

CONTENT ANALYSIS

The final questionnaire item was an open-ended question: "In the space below (and continue on the back if necessary), briefly describe your reactions to the group with which you were working." A total of 167 (84%) participants wrote one or more comments. These were content analyzed (Krippendorff, 1980). Comments were separated into syntactic units according to the participants' punctuation. This resulted in both sentences and phrases. Categories were developed based on a random sample of the comments (see Table 3). Then three trained coders, blind to their source, coded the comments into the categories. When syntactic units represented more than one category, they were coded into two or more categories. Inter-coder reliabilities for multiple coders indicated a simple agreement of .82 and agreement correcting for chance agreement (Kappa) of .79 based on 394 units (Fleiss, 1971). Data were coded into a category when two or three coders agreed on the category. Six units (1.5%) on which there was no agreement between the coders were treated as uncoded, a category for statements not fitting into any other category.

TABLE 3: Categories and Examples From Open-Ended Comments

<i>Categories</i>	<i>Typical Category Examples</i>
Group communication	
Positive interaction	All persons had an opportunity to talk.
Negative interaction	The group started out not talking much.
Positive listening	Everyone was open and willing to listen.
Negative listening	(No comments coded into this category)
Group process	
Ideas positive	We were all very creative and had many good ideas.
Ideas negative	I thought we could have used more creative ideas.
Process effective	I think we worked really well together.
Process ineffective	We tended to wander off the subject somewhat.
Group decision	
Positive	Am satisfied with the overall result of the group.
Negative	I agree with some of the decisions but not all.
Group climate	
Positive	Very considerate, cooperative, fun, easygoing.
Negative	Group would have worked a little better if everyone had been better acquainted to ease group tensions.
Specific group members	
Positive	I had presented a main solution or an idea, and I was happy with support I got from the group.
Negative	Some could have contributed more during brainstorming.
General comments	
Positive	Things went well.
Negative	Was not very effective.
Uncoded	It was difficult to express in written form.

Once the comments were coded, it became apparent that some participants were rather repetitious, making the same type of comment more than once. For example, one participant wrote four vague, general, positive remarks, and another wrote four statements criticizing the same individual for her participation. To minimize any one individual's impact on the analysis, data were coded to show the presence or absence of a comment for each category for each participant rather than the total comments in each category.

RESULTS

MANIPULATION CHECKS

The first manipulation check determined whether groups followed their assigned procedures. Analysis of each audiotape indicated that none of the untrained groups used either brainstorming or the nominal group technique. All groups in the second condition used brainstorming, and all groups in the third condition used the nominal group technique.

The second manipulation check was used to confirm previous research, which found that nominal groups generate more ideas than brainstorming groups and that both generate more ideas than untrained groups. The number of unique ideas generated by each group was counted by two judges. For an untrained group, this involved reading a transcript of the group's discussion and counting the number of unique ideas. For a brainstorming group, this involved counting the number of ideas on the list kept by the group's secretary. In the nominal group technique, this involved counting the nonredundant ideas from the papers each member used for individual brainstorming. The interjudge correlation for these counts for the two judges was $r = .97$. A one-way analysis of variance (three types of groups \times number of ideas) indicated that there were significant differences in the quantity of ideas generated by each type of group, $F(2, 37) = 15.44$, $\eta^2 = .45$, $p < .001$. Post hoc Student-Newman-Kuels tests indicated that all three groups differed significantly from each other. As expected, untrained groups produced the fewest number of ideas ($M = 11.7$, $SD = 6.0$), brainstorming groups considered more ideas than untrained groups ($M = 15.9$, $SD = 9.0$), and nominal groups produced more ideas ($M = 28.6$, $SD = 8.8$) than either untrained or brainstorming groups.

H1: QUALITY OF DECISION

Three measures of the decision quality were used: the participants' self-report ratings, the judges' multiple-item scale, and the

judges' overall rating scale. Given that various individuals are likely to evaluate an effective program for recruiting high school students differently, the intercorrelations between these different ratings were moderate to high (.51 to .91). Given these relatively high correlations, a MANOVA (three types of groups \times three different quality ratings) was computed to determine if there were any systematic differences across the three ratings. MANOVA results indicated no significant multivariate differences $F(6, 70) = 1.19$, $\eta^2 = .09$, $p < .32$. In addition, there were no significant differences in the univariate analyses for either the self-report ratings, $F(2, 37) = .04$, $\eta^2 = .00$, $p < .96$; the judges' multiple-item scale, $F(2, 37) = 1.33$, $\eta^2 = .07$, $p < .28$; or the judges' single-item scale, $F(2, 37) = 2.32$, $\eta^2 = .11$, $p < .11$. These results indicate no support for the first hypothesis.

