# Student Interaction and Learning in Small Groups

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# Student Interaction and Learning in Small Groups

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*While research on learning in cooperative small groups has greatly increased during the past several years, few studies have focused on the interaction processes occurring within groups. This review focuses on the role of the student's experience in small group interaction in learning. Research bearing on three aspects of small group learning is examined: (1) the relationship between interaction and achievement, (2) cognitive process and social-emotional mechanisms bridging interaction and achievement, and (3) characteristics of the individual, group, and reward structure that predict interaction in small groups. Methodological and substantive issues are discussed to evaluate and integrate research findings, and as guidelines for further research. The conclusion is that an individuaVs role in group interaction is an important influence on learning, and that interaction can best be predicted from multiple characteristics of the individual, group, and setting.*

Interest in the influence of cooperative small groups on learning has burgeoned during the past few years. Research on cooperative learning has focused on small groups of students working on academic tasks. The key feature distinguishing cooperative settings from other learning settings is interaction among students. Students in group settings usually work together to complete tasks, whereas students in other settings work at their seats or receive instruction in large groups in which most interaction occurs between teacher and student.

While several recent reviews have presented favorable pictures of cooperative learning (Johnson, 1981; Johnson & Johnson, 1974; Sharan, 1980; Slavin, 1977, 1980a, 1980b), not all reviews have concluded that working in small groups is beneficial for learning. Michaels (1977) concluded that individual competition consistently produced greater achievement than group conditions. Even staunch supporters of cooperative learning recognize the discrepancies among findings from research comparing achievement in cooperative and individual settings. Furthermore, they readily point out the inconsistencies among studies comparing achievement across different cooperative learning methods. Inconsistencies have been explained on the basis of characteristics of the cooperative learning techniques, settings, measures, experimental designs (Slavin, 1980a), and student characteristics (ethnic group, socioeconomic status), and subject matter (Sharan, 1980).

Rarely explored to help explain the inconsistent findings among cooperative group studies, however, are the interaction processes that take place in small groups. Different group interaction patterns may give rise to a variety of achievement results:

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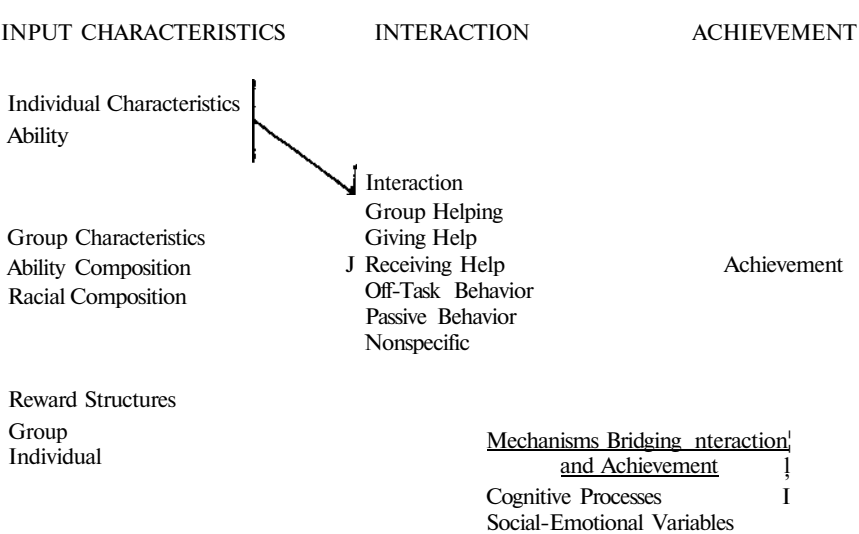
some kinds of interaction might be beneficial for achievement whereas other kinds might be detrimental Although the importance of interaction for learning is clearly recognized: "It is through the medium of this interaction and communication process within small groups cooperating on academic tasks that these team-learning methods strive to influence pupils' cognitive learning" (Sharan, 1980, p. 242), few studies have systematically examined interaction in groups. Most studies have sought to predict achievement from a few characteristics of the individual, group, or setting. Without data on students' experiences in groups, these studies present incomplete pictures of the influences of group work on individual learning.

The present paper, then, reviews the research that has focused on the student's experience in small group interaction. The structure of the review is a two-stage system linking interaction to achievement and linking characteristics of the learning setting to interaction. The review examines research bearing on the relationship between interaction and achievement, and research exploring the predictors of interaction in small groups. Also examined are the mechanisms that have been hypothesized to explain *how* interaction in groups relates to achievement. The interaction variables, predictors of group interaction, and mechanisms bridging interaction and achievement are summarized in Figure 1. Following the presentation and evaluation of the research findings, methodological and substantive issues are discussed as possible explanations for inconsistent relations among input characteristics, interaction and achievement, and as guidelines for future research.

