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Group versus individual performance on tasks requiring ideational proficiency (brainstorming): A review*

HELMUT LAMM
GISELA TROMMSDORFF

Universität Mannheim

Abstract

In the experiments reviewed in this article the subjects are asked to produce ideas that are relevant to a given task request (e.g., possible consequences of a hypothetical event). After describing the specific task material and the performance measures used in the relevant research studies, some analytic background is given by outlining the cognitive resources required in this kind of experimental task and by listing the various factors that may come into play when subjects perform in groups (with discussion) instead of individually. We then review the studies comparing individual and group performance. In all of these experiments the subjects were asked to work according to the rules of brainstorming, which prescribe that participants refrain from evaluating their ideas. This procedure purportedly results in superior group, relative to individual, performance. However, the empirical evidence clearly indicates that subjects brainstorming in small groups produce fewer ideas than the same number of subjects brainstorming individually. Less clear evidence is available on measures of quality, uniqueness and variety. The discussion considers factors that may be responsible for this inferiority of groups. The role of social inhibition receives particular attention also in terms of suggestions for research. Apart from the group-individual comparison we review the existing research concerning factors that may influence group performance on idea-generation tasks.

Introduction

While there have been several recent comprehensive works concerned with group

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performance on tasks calling for only one cognitive product (e.g., Davis, 1969; Kelley and Thibaut, 1969; Steiner, 1972), there has been no detailed review of the research concerned with group performance on tasks allowing for an unlimited number of cognitive products. As will be shown below, the latter kind of task, with its emphasis on ideational proficiency, involves special cognitive processes that are important in creativity.

This introduction will provide a methodological and analytical preparation by describing the various kinds of ideational-proficiency tasks used in the relevant research, sketching out the cognitive resources required for performing these tasks and listing the influences that may arise when performance takes place in a group instead of an individual context. The second part of the article will consist of a review of experimental investigations. The concluding discussion will be concerned with an interpretative assessment of the research reviewed as well as a consideration of fruitful directions for research.

Tasks, performance measures, and cognitive resources

Tasks

In the tasks of interest here subjects are asked to produce an unlimited number of (different) ideas that may qualify as 'solutions' to a given 'problem' (or, in other words, that satisfy the constraints contained in the task statement).

An important characteristic of these tasks is that they allow responses (ideas) for which it is impossible to determine by objective criteria whether they are acceptable or unacceptable, or 'correct' or 'incorrect'. In the following overview the tasks that have been used will be named according to the kind of product being required.

Means: The task here is to think of ways to solve a given problem – which doesn't have just one predetermined solution – or, in other words, to suggest steps as to how a given goal might be attained or approximated. For example, in the frequently used 'Tourist Problem', the task is to come forth with ways to increase the number of tourists visiting the United States. In another problem, the task is to come up with ways to improve a given commercial product. *Consequences:* The task here is to think of consequences that might result from a given (fictitious) event or state of affairs. For example, in the 'Thumbs Problem', subjects are to enumerate consequences (benefits and difficulties) that might result if everyone born after 1960 had an extra thumb on his hand. *Verbal labels or captions:* The task here is to think of names for a given object (e.g., a brand name for a new product) or to produce verbal statements in some way fitting to a given stimulus situation (e.g., captions for a given cartoon). *Uses:* The task here is to think of possible uses for a given object (e.g., for a brick, a coat hanger, a newspaper). *Causes:* The task here

is to think of possible causes for a given state of affairs (e.g., for the action shown in a given picture). *Questions:* The task here is to ask any questions – to request pieces of information – relevant to understanding a given event or state of affairs.

Most of the relevant studies (about eighty percent), following the lead of Taylor, Block, and Berry (1958), have used the first two kinds of tasks named above. Additional tasks – which have not yet been used in studies of group performance – can be found in Wallach and Kogan (1965).

The 'Riguet's Tree' task used by Moscovici, Faucheux and their associates in studies of group creativity, though similar in many ways to the kind of task here considered, is not included since only a fixed number of correct answers are possible (see, e.g., Abric, 1971).

Performance measures

Quantity. This measure refers simply to the number of (different) task-appropriate ideas produced. (We thus use the term 'idea' to denote any instance of the product type called for in the task statement.) Whether any one idea is in fact different from another one has to be judged by the investigators (e.g., two independent judges).

Quality ratings. Since we are dealing here with 'open' problems with no fixed solutions criteria, the products (ideas) cannot be objectively classified as to quality. Thus, quality assessment has to rely on ratings. Different quality indices are applicable to the different kinds of task listed above. Thus, in *means* tasks the typical quality dimensions are effectiveness (i.e., to what extent would a proposed solution help attain the given goal) and feasbility (i.e., to what extent could a proposed solution be carried out, given the constraints of reality; are unrealistic assumptions presupposed by it?). In *consequences* tasks, the typical quality dimensions are probability (i.e., how likely is it that the suggested consequence would really occur) and significance (i.e., how important is the consequence for society). Dimensions used on other tasks include originality, humor, creativity and usefulness.

Apart from the content dimension, three different quality measures have to be distinguished from each other. (a) *Total quality:* In the most widely used measure, a judge uses a five-point scale, each point containing a verbal description, to rate all of the ideas produced by a given subject (or group) on a given task. Usually a second judge rates the same set of responses. If inter-rater reliability is sufficiently high, the two ratings on each response are combined. The total quality score is the sum of the quality ratings over all (different) ideas. (b) *Average quality:* Obviously the higher the number of ideas, the higher will the total quality score be. To obtain a 'purer' quality measure, the total quality score is divided by the number of ideas. This yields an index of the average quality of the ideas produced by a subject or group. (c) *Number of 'good' ideas:* In another measure used in some studies, a

cut-off (or criterion) point is selected on the scale, such that any idea receiving a score above it is classified as 'good'. The final measure, then, is the number of 'good' (or otherwise criteria-fulfilling) ideas produced by the respective individual or group. This measure is likely to be correlated with quantity but to a lesser extent than in the case of the total-quality index.

Uniqueness. A given idea is defined as unique if it occurs only once in the total pool of ideas generated by all the subjects (or groups) participating in a given experiment. Of course, the criteria could be relaxed so as to include as (relatively) 'unique' any idea produced by a small percentage of all subjects (or groups). Thus, an (absolute) uniqueness score can be assigned to every individual (or group) participating in a given experiment. As in the case of quality – though for more psychotheoretical reasons – quantity and uniqueness are likely to be correlated with each other (see Wallach and Kogan, 1965, p. 17). Hence, to obtain a 'pure' measure of uniqueness, quantity has to be partialled out, for example by an analysis of covariance, as Taylor, Block, and Berry (1958) have done. Uniqueness, thus operationalized, can be considered an index of originality since it measures the extent to which one's ideas are uncommon. In fact, Wallach and Kogan (1965) use this measure as their central index of creativity. However, they count only those ideas that are (adjudged to be) 'relevant' or appropriate to the given task. Such a check was omitted in the few relevant studies to be reviewed here.

Variety. This measure refers to the number of different *kinds* of ideas produced by a given individual or group. Probably due to problems posed by the categorization of ideas, this measure has scarcely been used at all in the studies to be reviewed.