H2: GROUP COMMUNICATION AND PROCESSES

A series of one-way ANOVAs (three types of groups) was computed for each dependent variable. When results showed a significance level of $p < .05$, post hoc Student-Newman-Kuels tests were computed to determine where significant differences existed between groups.

Group satisfaction. For group satisfaction, results indicated there were significant differences between groups, $F(2, 37) = 3.37$, $\eta^2 = .15$, $p < .05$. Post hoc tests indicated that those in untrained groups reported significantly less satisfaction with their groups ($M = 4.1$, $SD = .29$) than did those in nominal groups ($M = 4.4$, $SD = .31$). Brainstorming groups ($M = 4.3$, $SD = .26$) did not differ significantly from the other types of groups.

Effective process. For the effectiveness of group procedures, results also indicated significant differences between groups, $F(2, 37) = 4.61$, $\eta^2 = .20$, $p < .05$. Post hoc tests indicated that those in untrained groups rated the effectiveness of their groups' process as lower ($M = 3.8$, $SD = .34$) than those in nominal groups ($M =$

4.2, $SD = .39$). Brainstorming groups ($M = 4.1$, $SD = .31$) did not differ significantly from the other types of groups.

Communication. In terms of satisfactory and effective communication, results indicated that there were significant differences between groups, $F(2, 37) = 4.18$, $\eta^2 = .18$, $p < .05$. Post hoc tests indicated that those in untrained groups rated the communication lower ($M = 4.1$, $SD = .21$) than did those in brainstorming ($M = 4.3$, $SD = .26$) and nominal groups ($M = 4.4$, $SD = .29$). Brainstorming and nominal groups did not differ significantly.

Dominance. For the concept of dominance, results indicated there were significant differences between groups, $F(2, 37) = 4.54$, $\eta^2 = .20$, $p < .05$. Post hoc tests indicated that those in untrained groups ($M = 3.0$, $SD = .59$) felt that power and influence were not equal in the group and that one or two people dominated or led the group, compared with those in brainstorming ($M = 2.6$, $SD = .27$) and nominal groups ($M = 2.4$, $SD = .67$) who felt participation was more equal. Again, those in brainstorming and nominal groups did not differ significantly.

Content analysis. The number of individuals making comments for each category for each type of group is reported in Table 4. Overall, these results suggested a number of things. First, most participants found the activity and process to be fairly positive. Of those individuals making remarks ($n = 167$), far more wrote positive ($n = 155$ or 78%) than negative ($n = 34$ or 19%) remarks, although a few wrote both. There were more positive than negative remarks concerning group communication (both interacting and listening), considering ideas, following an effective process, making a good decision, and having a positive group climate, as well as general positive remarks. The only category in which there were more negative remarks than positive ones concerned specific group members, in which there were more comments criticizing one or more individuals in the group than there were comments praising an individual's contribution.

TABLE 4: Response Rates by Participants for Content Analysis

<i>Categories</i>	<i>Untrained Group Members (n = 65)</i>	<i>Brainstorming Group Members (n = 70)</i>	<i>Nominal Group Members (n = 65)</i>
Group communication			
Positive interaction	15	8	9
Negative interaction	1	1	1
Positive listening ^a	3	11	6
Negative listening	0	0	0
Group process			
Ideas positive ^b	17	30	10
Ideas negative ^b	7	7	0
Process effective	20	24	12
Process ineffective	1	3	0
Group decision			
Positive ^a	3	7	1
Negative	2	2	1
Group climate			
Positive	11	23	17
Negative	2	0	0
Specific group members			
Positive	3	5	1
Negative ^b	14	6	1
General comments			
Positive	14	15	14
Negative	3	2	0
Uncoded	6	4	1

a. $\chi^2 = p < .10$.b. $\chi^2 = p < .05$.

To use the comments to analyze differences between the three groups, a series of 2×3 contingency tables (presence or absence of comment \times type of group) was calculated for each category. An overall chi-square of Table 4 could not be calculated because participants frequently contributed more than one comment, a violation of the independence of observations assumption of a chi-square analysis (Hays, 1981). A significant chi-square indicated that a higher than predicted number of participants made comments in a particular type of group compared with those in other types of groups.

As indicated in Table 4, brainstorming group members made more positive comments concerning the creativity of their ideas or

their ability to build on one another's ideas, $\chi^2(2) = 12.74, p < .01$. Typical of those remarks were "We continually modified our ideas until we stumbled on the final one and it was like 'Eureka! We've got it' " or "Our group combined everyone's ideas together well so that no one's ideas were left out."