Research studies were selected for review according to two criteria. First, research included in this review investigated small groups learning educational material. The focus of small group work was on individual learning rather than group productivity. The emphasis on educational tasks and learning eliminated most of the voluminous social-psychological literature on group dynamics. Second, only research that system-

FIGURE 1. Variables in the inputs-interaction-achievement system.



aticaily measured interaction in groups is considered here. This criterion excluded studies that reported only anecdotal observations of groups at work.

## Interaction and Achievement: Research Findings

### *Helping Behavior*

The most common interaction variable used to predict achievement in small groups is helping behavior. The majority of studies have examined the frequency of helping in the group without differentiating between those who give the help and those who receive it. Only a few studies have tried to determine whether giving help or receiving it is beneficial for achievement.

*Group helping.* Evidence of the relationship between group helping behavior and achievement comes from eight studies of small group work in classrooms. Two studies correlated helping behavior and achievement in two-person groups instructed to work together (Hanelin, 1978; Johnson, 1979). The other six studies contrasted group and individual reward conditions. In the group reward condition, students worked in four- or five-member teams. The team's score was the lowest score, the sum, or the average of the scores of its members on an achievement test administered individually after group work. All group members received the same score. In the individual reward condition, students received their own scores on the test, and worked individually (Edwards & DeVries, Note 4; Slavin, 1978a, 1978b, Note 1) or were encouraged to work with others (DeVries & Mescon, Note 2; DeVries, Mescon, & Shackman, Note 3). The number of classes observed in these studies ranged from 3 to 17, and the number of students ranged from 54 to 424. Grade level ranged from third grade to high school, and subject matter included language arts, mathematics, and social studies.

Data on helping behavior came from observations of group work in five studies (Hanelin, 1978; Johnson, 1979; Slavin, 1978a, 1978b, Note 1), and from student questionnaires in three studies (DeVries & Mescon, Note 2; DeVries, Mescon, & Shackman, Note 3; Edwards & DeVries, Note 4). The studies observing groups at work defined helping behavior (also called peer tutoring or peer-task behavior) as on-task interaction with other members of the group. Students were typically observed for 5- or 6-second intervals, with observers cycling through group members in sequence or sweeping all students in the class before observing a student twice. The behavior variable was usually the percentage of intervals spent interacting with others about the task. The studies using questionnaires asked students to write the names of students in the group (1) whom they helped and (2) who helped them. The number of names served as the behavior variable.

The results of the two studies correlating helping behavior and achievement were mixed. Johnson (1979) reported a correlation of .26 ($p < .01$), whereas Hanelin (1978) reported nonsignificant correlations (—.29 for groups working on easy tasks, .13 for groups working on difficult tasks).

The other six studies compared group and individual reward conditions on helping behavior and achievement and provided more consistent evidence of a positive relationship between helping behavior and achievement. Because one study carried out the experiment in mathematics and social studies classrooms (Edwards & DeVries, Note 4), the six studies provided seven comparisons of group and individual reward conditions. Among the seven comparisons, five yielded results for helping

behavior that were in the same direction as the results for achievement: more helping and greater achievement in the group reward condition than in the individual reward condition (DeVries & Mescon, Note 2; DeVries, Mescon, & Shackman, Note 3; Edwards & DeVries, Note 4), and equal helping and equal achievement in the two conditions (Edwards & DeVries, Note 4; Siavin, Note 1). In the other two comparisons (Siavin, 1978a, 1978b), the difference between conditions on achievement corresponded not to helping behavior but to on-task behavior (time spent working alone or with others on task-related material). In Slavin's (1978b) study, for example, students instructed to work with others helped each other more, were on task less, and showed lower achievement than did students instructed to work individually. Siavin suggested that this finding calls into question the role of helping behavior as a link between cooperation and performance. An alternative interpretation, however, is that helping behavior does have positive effects on achievement that, in Slavin's study, may have been overshadowed by negative effects of passive or off-task behavior (to be discussed later in this section).

A question left unanswered by the above research is whether giving help and receiving help have different relationships with achievement. The studies examined next address this question.