Cognitive/motivational resources necessary for performance on ideational-proficiency tasks

The following will be a list of mental resources that are needed for performing idea-generating tasks, the sole purpose here being to provide a set of analytic tools. (a) *Cognitive energy:* This resource, to which Wallach (1971) calls attention repeatedly, is particularly important in order to sustain the ideational process over time, which is important in view of the goal of producing as many ideas as possible. (b) *Cognitive flexibility:* To the extent that one wants to produce ideas that are unique, he has to move into areas of stored information having less and less associational connection with the given task stimuli. Ideational diversity requires that one 'skip' and/or 'change directions', moving out of any given cognitive category into a different one. (c) *Task-specific cognitive operations:* To illustrate by way of example, a means task requires that one find and apply heuristics (that is, a series of steps for transforming a present state into an end state). The logical operation of implication is particularly relevant (i.e., finding conditions implying the given

end state). (d) *Observance of task-implied constraints:* Part of such constraints consists in the rules governing the task-specific operations just considered. Another class of constraints has to do with the reality in which a given problem is placed. For example, the Tourist Problem (a means task) is set in present reality: Any idea offered as a useful solution must start from reality and cannot assume different conditions. To give another example, if the task is to think of brand names, any given idea, to be useful, must be 'relevant' to the given product; not just any idea would do (though it might qualify as unique). (e) *Familiarity with the task-surrounding reality:* This type of resource refers to the presence, in the subject's memory, of potentially task-relevant reality-based information which he has stored as a result of past experience. For example, in the Tourist Problem, if the subject happens to be employed in an international traffic agency and is himself acquainted with European attitudes, he will have more cognitive background on which to draw in formulating task-relevant ideas than a person who has to rely largely on his imagination. Thus this type of resource helps productivity (quantity) but it may also imply a greater awareness of task-implied constraints (see above). (f) *Temporary detachment from task-implied constraints:* If the (initial) sole purpose, or performance measure of interest, is to produce many ideas – regardless of their quality – then the ability to keep task constraints in (temporary) abeyance is helpful, since one is not inhibited from putting out low-quality ideas. Likewise, if uniqueness – without attention to task-appropriateness – is the only measure that counts, the most unique ideas will be the ones that are 'far out', in the sense of being utterly irrelevant to or detached from the task as stated.

Obviously, not all of the above are equally relevant to the performance measures mentioned earlier. In fact, one-and-the-same resource may be beneficial for one measure and detrimental for another. Similarly, two of the resources may seem to contradict each other, as in the case of observance of, versus detachment from, task-implied constraints. These contrasts mirror some of the cognitive-motivational dilemmas involved in creative problem solving. More elaborate analyses of creative functioning will be found in Wallach and Kogan (1965), who deal primarily with the quantity and uniqueness aspects [(a), (b), and (f) of the above]. (Maier's, 1970, work is concerned more with the quality aspects.) Wallach (1971), after reviewing relevant empirical research, concludes that 'ideational fluency . . . does play a role in creativity' (p. 17), in the sense of predicting a person's talented accomplishments. ('Ideational fluency' there is defined as 'productivity with respect to ideas', p. 6; in other words, it refers basically to the same as the quantity measure described above.)

Effects of group participation

In this section we shall briefly note the principal effects which may arise when (say) four individuals perform not alone but as a group (with free discussion) on a task requiring ideational proficiency. For this general outline we are considering a face-to-face group composed at random of individuals who have not previously collaborated. Some of the influences to be mentioned below do not presuppose verbal interaction – but merely the presence of an audience, or the presence of others performing on the same tasks – whereas others do. We will note only those consequences of group participation that are directly relevant to performance. (Thus motivational effects – for example, on participants' task enjoyment or satisfaction – will not be considered.) More elaborate analysis and empirical evidence can be found in Kelley and Thibaut (1969), Davis (1969), and Steiner (1972).

(a) *Arousal:* The mere presence of others performing the same task and/or of others watching while one is performing is likely to be arousing so that more energy is invested (see Zajonc, 1965). (b) *Observational learning:* Watching others perform the same task may give rise to imitation of their responses, response tendencies, or the procedures they use. (c) *Social inhibition:* The others present may evaluate and criticize one (overtly or covertly). To the extent that one cares about their judgment and esteem, he will try to hold back responses that are not 'safe'. (d) *Distraction:* Interacting with others in a face-to-face setting provides social-emotional stimuli, not directly relevant to the task, which may distract one's attention from the task. (e) *Production blocking:* In a normal discussion setting, the implicit rule is that only one person should talk at a time. This means that when one member is talking, all other participants' (overt) production of ideas is being blocked. (f) *Cognitive interference:* The (content of the) utterances of another participant may interfere with one's (internal) generation of ideas. (g) *Cognitive stimulation:* At the same time the utterances of another participant may contain task-relevant stimuli that elicit ideas in oneself which otherwise he might not have generated (at least not at the given point). (h) *Combining cognitive resources:* The problem at hand may require various kinds of cognitive skills for an optimal solution, or it may be such that ideas from various experiential backgrounds are needed. (i) *Cognitive uniformity:* To the extent that (part of) an utterance provides the same stimulus to all other participants, the task-relevant cognitive reactions (ideas, associations) experienced by them may be more mutually similar than if each of them had not been exposed to that stimulus. In addition, there may be *motivational* pressure toward uniformity in decision-making groups, since interpersonal agreement is psychologically more comfortable than disagreement. Response tendencies may thus be shaped through social feedback. (j) *Mutual correction:* A given idea may be

inappropriate or a proposed solution may be inadequate (e.g., it may contain a false, hidden assumption). Such deficiencies may be more easily discovered by several observers than by the person who generated a given idea. (k) *Prevention of duplication:* Individuals working separately have no way of preventing the production of identical ideas, whereas in the group setting they are aware of (if they remember) the ideas already contributed by each other. (l) *Division of work:* If the task is divisible, then a group may organize itself and assign different sub-tasks to different members, with the result of a higher total output. (m) *Slower task performance:* Group performance may be time-consuming – not only because of (d), (e) and (f), but also because the group may have to discuss procedures to organize itself (e.g., how to divide work and coordinate activities).

The above inventory is intended merely for analytical guidance. Some of the above group influences favor the performance of groups, others favor individuals. In a theoretical paper these potential factors would have to be related systematically to one another and to the cognitive processes listed earlier, yielding a set of testable theorems concerning group as compared to individual performance. (The most difficult problem would be that of the relative weights of the various group influences.) This being an article reviewing empirical research, we turn now to such research.

Review of empirical studies

A few preparatory remarks are necessary. Independent variables will be mentioned even if they yielded no significant effects. Similarly, all results concerning the main performance measures reported in an article will be mentioned, even if not statistically significant. This we deem advisable in order to give a true picture of this research area to potential investigators (e.g., help to avoid duplication, identify unpromising and ambiguous variables, or improve operationalizations and procedures). If we do not mention any results concerning a particular performance measure it means that no pertinent data are reported in the respective article. The latter is, unfortunately, rather frequently the case. Finally, the mention of a difference between conditions implies statistical significance by the $p < .05$ criterion.