Results also show that those in the nominal groups were least likely to make negative idea comments, indicating that they had failed to consider enough ideas or build on each other's ideas, $\chi^2(2) = 7.27, p < .05$. Those in the untrained and brainstorming groups made comments such as "I thought we could have used more creative ideas" or "We seemed . . . unable to generate many ideas." Nominal group members did not make such comments.

Those in untrained groups were most likely to make negative comments concerning the participation of specific group members, $\chi^2(2) = 14.26, p < .001$. Characteristic of such remarks were "She seemed to stop participating halfway through" or "Some people (one person) led the group and was kind of closed minded to others' ideas." There were a few such comments from brainstorming group members, but almost none from the nominal group members.

Finally, although not indicated in Table 4, a pair of chi-square analyses based on whether individuals made any positive or negative remark indicated that those in brainstorming groups were most likely to make a positive remark, $\chi^2(2) = 11.23, p < .01$, and those in the nominal groups were least likely to make a negative remark, $\chi^2(2) = 18.45, p < .001$.

DISCUSSION

Previous research has examined the impact of brainstorming and nominal group techniques on generating ideas. In dismissing groups after they have generated ideas, such research has failed to consider the impact of these techniques on subsequent group communication and processes. By having groups continue to work together until they actually reached a decision, this study examined the impact of these techniques on subsequent decision making.

An underlying assumption of previous research in this area has been that groups with more ideas make better decisions (Taylor et al., 1958). Although previous research indicates that as the idea quantity increases, so does the idea quality, results from this experiment do not support the claim that these techniques have a significant impact on the quality of groups' decisions, although, as in previous research, they did affect the quantity of ideas considered. Neither group members' self-report evaluations nor outside judges' ratings indicated any significant differences in the quality of the final decisions made by the different types of groups. This lack of significant differences in decision quality may have been due to the subjects, the setting, or the research topic. Perhaps these techniques do not provide an advantage in decision-making quality for temporary groups dealing with common situations such as the ones used here, but they would be advantageous in addressing more unusual, less familiar situations in ongoing groups. Future research should examine whether these techniques improve the decision quality for certain types of decisions.

The fact that the quality of the decision may not be affected by these techniques does not signify that their use is insignificant or unproductive. The use of groups in organizations often serves multiple goals besides reaching high-quality decisions, such as team building, consensus building, or increasing participation (Delbecq et al., 1975). The results suggest that the use of brainstorming and nominal group techniques has a variety of positive outcomes related to these other goals for group activities. For example, those in the untrained groups were less satisfied in general, thought the process was less effective, and thought that communication was less positive. Lower affective responses to group experiences are likely to affect other group outcomes, such as cohesion or commitment to the group activity. To the degree that these are desired outcomes for the group activities, the use of brainstorming and nominal group techniques may serve group goals.

A concern for group facilitators is the equity of interaction among members. Although the goal of group activities is frequently to achieve "maximum feasible participation," too often people leave groups feeling they were influenced too much by one or two

assertive members (Delbecq et al., 1975). Results indicated that dominance by some member(s) and negative participation were associated more with untrained groups than brainstorming and nominal groups. This occurred even though there were no significant status differences among individuals as they began working and the groups had almost no history of working together. The inequality in participation would be expected to be even stronger in groups with clear status differences (e.g., superior-subordinate). Between 55% and 80% of organizational teamwork efforts are unsuccessful at achieving their goals (Ju & Cushman, 1995). These results suggest that providing groups with simple procedures to follow, such as brainstorming or the nominal group technique, may help facilitate the more equitable participation needed for successful teamwork.

This study provides limited information concerning the relative merits of brainstorming compared to the nominal group technique. There were no significant differences between the two concerning the quality of decisions or measures of affective response. The content analysis results suggest that the brainstorming procedure resulted in perhaps more intense positive reactions. Individuals from the brainstorming groups wrote more positive remarks about ideas considered and more positive remarks overall. However, at the same time, members of brainstorming groups also were more likely than those in nominal groups to make comments suggesting that their ideas were negative or that specific people were negative group participants. This tentatively suggests a trade-off, in which brainstorming increases positive and negative responses to the group activity compared with nominal group techniques, even though both produce more positive reactions than does no training. Clearly, further investigation of these differences is needed.