*Giving help.* Five studies of mathematics learning in small groups distinguished between giving help and receiving help. Four studies took place in classroom settings; one took place in a special setting outside school. Peterson and Janicki (1979) examined the participation and achievement of 100 fourth-, fifth-, and sixth-grade students in four classes learning a 2-week unit on fractions. Peterson, Janicki, and Swing (1981) studied 93 fourth- and fifth-grade students in two classes learning a 2-week geometry unit. In the third study, 48 1 lth-grade students worked in four-person groups for three sessions to learn how to carry out three algebraic and geometric tasks (Webb, 1980a, 1980c, l98Od; also see Webb, 1980b, Note 5)[1]. Webb (in press-a) studied 96 seventh-, eighth-, and ninth-grade students in four classrooms as they worked on a 1-week unit on consumer mathematics. In the final study, 77 seventh- and eighth-grade students in two classrooms learned a 2-week unit on exponents and scientific notation (Webb, in press-b).

Data on group interaction in these studies came from observations of groups at work. In the Peterson studies, the observation instrument required the coder to check categories of behavior for each student and the teacher during consecutive 20-second intervals. An observation instrument was also used in the fourth study above (Webb, in press-a). The observer wrote notes about group interaction, which identified the speaker and recipient of each interchange, the observation category, the content, and the duration of the interchange. In the third and fifth studies described above, group interaction was recorded on an audio recorder and peer interaction was coded from transcripts of the tapes.

All but one of the five studies found a positive relationship between giving help and achievement. Peterson and Janicki (1979) and Peterson, Janicki, and Swing (1981) reported correlations between .24 and .29 ($p < .05$). Webb (1980a) found that

[1] Because Webb (1980a, 1980c, l98Od) analyzed data from the same data set, the several papers are considered one study. It should be noted, however, that the papers addressed different questions (for example, differentiating between new and previously learned information).

students who gave explanations of how to complete the task showed higher achievement than students who did not actively engage in group interaction, even when ability level was held constant. A significant relationship between giving explanations and achievement holding ability constant also appeared in Webb's (in press-b) study: the partial correlation controlling for ability was .22 ($p < .05$). Reanaiysis of the data in the Webb (1980a) study, distinguishing between the material that students had learned previously (computational and algebraic manipulations) and the material that was new (an algorithm for completing the mathematical task), also yielded positive results (Webb, l98Od). Explaining how to perform computational or algebraic manipulations was related to achievement on these manipulations (partial $r$ controlling for ability = .39, $p < .05$), and stating or describing the algorithm was related to achievement on the algorithm (partial $r$ controlling for ability = .37, $p < .06$).

The appearance of significant partial correlations between giving explanations and achievement controlling for ability helps clarify the direction of the relationship between giving help and achievement. Two competing hypotheses about the direction of the effect are that interaction influences achievement, and that interaction is a function of achievement (or ability) level. The significant partial correlations provide support for the former hypothesis, that interaction influences achievement.

*Receiving help.* Although the above findings relating giving help to achievement were straightforward, the results relating receiving help to achievement were complex, and suggest that receiving help is an amalgam of several variables with different effects on achievement. Only two of the five studies reported a significant relationship between receiving help and achievement (Webb, 1980c, in press-b; also see Webb, 1980b). Intensive reexaminations of the data in the first study revealed, however, that the effectiveness of the help received depended on (1) the nature of the help received, and (2) the student behavior that elicited the help (Webb, 1980c). When students making errors or asking questions received explanations about the task, they learned how to complete it. When they received either no response from the group or only restated solutions without explanations, they did not learn how to complete the task. Moreover, their errors on the achievement test corresponded to material they had difficulty with in group work. The results of the second study were similar: the relationship between receiving explanations and achievement was positive (partial $r$ controlling for ability = .21, $p < .05$), whereas the relationship between receiving restated solutions without explanations and achievement was negative (partial $r$ controlling for ability —.44, $p < .01$; Webb, in press-b).

The results of another study corroborated these findings, showing that receiving help was effective only when given in response to student need (Webb, in press-a). The frequency of receiving help, without differentiating between solicited help and unsolicited help, showed a near-zero correlation with achievement. Receiving help in response to a question, however, significantly related to achievement (r = .19, $p < .05$).

In a striking result, *not* receiving help in response to a question showed a strong negative relationship with achievement in two studies (r = —.53, $p < .001$, Webb, in press-a; and $r$ = —.55, $p < .001$, Webb, in press-b). Therefore, although students' responses to teammates' questions may not always alleviate confusion, receiving no help when needed seems to be detrimental to achievement.