Research comparing individual and group performance

Historical background: Brainstorming prescriptions

In his widely read book, Osborn (1957), an advertising executive, contended that more ideas can be produced by a group than by the corresponding number of

separately working individuals – provided that the group follows the principles of 'brainstorming': (a) Criticism is ruled out ('adverse judgment must be withheld until later'); (b) freewheeling is welcome ('the wilder the idea the better'); (c) quantity is wanted; (d) combination and improvement are sought. If these rules are followed, the claim was, 'the average person can think up twice as many ideas when working with a group then when working alone' (Osborn, 1957, p. 229).

Method used in the first empirical study

In their now classical study Taylor, Berry, and Block (1958) put the above proposition to a first empirical test. Their 96 subjects, male university students, were asked to perform two means tasks and one consequences task, in one of two conditions: Alone (48 subjects) or in four-person groups (48 subjects) in which free discussion was allowed. (The group members had worked together within larger discussion groups taking place periodically in the psychology course from which they were recruited as subjects.) The experimenter read out a statement explaining the four brainstorming rules (see above). He also explained that the discussions would be recorded on tape. The subjects in the individual condition also performed orally, speaking into a microphone, as opposed to noting down their ideas. Twelve minutes were allowed for each of the problems. The experimenter, present during the experiment, intervened only when a critical comment was made, calling attention to the basic brainstorming rule against criticism.

In analysing their data Taylor, Berry, and Block (1958) assembled the subjects from the individual condition into (four-man) 'nominal groups' to permit appropriate statistical comparisons with the 'real group' condition. Just as in the case of real groups, the ideas of each nominal group were checked through for duplications, which were eliminated so that the measure of quantity referred to the number of *different* ideas. (An idea was classified as different from another, similar, one if it 'clearly added something'.) The other measures, beside quantity, were also based on the (real or nominal) group as the unit of analysis.

A number of later studies concerned with the individual-group comparison have essentially used the experimental paradigm and statistical analysis just described. Some have not used all three of the tasks, others have used altogether different ones; some have used a same-subjects design (in which the same set of individuals performed as a real group in one phase and as a nominal group in another phase). Such procedural differences from the baseline study described above will be noted only if there is reason to assume that any of the dependent variables (performance measures) were significantly affected. The reader is reminded that the subjects in these studies performed under brainstorming instructions, unless noted otherwise.

Findings of studies concerning individual versus group performance

Quantity. Of twelve experiments, nine found the performance of nominal groups (i.e., subjects working alone) to be superior to that of real groups (Bouchard, 1969, experiment 2; Bouchard and Hare, 1970; Bouchard, Barsaloux, and Drauden, in press; Dunnette, Campbell, and Jaastad, 1963; Gurman, 1968; Milton, 1965; Rotter and Portugal, 1969; Taylor, Berry, and Block, 1958; Vroom, Grant, and Cotton, 1969). (Group size in these experiments was typically four, in no case smaller than three.) Three experiments, all involving two-person groups, found no difference (Cohen, Whitmyre, and Funk, 1960; Torrance, 1970, experiments 1 and 2).

Quality ratings. (a) *Total quality:* Of the eight (out of twelve) experiments which report some total quality score, six found nominal groups to be superior (Bouchard, 1969; Dunnette *et al.*, 1963; Gurman, 1968; Milton, 1965; Taylor *et al.*, 1958; Vroom *et al.*, 1969), while two found real groups to be superior (Torrance, 1970, experiments 1 and 2). In the latter study a real group consisted of two persons sitting side by side under instructions to read their ideas to each other while noting them down. 'Hitchhiking' on each other's ideas was encouraged. The brainstorming instructions were not given here. The particular quality dimension involved here was 'originality'. (b) *Average quality:* Only four of the studies report data on average quality. In every one of them no differences were found between real and nominal groups in at least half of the conditions (e.g., on half of the tasks) (Bouchard, 1969; Dunnette *et al.*, 1963; Taylor *et al.*, 1958; Vroom *et al.*, 1969). Nominal groups were found to be superior among advertising personnel – but not among research personnel – in Dunnette *et al.* (1963). Similarly, nominal groups were superior on the consequences task – but not on the two means tasks – used in Taylor *et al.* (1958). In contrast, real groups were found to be superior in one of the two means tasks (a 700-word case description of an administrative problem involving human relations) in Vroom *et al.* (1969). (c) *Number of 'good' ideas:* Bouchard (1969) found nominal groups to be superior on this measure.

Uniqueness. Only two of the relevant studies report data on uniqueness. Taylor, Berry, and Block (1958) found that nominal groups produced a greater number of unique ideas than real groups. However, when the greater quantity of the nominal groups was taken into account (through an analysis of covariance), no differences remained on the two means tasks whereas *real* groups were found to be superior on the consequences task. Cohen, Whitmyre and Funk (1960) found no differences regarding the number of unique ideas on one means task and on one consequences task in their various types of dyads (trained or untrained, cohesive or uncohesive). But they found *real* dyads to be superior on another consequences task, one which was relevant to the subjects' daily work (hospital administration). This difference was significant only in the case of cohesive dyads but it was in the same direction

for the uncohesive dyads. In this study no adjustment for quantity was needed since real and nominal dyads did not differ with regard to quantity.

Variety. Only Vroom, Grant, and Cotton (1969) report data on variety ('number of qualitatively different solution categories'). On one of two means tasks nominal groups were found to be superior to real groups.

Experiments involving group and individual performance phases

If groups produce no more and no better ideas than individuals working alone, even under brainstorming instructions, one might still find that overall performance is optimized by arranging for subjects to go through individual as well as group activity.

Dunnette, Campbell, and Jaastad (1963) had each of their subjects work on two tasks under group brainstorming conditions and on two other tasks under individual brainstorming conditions. *Results:* In one of the two experimental samples (advertising personnel versus research personnel) the superiority, regarding quantity, of the individual over the group condition was larger when it followed than when it preceded the group condition.

In the study by Lindgren and Lindgren (1965a), following up the last-mentioned experiment, each group of subjects participating in a session performed alone on task A (phase 1), then together on task B (phase 2), and finally again alone on task C (phase 3). Thus, the tasks were presented in the same fixed order to all subjects. *Results:* For females there was an increase in quantity from phase 1 to phase 3. For both males and females there was an increase in quality (each of three judges gave one 'creativity' rating for the whole set of ideas produced by each subject). No other data are reported. (The groups apparently were heterogeneous as to sex composition.) The authors conclude that the group-brainstorming experience (phase 2) in their study led to an improvement in (individual) performance.

In a replication experiment with subjects from the Middle East, Lindgren and Lindgren (1965b) included a control condition in which apparently phase 2 involved individual activity. The results of the earlier study were replicated in the experimental condition (group activity in phase 2): An increase in quantity as well as quality ('creativity') from phase 1 to phase 3 for men as well as for women. No such increase was displayed by the subjects in the control condition. The latter result indicates that the improvements noted above were not due to practice or to task characteristics but rather were an effect of the group activity.