Most previous research examining the use of brainstorming and nominal group techniques has been atheoretical. What little theory has been generated examines reasons why nominal groups produce more ideas than brainstorming groups (e.g., Diehl & Strobe, 1989), without considering the impact of these techniques on decision making. The results suggest that structuration theory (e.g., Giddens, 1979) provides an explanation for the differences in group mem-

bers' perceptions of their interactions. According to structuration theory, group members use the available rules and resources to produce and reproduce the social system (Poole et al., 1985). Results suggest that the rules of brainstorming and the nominal group technique, which promote equal participation, become resources that group members use to create and re-create a social system in which there is less dominance and more positive interaction between members than in groups untrained in these techniques. Without the rules of these techniques as resources for determining interaction norms, untrained groups create a social system that is less positive and less equitable for participants. Research based on structuration theory could examine the impact of these techniques in naturally occurring groups to increase understanding of theory and practice. For long-term groups, structuration theory would suggest that the use of the rules as resources and the resulting positive affective responses should affect the quality of future interactions, which might then affect the quality of future decisions.

LIMITATIONS

The research design adopted has its strengths and limitations. Such a laboratory setting enabled the systematic control over many parts of the process that would have been lacking in a field study. As others have noted, a laboratory study allows for the systematic comparison of techniques, although the generalizability of the results is limited compared to a field study (e.g., Hirokawa & Rost, 1992).

As is typical of previous research, untrained groups began interacting without any training or instruction (e.g., Nemiroff et al., 1976; Sniezek, 1990). Differences due to time spent together being trained in the techniques or time differences due to use of the procedures might be considered problematic. An ANOVA showed that nominal groups took significantly longer ($M = 39.2$ minutes) to complete the task than did brainstorming ($M = 20.1$) and untrained groups ($M = 20.4$), which did not differ from each other, $F(2,37) = 19.52$, $\eta^2 = .53$, $p < .001$. This difference is understandable because nominal groups were silent for 10 minutes and then had to explain

their ideas before beginning the decision-making process. However, brainstorming and nominal groups were undifferentiated on all dependent variables but differed from untrained groups. This suggests that time spent together or time spent in training does not provide a viable explanation for the results.

Although the results for decision quantity and quality are based on outside judges' evaluations, results for the other measures are based on self-report data. Although self-report data are probably the most appropriate way to measure affective responses to the group activity (e.g., satisfaction), they do not indicate whether actual differences in communication and processes occurred. Future research should examine whether behavioral differences in the communication and decision-making processes functioning groups use when trained in these techniques lead to these perceptual differences.

The use of mixed-gender student groups with almost no history is also a limitation. However, results from previous research using various groups—same-gender and mixed-gender groups, student and adult groups, groups with or without a history—have shown consistent findings across groups of various demographics concerning the ability to generate ideas using these techniques (Diehl & Strobe, 1989). Further, a series of *t* tests showed that the gender of the individual was not a significant determinant of the response to the activity, nor did the gender makeup of the group (majority male or majority female) make a significant difference in the number of ideas generated by the group or the group response to the activity. However, this research should be viewed as a first step in the process of examining these issues. Future studies with functioning organizational groups can explore the applications of the findings to various decision-making settings.

CONCLUSION

Research on brainstorming and the nominal group technique has been limited lately. This is likely due in part to the narrow focus of previous research on these approaches as idea-generating techniques only, an area in which the results are quite unequivocal.

Although the results did not show that these techniques affected the decision quality, they did show that these techniques affect subsequent group decision-making processes. Structuration theory suggests viewing these techniques as rules and resources that group members can use as they produce and reproduce their social system after the idea-generating periods have ended. This could potentially have significant implications for organizations. As organizations emphasize team building and total quality management through team decision making, brainstorming and nominal group techniques may improve the communication and practice of team-oriented democratic principles in groups. Future research might determine that the 55% to 80% failure rates for teamwork efforts in organizations (Ju & Cushman, 1995) can be affected by the use of these fairly simple techniques.

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Michael W. Kramer (Ph.D., University of Texas at Austin, 1991) is an associate professor in the Department of Communication at the University of Missouri–Columbia. In addition to decision making, his research interests include the communication of emotions in organizations and the assimilation of employees throughout their careers.

Chao Lan Kuo (M.A., University of Missouri–Columbia, 1993) is a doctoral candidate at the University of Missouri–Columbia and an instructor at the The World News and Communication College in Taipei, Taiwan. Her research interests focus on intercultural communication, particularly as it relates to the mass media.

John C. Dailey (M.A., Kentucky, 1991) is a doctoral candidate at the University of Missouri–Columbia and is an instructor in the Department of Communication at Southwest Missouri State University. His research interests include human-computer interaction.