The importance of receiving help when needed and of elaborated responses to

need finds support in a recent large-scale study of first-grade reading groups. Although the First-Grade Reading Group Study (Anderson, Evertson, & Brophy, 1979) investigated teacher-led small groups with little overt interaction among students, rather than cooperative or interactive small groups, its findings about the impact on achievement of specific teacher responses to student behavior parallel those described above. Receiving *terminal* feedback to an error—in which the teacher stated the correct answer, asked another student to supply the answer, or allowed another student to call out the answer—was negatively related to achievement ($p < .01$). Receiving *process* feedback to an error—in which the teacher explained how to obtain the correct answer—was positively related to achievement ($p < .01$).

*Summary.* The research relating helping behavior and achievement suggests that giving help and receiving help are beneficial for achievement. More importantly, the findings show that observations of helping behavior must be fine tuned: observers should distinguish between solicited and unsolicited help and should determine whether calls for help are answered. As instructional logic would dictate, students needing help, as indicated by questions or errors, stand to gain more from explanations than do students not needing help, as indicated by a lack of questions and errors (except for students who do not participate at all in group work; see next section). Furthermore, help consisting of explanations has a greater chance of eliminating confusion than does help consisting only of a correct answer.

Failure to distinguish among different degrees of "help" and between needed and unneeded help may account for the lack of significant results in some of the studies reviewed earlier that investigated the relationship between the frequency of general helping behavior in the group and achievement (e.g., Hanelin, 1978; Slavin, 1978b). The nonspecific helping variable used in those studies probably combined positive and negative events, thereby reducing the chances of finding a systematic relationship between interaction and achievement.

### *Off-task and Passive Behavior*

Students not actively involved in group work could be engaged in off-task activities or passively observing others at work. All of the studies reporting results of off-task behavior showed a negative but nonsignificant relationship between off-task behavior and achievement (Hanelin, 1978; Webb, 1980a, in press-a). The major reason for the lack of significant relationship in these studies seems to be restriction of range in off-task behavior. Hanelin reported that students spent less than seven percent of group time, on the average, talking or listening to another student concerning topics that were not relevant to the task, and Webb (in press-a) observed this behavior only two percent of the time, on the average. It is not clear, however, whether a low level of off-task behavior is a feature of small group work or is due to the settings in which the studies took place. Only one study took place in a regular classroom setting (Webb, in press-a); the other studies were under the direction of the investigators, with no teacher present. The latter studies may have underestimated the amount of off-task behavior that would take place in small groups in natural classroom settings. Investigations of teacher-student interaction in whole-class settings have yielded substantial amounts of off-task behavior, as implied by observations of child behavior and teachers' reprimands for misbehavior, and significant negative relationships between such indicators of off-task behavior and achievement (Anderson, Evertson, & Brophy, 1979; Good & Grouws, 1977; Rosenshine, 1977; Stallings & Kaskowitz,

1974). This finding suggests that the negative relationship found in small groups, although not significant, should perhaps be taken seriously.

Only one study investigated the relationship between passive behavior and achievement (Webb, 1980c). Passive behavior was defined as lack of *any* discernable involvement in the group task; it did not include working individually on the task. The relationship was negative: merely observing other students' work activities and listening to others' explanations was not sufficient to learn the material. This study was short term, however. The experience over time of initially passive group members has not yet been investigated. As these students become more familiar with the group context, they may be more likely to participate in group work.

### *General Participation*

The only study that included a measure of general participation, the amount of time spent talking with the other members of the group, found no relationship between talking and achievement (Johnson, 1979). This result is not surprising in light of the results of the studies already described. Talking may have included explaining to others or receiving help in response to questions, positively related to achievement, and asking for help and not receiving it or off-task behavior, negatively related to achievement. Such competing effects would be expected to cancel out.

### *Summary and Discussion*

The research relating interaction in groups and achievement generally shows that giving help and receiving help are positively related to achievement, and off-task and passive behavior are negatively related to achievement. Not surprisingly, general measures of participation, such as the number of utterances, and nonspecific helping variables tend to be weakly correlated with achievement or show inconsistent relationships with achievement.

Although the relationships between giving explanations and receiving explanations and achievement tend to be positive, not all studies obtained significant results. Two factors may help account for the inconsistent results: complexity of the task and accuracy of explanations. First, explaining to others may be more beneficial to the explainer when the material is complex, requiring integration or reorganization, than when the material is simple or straightforward. Second, receiving explanations about the task would not be expected to relate to achievement if the explanations are inaccurate. Separate analyses for accurate and inaccurate explanations, and for complex and straightforward material may help resolve these questions.