In Rotter and Portugal (1969) the subjects worked on one task for 16 minutes in one of four types of conditions. In two *'pure'* conditions they performed in groups or alone. In the two *combined* conditions they performed for eight minutes in

groups and then for eight minutes alone, or in the reverse order. *Results*: The pure *individual* condition was not only superior to the pure group condition with regard to the quantity measure but was also superior to either of the combined conditions. The pure *group* condition was inferior to either of the combined conditions. Comparing the two combined conditions among each other, there was no evidence that more ideas were produced in the individual phase when it followed than when it preceded the group phase.

In one condition of Bouchard (1969, experiment 1) subjects worked individually on one set of two problems and then again individually on two other problems. In the other condition subjects worked first in groups and then individually. (The order of problem sets was appropriately balanced among the conditions.) *Results:* The two conditions did not differ with regard to quantity and number of good ideas. In contrast, the individual-individual treatment was superior with regard to average quality of ideas. Unfortunately no data are presented such that one could compare performance in the second, individual, phase among the two conditions in order to find further evidence on the possible enhancing effect of prior group brainstorming on subsequent individual brainstorming.

The interesting procedure used in Parloff and Handlon (1964) and Triandis, Hall and Ewen (1965) involved an individual and then a dyadic generation phase.[1] However, their experimental variations do not allow comparisons of different individual-group work arrangements, or of the effect of prior group on later individual brainstorming. Hence, these studies will not be considered here.

In Collaros and Anderson (1969) subjects were given an opportunity after the group phase (where no time limit was given) to note down in private any further ideas relevant to the given task. This permitted an (inferential) comparison between the number of ideas produced and the number of ideas presumably held back in the group phase. *Results:* Only about two percent additional ideas were noted down in the individual phase, relative to those produced in the group phase. On further details see below (paragraph headed 'perceived expertness of other group members').

1. In this study the basic procedure was as follows: On each of the problems subjects generated and noted down ideas individually in a first session (with a time limit). For a second session subjects were paired, given their note-sheets from the first session, and asked to produce *new* ideas on the same problems. Each idea on which both members agreed that it was new and appropriate was to be entered on a 'team recording sheet'. The results mentioned in the text refer to the ideas *generated* (that is, ideas which were mentioned orally but not necessarily written down) in the dyads. In addition, Parloff and Handlon (1964) report data based exclusively on the ideas written down (i.e., 'screened' by the dyads for presentation). Here again, more ideas were produced under brainstorming, relative to non-brainstorming, conditions; furthermore, a greater number of 'good' ideas was generated under brainstorming conditions.

Investigations of various factors in group performance

In this section we will consider studies investigating various experimental treatments as to their possible effect on group performance. The main purpose in most of these studies was to find ways to optimize group performance or to gain insight into why group productivity, even under brainstorming instructions, is inferior to individual performance. The reader is reminded that the groups performed under brainstorming instructions (unless we give other information).

Group performance under brainstorming as compared to non-brainstorming conditions

Osborn's (1957) proposition on the effects of brainstorming implies the hypothesis that brainstorming groups are superior to groups performing under more 'traditional' conditions. Four empirical studies have tested this hypothesis. The 'absence-of-criticism' rule was considered as the crucial element of the brainstorming procedure. Accordingly the 'non-brainstorming' groups, in addition to not receiving the brainstorming instruction, were reminded that the quality of ideas was important, implying mutual criticism and suppression of low-quality ideas. Thus, in their non-brainstorming condition, Weisskopf-Joelson and Eliseo (1961) called for 'good, practical ideas'; Brilhart and Jochem (1964) instructed their groups to 'consider what are the relative merits of the ideas . . .'; in Parloff and Handlon (1964) emphasis was placed on 'doing one's best and analyse and scrutinize carefully each idea . . .' (p. 21); and in Bouchard (1969, experiment 2) subjects were instructed to pay attention to 'analysis, criteria for good solutions, and defensibility of solutions' (p. 13).

Results on quantity. In each of the four studies just mentioned, the brainstorming groups produced more ideas.

Results on quality ratings. (a) *Total quality:* The two studies reporting relevant data found brainstorming groups to be superior to non-brainstorming groups (Bouchard, 1969, experiment 2; Weisskopf-Joelson and Eliseo, 1961). (b) *Average quality:* No differences were found in the two studies just mentioned. (c) *Number of 'good' ideas:* Three out of the four studies report relevant data. Brilhart and Jochem (1964) found the non-brainstorming groups to be no different from one type of brainstorming groups (in which, by experimental instructions, the idea-generation phase *followed* the criteria-consideration phase) but inferior to another type of brainstorming groups (in which the generation of ideas preceded the consideration of criteria). Parloff and Handlon (1964) (see footnote 1) and Weisskopf-Joelson and Eliseo (1961) found no differences on this type of measure.

Regrettably, no data are reported on the uniqueness and variety measures in the relevant studies.

Effects of various preparational and procedural techniques

Relevant preparatory experience. In Cohen, Whitmyre, and Funk (1960) half of the subjects participated in a ten-hour training course on creative thinking – including a detailed explanation of the brainstorming technique – prior to the experiment. *Results:* On only one, professionally relevant, problem did the trained groups (dyads) produce more unique ideas than the untrained ones; but this difference was significant only for 'cohesive' dyads (whose members had voiced a high preference for each other as brainstorming partners). However, the same difference was found for nominal groups (i.e., subjects working alone). This finding thus possibly attests to the beneficial effects of a creative thinking course but gives no information on how the performance of a group – over and above the performance capacities of its constituent members – can be improved. (Beside attributing the effect to the greater idea-generating skills of the 'trained subjects', an alternative interpretation is that they tried harder – their cognitive energy was higher – after having invested both effort and interest in 'creative' activities. However, given no differences in the quantity of ideas, a more probable alternative interpretation is that the trained subjects were aware that it was important to produce unique [original] ideas.)

In Bouchard (1972a) each group in the *training* condition met on three different sessions prior to the critical session. In each of the pre-experimental sessions the groups brainstormed on three different problems (nine problems altogether). The *untrained* groups worked only on the three problems presented in the critical session, with no pre-experimental group experience.[2] *Results:* Training had an effect only on groups of subjects high in interpersonal effectiveness, moderating the influence of a third variable investigated in that study. (Details are given below in the paragraph on 'competition against another group'.)

Feedback versus no feedback. In Bouchard (1969, experiment 2) half of the groups performed on each problem for 20 minutes without interruption (no-feedback condition). The other half (feedback condition) performed five minutes, then listened for five minutes to a tape recording of the period just completed (five-minute feedback phase), and finally worked for another ten minutes. *Results:* Feedback had no effect on the performance of brainstorming groups (even if the mea-

2. In this study the group instructions called for a forced-participation procedure: Group members contributed ideas according to a fixed sequence over as many rounds as the time limit permitted. If a participant had no contribution when it was his turn he simply said 'pass'.

sures were based on only the first fifteen minutes in the non-feedback groups, keeping actual production time constant). Feedback actually proved detrimental in the case of non-brainstorming groups, resulting in a smaller number of 'good' ideas produced in 15 minutes production time.

Temporal sequence of generation and evaluation. In Brilhart and Jochem (1964) half of the brainstorming groups were instructed to *generate* ideas (15 minutes), then consider *criteria* for the evaluation of the ideas (5 minutes), and finally to *evaluate* the ideas (10 minutes). In the other half the order was to consider criteria, generate ideas, and then evaluate the ideas. *Results:* No differences were found between these conditions with regard to number of ideas; there was a non-significant tendency for the former pattern to be superior with regard to number of good ideas. Post-experimental questionnaire responses showed that subjects preferred the former pattern.

Oral versus written performance. This comparison is relevant to the individual-group comparison, since normally people working alone jot down notes whereas group discussion necessarily involves oral performance. It may be noted that in some of the studies comparing individual and group brainstorming performance, mentioned earlier, the subjects performed orally in both conditions (e.g., Taylor, Berry, and Block, 1958); in others, group performance was oral whereas individual performance was in writing (e.g., Bouchard, 1969).

In Bouchard (1969, experiment 2) the subjects in the individual condition (nominal groups) wrote their responses down whereas in the comparable condition of Taylor, Berry, and Block (1958) they spoke into a microphone for tape recording. In the former case (Bouchard, 1969) only about half as many ideas were produced. In explaining this difference Bouchard (1969) refers to the research of Horowitz and Newman (1964) who found that subjects produced more responses under oral than under writing conditions (individual performance only). Those authors explain their findings with (a) the avoidance of embarrassing silent periods in the oral condition, and (b) the greater amount of screening taking place under writing conditions due to a presumably greater sense of commitment by subjects to written than to oral responses.

Forced versus unregulated participation by group members. In Bouchard, Barsaloux and Drauden (in press) group members voiced their ideas in sequence so that everyone had an equal participation chance (see footnote 2). This procedure was designed to eliminate the possibly detrimental influence of a dominant member usurping the group's production time. *Results:* The superiority of nominal over real groups regarding the quantity of ideas was not affected. However, a test within one design (comparing forced with unregulated participation and real with nominal groups) remains to be done.

The 'personal analogy' technique. Bouchard (1972b) investigated the effect of a 'personal-analogy' procedure, one of the creativity techniques proposed by Gordon (1961). According to this technique each group member in turn plays 'a central part of a problem while the group works on it. For example, if the problem were "Think up as many brand names as you can for a new spray deodorant", one of you would get up on the table, sit down, close your eyes, and play the can of deodorant' (Bouchard, 1972b, p. 419). Thus, in the 'personal-analogy condition' in Bouchard (1972, p. 419) each of the four group members played the central aspect of the respective problem for one minute, five minutes being allowed altogether for work on the problem. The brainstorming instructions in both conditions (personal analogy and ordinary brainstorming) were supplemented by the 'forced-participation' rule described in footnote 2. *Results:* Groups in the personal-analogy condition produced more ideas than those in the normal condition. This effect was significant on each of the three tasks (one brand-names task, one uses task, and one consequences task) in the first of the three sessions in which each group participated. It fell short of acceptable significance levels – but the trends were in the same direction throughout – in the two later sessions. Bouchard (1972b) interprets this effect as being due to the inherent characteristics of the process of 'personal identification' and/or to the possibility that the personal-analogy procedure served as 'generalized motivator'. The latter interpretation is consistent with the fact that the effect became weaker from the first to the subsequent sessions. However, the decrement may have been due also to the possibility that the later tasks were less suited for the personal-analogy technique, given a fixed order of tasks. These interpretations should be tested by further research. In particular, attention should be paid to measures of quality and uniqueness. Also, individuals working alone should be subjected to the personal-analogy procedure for comparison with groups. This would allow one to determine whether the effect is specific to group performance or whether it holds generally for idea generation.

Situational variations

Sex of experimenter. Half of the male groups in Bouchard and Hare (1970) were run by a male, the other half by a female experimenter. No differences were found.

Competition against another group. In Bouchard (1972a) half of the groups were told at the beginning of the 'critical' experimental session that they were competing against another group, working concurrently, and that the better-performing group would receive a $ 40 cash prize ('high motivation condition'). *Results:* The groups in this condition produced *fewer* ideas if they had received prior group training (three earlier brainstorming sessions) whereas they produced *more* ideas if they had not received such training. But this interactive effect obtained only for groups

homogeneously composed of individuals high in interpersonal effectiveness. (See the section on personality variables for details on the measure, and footnote 2 for an additional detail concerning the performance procedure in this study.) For an *ad-hoc* explanation of these results, see Bouchard (1972a, p. 328).

Performance under light versus dark conditions. Bouchard, Barsaloux and Drauden (in press) had half of their (real or nominal) groups work under normal conditions; in the other half, the lights were dimmed in the first ten minutes and then turned off entirely so that performance took place in complete darkness for another 25 minutes. The problem being 'what would be the consequences if suddenly everyone went blind', the latter condition was conceived of as high in task-environmental concordance, the former as low. Real-group performance was not found to vary as a function of this manipulation. The results on nominal groups cannot be considered here for reasons of space.

Group composition (members' characteristics)

Personality and social characteristics. Gurman (1968) compared homogeneous groups of subjects that were high on one of three orientations (self orientation, interaction orientation, and task orientation) but low on the other two orientations. The measures were based on Bass's (1962) Orientation Inventory. No differences were found among any of the three types of groups.

Bouchard (1972a, 1972b) composed four-man groups homogeneously in terms of subjects' 'interpersonal effectiveness' (low versus high groups). This index was based on five subscales – Dominance, Capacity for Status, Sociability, Social Presence, and Self-Acceptance – of the California Personality Inventory (Gough, 1957). No differences were obtained with regard to quantity and quality of ideas. However, in Bouchard (1972a) the high groups did, whereas the low groups did not, respond to the additional treatments introduced in that study (see above, paragraphs on 'relevant preparatory experience' and on 'competition against another group').

Rotter and Portugal (1969) compared all-male with all-female groups. Females were found to produce more ideas. However, this was true of nominal as well as real groups so that the result does not constitute evidence specific to *group* performance. The same holds for Bouchard, Barsaloux and Drauden (in press) who obtained no differences between males and females except in interaction with the lights-on-versus-off factor.

Cohesiveness (mutual attraction of group members). In the low (versus high) cohesive dyads in Cohen, Whitmyre and Funk (1960), each participant had given the other top (versus bottom) rankings with regard to his attractiveness as a brainstorming partner. *Results:* There was no difference with regard to quantity. Regard-

ing the number of unique ideas, cohesive dyads were superior on one of the three problems (the one which was presumably most ego-involving, being relevant to the subjects' daily work as hospital personnel). However, the subjects may have been aware of the link between their sociometric rankings and the brainstorming experiment, which means that possibly the result was due to a demand characteristic (some subjects may have guessed that the experiment was testing the hypothesis that mutual attractiveness would lead to greater joint ideational proficiency).

In Parloff and Handlon (1964) half of the (female) dyads were composed of subjects who in pre-experimental testing had given each other overall top rankings on six sociometric questions ('high congeniality'), whereas in the other half the rankings were near the bottom ('low congeniality'). There is reason to believe that subjects did not connect the dyadic sessions with these rankings, which were obtained as part of a routine testing program. No differences were found between the two conditions.