Scrutiny of the designs and procedures used in the studies reviewed here reveal that some methodological strategies are more informative than others for assessing the relationship between interaction and achievement, which suggests guidelines for the design of future studies. First, measures of each group member's behavior are more informative than are group level indices of behavior. The most widely used group measure in these studies was helping behavior. Correlations between group helping and achievement cannot, however, be used to separate the effects of giving help from those of receiving help, nor can they be used to explain variation in achievement within a group. Second, correlations between interaction and achievement within the same setting (e.g., the same reward structure and instructions about working with others for all groups) provide more direct evidence of the relationship

between interaction and achievement than do contrasts between different settings that vary along several dimensions (e.g., group and individual reward structures), which may be subject to alternative interpretations.

## Mechanisms Bridging Interaction and Achievement

An important feature which is lacking in much of the research relating interaction in groups and achievement is discussion or investigation of *how* participating in group work helps group members learn. Researchers who have considered this issue have hypothesized two kinds of mechanisms that could bridge interaction in groups and student achievement: mechanisms directly affecting cognitive processes, and mediating variables thought to create an emotional or intellectual climate conducive to learning. Each kind of mechanism is considered in turn.

### *Cognitive Processes*

*Verbalizing versus cognitive restructuring.* One possible mechanism relating interaction in the group and achievement concerns the effects of the mere act of verbalizing information. Discrimination-learning studies, for example, have shown that vocalized stimuli are recalled more often than are nonvocalized stimuli (e.g., Carmean & Weir, 1967; DiVesta & Rickards, 1971; Weir & Helgoe, 1968). Further, Gagné and Smith (1962; see also Davis, 1968) found that vocalizing during practice of a problem-solving task produced greater performance than nonvocalizing.

The results of two recent studies cast doubt, however, on the hypothesis that mere verbalization of material is the mechanism responsible for increased achievement among active participants in group work. Durling and Schick (1976) compared concept attainment across three interactive settings: vocalizing to a peer also learning the task, vocalizing to a confederate supposedly learning the task, and vocalizing to the experimenter who supposedly had mastered the task. If merely verbalizing the material was the primary mechanism affecting achievement, then the three conditions should have yielded similar levels of achievement. Instead, the conditions produced different achievement results. On nearly all performance criteria, students vocalizing to a peer or to a confederate performed better than students vocalizing to the experimenter. This result suggests that the purpose of verbalizing is more important for learning than is the mere act of verbalizing. As Durling and Schick pointed out, the persons vocalizing to a peer or to a confederate may have viewed themselves as teachers, whereas those vocalizing to the experimenter may have viewed themselves as students. The purpose of verbalizing among those in a teaching role would most likely be to help the other person understand the material, whereas those assuming a student role would verbalize probably only to demonstrate mastery of the material.

Evidence about the relative efficacy of verbalizing to teach and verbalizing to demonstrate the degree of one's own learning comes from the second recent study: Bargh and Schul (1980). Bargh and Schul compared achievement of persons studying verbal material to learn it themselves with that of persons studying the material to teach it to another student. Students in the teaching condition scored higher than did students in the no-teaching condition. Bargh and SchuΓs interpretation of this finding may also account for the results of the Durling-Schick study. Bargh and Schul suggested that preparing to teach someone else could produce a more highly organized cognitive structure than only trying to learn the material for oneself. Evidence of a more highly organized cognitive structure came from Bargh and

Schul's finding that persons studying to teach showed superior performance on peripheral detail items as well as on items measuring the basic message of the material. Bargh and Schul (1980) further suggested that not only may someone *preparing to teach* reorganize the material for clearer presentation, but also that a person *actively teaching* someone else may reorganize or clarify material on the spot, both of which allow the "teacher to see the issue from new perspectives, enabling him or her to see previously unthought of new relationships between the discrete elements. It may be this building of new relationships that facilitates a better fundamental grasp of the material" (p. 595).

Educational researchers have also advanced hypotheses about the importance of cognitive restructuring in receiving help. Gall and Gall (1976) and Slavin (1977) suggested that group feedback and sharing of resources help group members reshape their ideas and learn new information that they might not discover on their own. Myers and Lamm (1976) and Wittrock (1974) have further emphasized the active role that the learner plays in restructuring this information. Myers and Lamm suggested that passive receipt of information is not sufficient for opinion change. Rather, cognitive rehearsal, in which individuals process, weigh, and reformulate information and arguments presented by other members of the group, is necessary for internalizing attitude changes. The notion of the individual as an active processor of information, rather than a passive receiver, is also at the heart of Wittrock's (1974) model of learning as a generative process, which has been applied to learning in group settings (Webb, 1980b). In Wittrock's model, the learner generates associations between new information and concepts already learned. When students in groups help each other, they can compare the new information to previously acquired information and modify or replace existing concepts as necessary.