Homogeneity versus heterogeneity of group members' characteristics. Triandis, Hall and Ewen (1965) used the same individual-dyadic idea generation procedure as Parloff and Handlon (1964) (see footnote 1). The dyadic performance scores were based exclusively on the new ideas generated in the dyadic session (relative to the pre-dyadic, individual session). Both relevant experiments ('IIa and IIb') involved two means tasks. In task A (the 'Fame Problem') subjects were to think of ways an average person could gain fame. Task B (the 'Church Problem') contained a brief case description in which the problem was for a community group to raise the money for a church building two-thirds completed. (The following description of details of the complex procedure and pattern of results has to be highly simplified.)

In one experiment ('IIa') the two independent variables involved dyadic composition: Half of the dyads were homogeneous with regard to members' attitudes on a liberal-conservative dimension, the other half were heterogeneous (i.e., one liberal and one conservative member). Cross-cutting this variable was the other factor, homogeneity versus heterogeneity of ideational proficiency ('creative ability'), which had been assessed on the basis of performance (quantity as well as quality) in the individual phase. *Results:* On task A, an interaction was found on the measures of quantity, total quality and average quality. (The quality measure was based on ratings of originality and practicality, the latter being given less weight.) More specifically, performance was superior in attitudinally heterogeneous, relative to homogeneous, dyads if abilities were homogeneous; it was equal (or inferior) if abilities were heterogeneous. Looking at the results from another perspective, dyads homogeneous in ability were superior to heterogeneous ones, but only if attitudes were homogeneous.

In experiment IIb of Triandis, Hall, and Ewen (1965) two independent variables were introduced via dyadic composition: (a) (homogeneous) dyads characterized by high or low ability (ideational proficiency) of members; (b) dyads characterized by attitudinal homogeneity or heterogeneity of members on a liberal-conservative dimension. (c) A third independent variable concerned whether or not the dyadic members were told that they were similar, dissimilar, or were told nothing, with regard to a self-description questionnaire (semantic differential) which they had filled out at the beginning of the experiment. (d) The sequence in which the two tasks were presented constituted an additional factor. The design thus was a $2 \times 2 \times 3 \times 2$ factorial, the last being a within-subjects factor. *Results:* On task A, dyads characterized by heterogeneous attitudes received higher total-quality ratings than homogeneous dyads. (The same direction of differences had appeared as a trend in experiment IIa.)[3] On task B, dyads with higher ability performed better (higher total quality ratings) than dyads with low ability.

The interpretation of Triandis, Hall, and Ewen's (1965) findings is plagued by the fact that results were significant for only one of the problems and that the sequence of problems evidently made a difference.

Perceived expertness of other group members. In their important study Collaros and Anderson (1969), by means of written instructions, varied the perception of group members as to how many of the other members had brainstorming experience. In the *all- (others-) experts* condition each participant in the four-man group thought that the three others were experts at brainstorming. In the *one- (other-) expert* condition each group member believed that one, unidentified, other member was an expert. (Thus in both conditions every subject considered himself as a non-expert, since in fact none of the subjects had any prior brainstorming experience.) The *control* condition contained no instructions regarding expertness. *Results:* (a) Quantity was lower in the all-experts than in either of the two other conditions; it was lower in the one-expert than in the control condition. (b) A behavioral measure of inhibition was constructed, consisting of the number of ideas noted down in private after the group session, divided by all ideas produced by the group (as noted down by each member). This index thus reflects the relative number of ideas which subjects held back in the group phase (where no time limit existed). On this measure subjects in the all-experts condition were higher than those in either of the two other conditions. No differences were found between the latter two conditions. (c) The all-experts condition yielded lower total quality ratings (performed by subjects themselves) on 'creativity', 'originality' and 'practicality' than either

3. Some other differences (statistical interactions) on this problem will not be mentioned here because of lack of space.

of the other conditions; the one-expert condition yielded lower ratings than the control condition on originality and on practicality. (d) After the group session various self-ratings were obtained on five-point scales. Subjects in the all-experts condition, relative to either of the other conditions, felt more 'reluctant in offering ideas for fear of criticism from other members'. Subjects in the one-expert condition were more reluctant than those in the control condition. The same pattern of findings obtained on the question of withholding ideas for fear of disapproval. Further, both experts conditions were higher than the control condition (but not different from each other) on subjects' reported inhibition due to the presence of other, more experienced, group members; and on the extent to which subjects 'sensed disapproval from other members although no overt criticism was expressed'.

'Open' versus 'closed' groups. In Ziller, Behringer, and Goodchilds (1962) groups of various sizes (4, 3, or 2) first performed a number-estimating task (not involving ideational proficiency). Then the experimental manipulation occurred via the withdrawal, replacement, or addition of one (random) member who, as instructions explained, was to work (or had worked, respectively) with another group working 'on these same tasks'. The 'open' (or 'unstable') groups just described were compared with a set of 'closed' (or 'stable') groups serving essentially as a control condition. *Results:* The three 'open' types of groups did not mutually differ, but their average performance was superior to the 'closed' groups with regard to quantity as well as total quality. Those authors note that the above findings are due most likely to a sense of intergroup competition that may have been unwittingly introduced through the instructions to the open (but not to the closed) groups in which it was mentioned that another group was working on the same task. As another possibility, they suggest that members' arousal increased through the membership-changing event. Still another interpretation is that the change of membership was perceived by the subjects as implicit disapproval of their prior work. In any case this line of research deserves more investigation.

Group size. Bouchard and Hare (1970) compared real and nominal brainstorming groups of the sizes 5, 7, and 9. They found that, as group size increased, the superiority of nominal over real groups with regard to quantity became larger (a significant interaction between group size and group type). Nominal groups performed better with increasing size but this was not true of real groups. These results were replicated by Bouchard, Barsaloux and Drauden (in press).

Concluding discussion

In this final section only the question of group versus individual performance will

be discussed. The wider topic of factors affecting group performance can only be considered in the context of research suggestions.

Interpreting the evidence on individual versus group brainstorming

The research reviewed above has demonstrated that individuals working alone produce a greater number of ideas than the same number collaborating in small face-to-face groups. Such clear evidence does not exist regarding the (average) quality, uniqueness (when quantity differences are taken into account), and variety of ideas. There might be clearer evidence if more of the relevant studies had reported the respective data.

The following is an attempt to interpret the available research findings with regard to the question of how the inferiority of groups is to be explained. As will be seen, much of our argument will have to rely on indirect evidence.

The role of production blocking. In our view, the most important source of the inferiority of groups noted above is the operation of the implicit rule that only one group member speaks at a time. True, not everyone in the group has something to say at every point, especially not in the later phases as the cognitive reservoirs become exhausted. Nor can it be assumed that all members stick to the above rule very strictly. Thus, while the production time theoretically available to each member of a four-man group would be one fourth of that available under individual conditions, in actuality the proportion will be much higher. Hence it is not surprising that the proportion of ideas produced in group, relative to individual, conditions is not lower than one half in any of the relevant investigations using four-person groups, even if it were assumed that production blocking is the only factor at work.

There is no direct evidence for the role, nor even for the presence, of production blocking. The only piece of indirect evidence comes from Bouchard and Hare (1970) who found that productivity did not increase from smaller to larger (real) groups. (The latter non-effect might also be explained by invoking the concept of social inhibition, to which we turn shortly.) Thus the production-blocking thesis calls for empirical research. For example, it should be ascertained whether the one-person-talk rule is really followed in the typical brainstorming group. Further relevant information could be gained by measuring the occurrence and length of silences and their distribution over consecutive periods of the performance session.

The role of social inhibition. A number of authors have speculated that the inferiority of groups is due to the social inhibition (fear of mutual negative evaluation) presumably present in the groups despite the brainstorming instructions (e.g., Dunnette, Campbell and Jaastad, 1963; Taylor, Berry and Block, 1958; Vroom, Grant and Cotton, 1969). It operates by making a participant hold back ideas that he fears

might be judged negatively by the others according to some criterion (e.g., unfeasible, improbable, useless, bizarre, far-fetched). The typical case will be that in which the participants in a group are differentially inhibited so that the less inhibited – but not necessarily the more capable – ones will usually have the floor, especially in the beginning phase.

Is there any evidence that participants in the brainstorming groups reviewed above were inhibited? In the one study providing behavioral data on inhibition the evidence is rather negative (Collaros and Anderson, 1969): The ideas noted down in an individual, post-group phase amounted to only two percent of those produced in the group phase. That is, virtually all ideas present in the participants' minds were communicated to the rest of the group, and virtually none were held back. (These results refer only to the 'no-experts' condition which is comparable to the group conditions of the studies involving individual-group comparisons.) Collaros and Anderson (1969) also provide post-experimental self-report data concerning the presence or absence of inhibition in group members. They found that the subjects felt scarcely 'reluctant in offering an idea for fear of criticism from other group members', sensed hardly any (unspoken) disapproval for 'way-out' ideas, and reported that such fear of possible disapproval hardly made them withhold any ideas (values of 1.4, 1.7 and 1.6, respectively, on five-point rating scales). Some relevant self-report data were also collected by Bouchard (1969). The subjects were asked whether they felt being judged or criticized by other group members. The average score in the brainstorming condition was 7.48 on a ten-point scale (0 = felt judged a great deal, 10 = did not feel judged at all).[4] Unfortunately, this easily available method for gaining information on the presence and role of inhibition has been largely neglected in the relevant studies.

Thus it may be assumed that there was generally little social inhibition operating in the brainstorming groups under consideration. Yet, given that the above are statistical averages, some groups of each experiment may have contained at least one participant who felt a considerable amount of inhibition.

Is there any evidence that under conditions of reduced inhibition groups come to match individuals in productivity? Such conditions were arranged experimentally in the studies of the effects of prior ingroup training and of mutual liking by group members. In general no positive results were obtained.

It can be tentatively concluded that the inferiority of brainstorming groups relative to individuals is less attributable to social inhibition than has been assumed by some

4. It would be desirable to have comparable ratings from subjects working under individual conditions. There, any inhibition can only stem from fear of evaluation by the experimenter. It can be expected that the latter source of evaluation apprehension is reduced in a group context, where the individual is relatively more 'anonymous'.

authors. (But social inhibition certainly does play a role in idea production in group contexts, as is indicated by seven findings noted above in the section on factors affecting group performance. Greater ideational proficiency was found in cohesive [vs. uncohesive] groups, in groups characterized by equal [vs. unequal] perceived expertise or ability, and in groups given brainstorming [vs. 'critical'] instructions [four studies]. In all these conditions participants were presumably less inhibited than in the comparison conditions.)

The role of cognitive uniformity versus interstimulation. Taylor, Berry and Block (1958) have suggested that the inferiority of real groups may have been partly due to 'one-track thinking' developing in groups. On the other hand, there is the opposite proposition of brainstorming proponents, that the cognitive interstimulation possible in groups may lead to a greater variety of ideas. These propositions need not be mutually exclusive. Thus, an idea offered by one member may result in other members' suggesting instances of the same kind (category) of ideas, thereby neglecting other possible categories. (The underlying mechanism may be seen in an implicit norm of 'not changing the subject' [category] and/or in a sort of cognitive fixation or inertia, keeping members from ideational search in other categories.) Thus while there may be more ideas within the given set of categories the ideational diversity (number of categories) may be smaller. Certainly more research is needed on these important aspects of idea generation in group contexts. Obviously the central difficulty lies in the construction of categories and the reliable assignment of ideas to these categories.

Other factors. The research reviewed above provides no data on the roles of any of the other factors hypothesized earlier as possibly coming into play when performance takes place in a group context. Considering factors that would seem *detrimental* to group performance, distraction and cognitive interference were probably present to some extent and may have contributed to the poorer output of groups relative to individuals.

Considering factors that would seem to provide an *asset* to group performance, it may be assumed that the prevention of duplication was indeed operative in the kinds of groups investigated but obviously was outweighed by the detrimental factors. Combination of cognitive resources (skills and information) and division of work probably entered hardly into play since the present type of task does not require the combinatorial activities and diverse expertise that are a prerequisite for good solutions on complex problems.

It should be noted that the factors mentioned above as distinguishing group from individual activity *have* been investigated – but in research involving cognitive tasks other than (mere) idea generation (see Davis, 1969; Kelley and Thibaut, 1969; Maier, 1970; Steiner, 1972).

Research suggestions

General considerations. Ideally a future research program should be more systematic than the ensemble of studies here reviewed. Of course it would be uneconomic and unfeasible to carry out a comparative investigation of the effects of all the group influences that might affect the cognitive and motivational processes involved in the performance measures considered above. But if we want to determine the relative *weight* of the various factors in question we need research in which these factors are orthogonally varied. For example, it would seem desirable to investigate the effects of social inhibition, production blocking, and task involvement in group and (where applicable) individual conditions in one single study.

Many of the studies reviewed above give rise to the plea for reporting not only one or two but all of the relevant performance measures (quantity, quality, uniqueness and variety) and their intercorreations.

Very few of the studies have collected data that might serve to understand the experimental situation as experienced by the subjects. Yet, post-experimental ratings concerning participants' feelings during the experiment – for example, their reluctance to voice 'wild' or particularly 'unoriginal' ideas, or their reluctance to speak while someone else is speaking – are relatively easy to collect.[5] Moreover, self-report data on such question as the sense of comfort, satisfaction and other motivational experience of participants would be useful for practical decisions (e.g., choice between individual and group contexts when the latter implies poorer performance but higher member satisfaction).

It would be more difficult, but no less important, to analyze the verbal performance process of groups (and of individuals speaking into microphones). For example, can cognitive interstimulation in groups be shown to occur at all? Does it occur mainly in later phases? What about the temporal lag involved between a stimulating utterance and the reaction to it? These are very simple questions but they pose difficult problems for analysis. A supplementary technique for using the verbal output of subjects would be to replay the tapes to the subjects and have them answer questions concerning what they remember to be their cognitive, social and emotional experiences at various points in the sequence of the verbal events.