The above descriptions of cognitive restructuring as a mechanism bridging giving and receiving help and achievement are largely speculative. Systematic research needs to be performed to test the role of cognitive restructuring. This could be done in several ways. One method of obtaining data on restructuring would be analyses of verbal interaction. Evidence of restructuring among helpers could include rewording or reorganizing material in response to other members' questions, errors, or other indications of confusion. Evidence of restructuring among those receiving help could include rewording or reorganizing explanations received, applying the help received to questions posed in the material, and asking further questions about the help received. One could then relate the amount of restructuring behavior to achievement. Another method would be stimulated recall, in which group members viewing a videotape or listening to an audiotape of the group session would be asked to describe their thinking processes while giving or receiving help.

*Conflict resolution.* Whereas Myers and Lamm described learning as a prerequisite for opinion change in problem-solving and decisionmaking groups, Johnson and Johnson (1979) focused on the role of opinion change in learning. They suggested a model of conflict-resolution-learning. In their model, interpersonal controversy leads to conceptual conflict and feelings of uncertainty. These feelings, in turn, lead group members to seek additional information and approach existing information from new perspectives. As a result of processing the new information, some students will change their opinions. Johnson and, Johnson (1979) described the cognitive benefits of resolving disagreements: "students who experience conceptual conflict resulting from controversy are better able to generalize the principles they learn to a wider

variety of situations than are students who do not experience such conceptual conflict" (p. 67). (For research findings supporting relations in this model, see also Anderson & Graessèr, 1976; Inagaki & Hatano, 1968, 1977; Kaplan & Miller, 1977; Grimme & Johnson, Note 6.)

*Verbal and nonverbal cues.* A different kind of cognitive process mechanism has been discussed by Buckholdt and Wodarski (1978) and by Allen and Feldman (1973) to explain the relationship between working in groups and achievement. This mechanism concerns the verbal and nonverbal cues that students use when working with one another. Buckholdt and Wodarski suggested that children may learn better in interacting groups because they use language that other children can understand. The results of Allen and Feldman's study on decoding nonverbal behavior suggest further that children may recognize other children's nonverbal signals of confusion more frequently and more accurately than do adults. Allen and Feldman videotaped third-grade students listening to easy and difficult arithmetic lessons. All students listened to both lessons. The videotapes were presented in random order, without sound, to groups of third graders, sixth graders, and experienced adult teachers. All observers estimated how much each child understood each lesson. The results showed that third- and sixth-grade students were able to differentiate between the easy and difficult lessons, but the adults were not. The adults overestimated the children's understanding of the difficult lesson. This finding suggests that students experiencing difficulty while learning might be especially likely to benefit from working with other students.

Allen and Feldman offered two possible explanations for the superior ability of children to decode other children's nonverbal behavior: (1) children's nonverbal cues may be different from those of adults, and (2) adults, thinking that children's nonverbal cues are different from theirs, may misinterpret the meaning of children's nonverbal behavior. These hypotheses should be tested directly: for example, by asking children and adults to interpret specific nonverbal cues emitted by children and by adults.

### *Socioemotional Variables*

Socioemotional variables hypothesized to mediate the effects of participation on achievement include motivation, anxiety, and satisfaction. Hammond and Goldman (1961) and Slavin (1978c) contend that motivation is a strong force at least in group reward structures. They hypothesize the following sequence of events. When every group member's performance influences the rewards of the group, group members will support each others' academic efforts, which in turn will lead to increased individual effort. This hypothesis needs to be tested directly, using questionnaires or interviews to elicit student perceptions, for example. Also in need of testing is whether group work increases individual motivation in the absence of a group reward structure. Speculations by group dynamicists (e.g., Hackman, 1976; Hackman & Morris, 1975) suggest that it does.

Hypotheses about anxiety come from observations of students working in groups and in whole class settings. Buckholdt and Wodarski (1978) suggest that slow learners may learn more quickly from other students than from the teacher because children are smaller and less frightening than adult teachers. Artzt (1979) and Jackson and Riessman (1977) have made similar comments about students' greater willingness to ask for help from students rather than from the teacher. Feedback from students

about their anxiety across different settings would help test the hypothesis that students experience less anxiety in small groups than in other settings. Haines and McKeachie (1967) obtained such self-reports from students in large discussion groups (20 students each) learning under cooperative or competitive reward structures. In the cooperative condition, whenever any student answered a question correctly all group members received credit for it. In the competitive condition, students received credit only for their own correct answers and their scores were compared to those of the other group members in determining their final grade. Students were asked to respond to questionnaire items asking whether their learning condition promoted an easy, relaxed atmosphere and whether it made them feel anxious and uneasy. Differences in questionnaire responses between conditions were significant for both items: students in the cooperative condition reported less anxiety than did students in the competitive condition. Haines and McKeachie's results leave unanswered the question of whether interacting with others or the reward structure (or both) influences anxiety. Further research is needed to disentangle these effects.