All studies concerning the individual-group comparison have compared 'nominal' groups with 'real' groups for good reasons. However, not infrequently a practioner

5. Bouchard (1969, experiment 2) did collect such post-experimental data. He found no difference between groups and individuals as to how much they enjoyed working on the problems. Unfortunately, the subjects in the individual condition were not asked the questions about their satisfaction with their performance and their nervousness.

may ask whether it is worthwhile to assign a particular idea-generating job to a single person or assemble a team for it. It may cost him little to dispatch a few co-workers for such an *ad-hoc* task, quite apart from the routine-breaking, motivating and learning experiences it may provide them. For example, he may need one or a few good ideas as soon as possible. Thus it would be desirable in future research to also compare N groups with N individuals on certain measures.

Research on inhibition. While, as noted above, there are indications that inhibition is largely absent in simple group brainstorming – which needs to be corroborated by further evidence – it can be assumed to be present in groups having real-life features (e.g., status differentiation, evaluation by an outside agent, groups not operating under brainstorming procedures). Thus further research on the role of inhibition seems desirable. In any such study it would seem imperative to investigate the effect of the independent variable in both group and individual contexts, in order to be able to identify the specific inhibiting effects of the presence of a group on individual inhibition. Furthermore, it would seem desirable to obtain multiple indicators of inhibition: Behavioral, self-report (see Collaros and Anderson, 1969), and perhaps even observational data ('body language').

One possibility would be to investigate the effect that inhibition-reducing physiological agents (drugs) may have on ideational proficiency. Teger, Katkin and Pruitt (1969) have shown that alcohol enhances the risk-taking tendencies of individuals. It would be interesting to investigate whether alcohol can be shown to decrease the social caution (inhibition) presumably preventing group members from voicing 'risky' ideas. A complicating problem would be the fact that alcohol may be expected also to affect cognitive functioning (e.g., cognitive energy, flexibility). Another method would be to provide a context of de-individuation, for example, by having subjects perform in masks making them unidentifiable (see Zimbardo, 1969). A further approach would be to use modeling procedures, for example, having one group member (experimenter's confederate) voice 'wild' or low-quality ideas very early in the group session. Thus the work on the disinhibiting function of models discussed in Bandura (1969, pp. 192-196) may be relevant to the present concern.[6] 'Planted' group members might also be used in research on minority influence concerning ideational proficiency. Moscovici and Faucheux (1972) show that if a minority *consistently* displays responses that run counter to the implicit norms or

6. How the risky (here – novel, unusual, untested) responses displayed by one or two group members may have a releasing effect on the rest of the group, has been discussed by Pruitt (1971a, 1971b). As he concludes from his review of research, such release (e.g., release from fear of aversive consequences blocking risk acceptance) is probably one factor underlying the so-called risky shift (tendency toward riskier responses after group participation, found in some situations).

habits of the group, some of the rest of the group will come to adopt such an alternative response tendency. Thus, in the present task context the group might be moved from a tendency to generate common ideas toward a tendency to generate more unusual (original) ideas (responses to the task stimulus).

Concluding note

Virtually all of the experiments reviewed above contained very simple idea-generating tasks. These task contexts are hardly susceptible to group organization (identifying the different informational backgrounds and skills of groups members, making appropriate assignments to sub-activities, coordinating the latter, and then combining the various sub-products into optimal end products). The more complex problems of real life (e.g., in politics, business or science) are amenable to, and performance may profit from, the organizational possibilities provided by group contexts.

Further, it must be kept in mind that the generation of ideas (in particular, alternative problem solutions) is only one out of the range of activities required when people have to cope with the demands of life. Tasks of combination, judgment, evaluation, decision and implementation normally arise along with (usually after) idea generation.[7] Such additional task activity being performed by the group may be affected by whether or not the ideas were originally generated by all group members working jointly, separately, or only by selected members. In many of the additional kinds of activities just mentioned a group context has been shown to provide distinct advantages but also to give rise to new human-relations problems (e.g., conflict, see Kelley and Thibaut, 1969), whereas the simple idea-generation tasks considered in the present article require little more than coaction. These larger contexts must be considered if one wants to arrive at an overall assessment of the advantages and disadvantages of group versus individual performance (and their optional combination) and if one wants to generalize or apply the findings reviewed above.

7. The judgmental and evaluative components are to some extent reflected in the measures of ideational quality (e.g., the practicality of a solution) considered earlier. In general, groups were not found to be inferior despite the fact that such judgmental-evaluative activities were discouraged through the brainstorming rules.

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Résumé

Dans les expériences décrites dans cet article, les sujets doivent avancer des idées pertinentes à un stimulus donné (par exemple, les conséquences possibles d'un évènement hypothétique). Après une description du travail spécifique demandé et des mesures de performance utilisées, on a composé une toile de fond analytique en déterminant les ressources cognitives demandées dans ce genre d'expérience et en faisant la liste des divers facteurs qui peuvent entrer en jeu quand les sujets agissent en groupe. On a ensuite comparé les performances individuelles et celles faites en groupe. Dans toutes ces expériences, on a demandé aux sujets de travailler en accord avec les règles du '*brainstorming*' suivant lesquelles ils ne doivent pas faire un jugement évaluatif sur la qualité de leurs propres idées. Cette procédure permet de distinguer un groupe supérieur, celui des participants ayant travaillé seuls: les données empiriques indiquent clairement que les sujets faisant du *brainstorming* en petits groupes produisent moins d'idées que ceux qui le font individuellement. Les résultats sont cependant moins significatifs en ce qui concerne la qualité, l'originalité et la variété. La discussion se penche sur les facteurs pouvant être responsables de cette inégalité. Le rôle de l'inhibition sociale est particulièrement examiné notamment sous l'angle des suggestions de recherche.

En plus de la comparaison des performances individuelles et en groupes, les recherches existantes concernant les facteurs pouvant influencer la performance en groupe de créations d'idées sont passées en revue.

Zusammenfassung

In den hier referierten Experimenten besteht die Aufgabe der Versuchspersonen darin, Ideen zu produzieren, die in einen vorgegebenen Rahmen fallen, sich aber einer Richtig-Falsch-Beurteilung entziehen (z.B. mögliche Konsequenzen eines hypothetischen Ereignisses). Auf eine Erläuterung des Aufgabenmaterials und der abhängigen Variablen (Leistungsindices), die in den relevanten Untersuchungen benutzt wurden, und der bei diesen Aufgaben erforderlichen kognitiven Ressourcen folgt eine Übersicht über Faktoren, die bei Gruppen- gegenüber Einzelaktivität wirksam werden können. In den für das letztere Thema relevanten Experimenten bearbeiteten die Versuchspersonen die gestellten Aufgaben nach den Regeln des 'brainstorming', die insbesondere Kritik ausschließen. Durchweg ergab sich, daß Vpn, die in Gruppen (mit Diskussion) arbeiten, weniger Ideen produzieren als die gleiche Anzahl von Vpn, die individuell arbeiten. (Bezüglich der anderen Indices – Qualität, Einzigartigkeit und Mannigfaltigkeit – sind die Ergebnisse nicht einheitlich). Dieser Befund wird im Hinblick auf zugrundeliegende Faktoren diskutiert, wobei – auch in unseren Vorschlägen für zukünftige Forschungen — die Rolle der sozialen Hemmungen besondere Beachtung erhält. – Neben dem Vergleich von Gruppen- und Einzeltätigkeit werden die Forschungsergebnisse zum allgemeinen Thema der Ideenproduktion in Kleingruppen referiert.