Direct evidence of satisfaction in cooperative and competitive groups comes from Haines and McKeachie's (1967) study described above and from a similar study conducted by Crombag (1966). Unlike the Haines-McKeachie study, Crombag focused on small groups with three persons each. In both studies, students reported greater satisfaction in the cooperative setting than in the competitive setting. Again, whether working in small groups promotes greater satisfaction than other settings when reward structure is held constant remains to be tested empirically.

Although the speculations and results of the above studies suggest that motivation, anxiety, and satisfaction may be related to achievement in small groups, they did not investigate the link between interaction in the group and these socioemotional variables. The studies do not address whether increased interaction per se leads to increased motivation and satisfaction and decreased anxiety. Future studies should relate the level of these socioemotional variables to the amount and type of interaction in the group, such as giving help and receiving help.

## Predictors of Interaction

The previous sections probed the kinds of verbal interaction that relate to achievement in small groups. Some interaction, such as receiving detailed explanations in response to questions, was shown to be beneficial for achievement, whereas other interaction, such as off-task discussion, showed hints of being detrimental to achievement. These findings are of limited utility for educators, however, without also providing clues about how to design the group context to promote beneficial interaction and discourage detrimental interaction among group members. This section focuses on research investigating characteristics of the individual, characteristics of the group, and the reward structure imposed on the group that might help predict interaction among group members. The individual characteristic examined here is ability. Characteristics of the group include group composition on ability and race. Each of these characteristics and the reward structure are considered in turn.

### *Ability of the Student*

The five studies differentiating between giving help and receiving help investigated ability of the student as a predictor of interaction in the group. The ability measures used in these studies were general ability or mathematical ability. Four of the five

studies reported that high-ability students gave more explanations than low-ability students: the correlations between ability and giving explanations ranged from .24 ($p < .05$) to .78 ($p < .001$) (Peterson & Janicki, 1979; Peterson et al., 1981; Webb, l98Od, in press-b). In contrast, only one study found a significant relationship between ability and receiving explanations. Webb (l98Od) reported that low-ability students received more explanations than high-ability students ($r$ = —.54 to —.71, **/7<.OI).**

The lack of a relationship between ability and receiving explanations in most studies is puzzling. An issue not yet addressed, but one that may help explain this puzzling result, is whether interaction in the group is best predicted by comparative ability within a small group or by ability without reference to a particular group. None of the five studies examined here measured comparative ability within the group. If comparative ability is a stronger predictor of receiving explanations than is absolute ability level, then the least able group member would be expected to receive the most explanations regardless of his or her absolute ability. When groups in a study vary in average ability level or in range of ability, the correlation between absolute ability level and receiving explanations may be nonsignificant even when a significant effect for comparative ability is present.

*Group Ability Composition*

Although debates on ability grouping have raged and ebbed since the beginning of this century (Esposito, 1973; Goldberg, Passow, & Justman, 1966), little attention has been paid to processes operating in groups with different ability ranges. The few studies that have compared interaction across group compositions suggest that the mixture of ability governs processes in the group. These studies focused on helping behavior in the group. In one study, helping behavior occurred frequently in heterogeneous groups and in homogeneous medium-ability groups but not in homogeneous high-ability and low-ability groups (Webb, 1980a). Another study reported that homogeneous medium-ability groups produced more helping in response to need than did heterogeneous groups (Webb, in press-b). In a third study, heterogeneous groups produced more helping in response to need than did homogeneous groups (Webb, in press-a). These somewhat inconsistent results may be explained in part by the different compositions of heterogeneous groups in these studies. In the first two studies, heterogeneous groups had one high-ability, one low-ability, and two medium-ability students. In the third study, heterogeneous groups had highs and mediums, *or* lows and mediums; no group had highs and lows. Clearly, a variety of ability group compositions must be studied before any conclusions are drawn about the relationship between group composition and interaction. The results do, however, suggest that the effects of ability composition on interaction depend on the mean level of group ability as well as the range of ability in the group.

Whereas systematic comparisons of group interaction across group compositions are scarce, social psychologists have often made informal observations of interaction in heterogeneous groups. Their expectations about the effects of heterogeneity of member ability or specific skills on group interaction tend to be pessimistic. Berkowitz (1957) and Mausner (1954), for example, investigated conformity in heterogeneous pairs, and found that less proficient members tended to conform to the judgments of more proficient members, regardless of the quality of their judgments.

Steiner (1972) described two other processes operating in heterogeneous groups.

The first process is antagonism, which arises from difficulties in evaluating and pooling information. What Steiner views as "dysfunctional" difficulties may, however, be beneficial for individual learning. Johnson and Johnson's (1979) model of conflict resolution, for example, suggests that members of groups experiencing such difficulties may learn more and gain wider perspectives than members of groups experiencing no conflict.

Steiner's (1972) second mechanism, a decrement in motivation, is a potential danger in all learning groups:

> If highly competent individuals are teamed with others who are noticeably less able, the former may feel that they should receive a share of the payoff that is commensurate with their greater contribution to the group's success. Unless rewards are allocated in a manner that reflects the unequal resources of the members, the more competent may be loath to work to their full capacity. They may also be inclined to disassociate themselves from the group when the opportunity arises, (p. 112)

Although manipulating reward structures in the way that Steiner suggests may not always have the desired impact on motivation (see, e.g., Miller & Hamblin, 1963), some action may be required to prevent motivational problems in heterogeneous groups.

The social psychologists' expectations, typically based on observations of small group discussions outside educational settings, may not prove true in classroom and other educational settings. In fact, anecdotal observations of cross-age and peer tutoring programs yield informal evidence of *reduced* antagonism and *increased* motivation in heterogeneous pairings (see, e.g., the review by Devin-Sheehan, Feldman, & Allen, 1976). In any event, these factors need to be examined systematically in groups with different ability compositions.

*Group racial composition.* The literature examining racial composition of groups, in contrast to that examining other group or individual characteristics, often focuses on group interaction. These studies show that in multiracial groups, white students tend to be more active and influential than minority students (Cohen, 1972; Cohen & Roper, 1972; Cohen & Sharan, Note 7), while minority students tend to be less assertive and more anxious, talk less, and give fewer suggestions and less information than white students (Battle & Rotter, 1963; Delbecq & Kaplan, 1968; Katz, Roberts, & Robinson, 1965; Lefcourt & Ladwig, 1965). Cohen (1972, 1973) attributed these results to status differences between white and minority students.

The depressed participation of minority students typically observed in multiracial groups is not immutable, however. In a series of field experiments, Cohen and colleagues were able to alter the pattern of white dominance by manipulating expectations for competent performance (Cohen, 1973; Cohen & Roper, 1972; Cohen, Lockheed, & Lohman, 1976). In these experiments, black students received special training on academic and nonacademic tasks and then instructed white students how to do the tasks. All students were then assembled in single-sex multiracial groups (typically, two black students and two white students) to perform a group task unrelated to the training tasks. Analysis of the videotapes of the group sessions revealed equal rates of task-related verbal activity among blacks and whites. This effect was maintained through three weeks of classroom work in cooperative multiracial small groups. When the treatment consisted only of training black students

without also manipulating the *white* students' expectations of black students' performance (as it was when white students were taught by black students), the usual pattern of white dominance in group interaction was not altered.

*Reward Structure*

Studies examining the effects of reward structures on student behavior usually compared two systems of rewards: individual, in which a person's grade or other reward depends on his or her own performance, and group, in which group members' performances are combined to form a group score and every member of the group receives the same score. Evaluating the effects of individual and group reward structures on interaction in the group is complicated by the fact that reward structure typically was confounded with three other factors that affect student behavior in the classroom. These factors are (1) interaction structure (whether students are encouraged to work with others), (2) weighting of scores to form the individual's or group's score, and (3) comparison group (whether the individual's or group's performance is evaluated relative to or independent of the performance of other individuals or groups in the class). These factors are described in more detail in Table I.

Of the factors described in Table I, three were usually examined explicitly in the studies to be reviewed here: reward structure, weighting of scores, and comparison group. The other factor, interaction structure, typically was a "hidden" factor, either confounded with reward structure or held constant. In very few studies was interaction structure recognized as a factor in its own right and systematically varied. The studies to be reviewed here are grouped into three categories according to how interaction structure was treated in their designs: (1) reward structure confounded with interaction structure, (2) interaction structure held constant, and (3) reward structure crossed with interaction structure.

*Reward structure confounded with interaction structure.* The studies with the first design incorporated the interaction structure into the reward structure. In the group reward condition, students typically worked in groups and received a group score. The key element of the group reward condition in these studies was the team. Students were assigned to four- or five-member teams to practice academic material presented earlier by the teacher. After practicing in teams, students demonstrated their learning in tournaments (as in Teams-Games-Tournaments [TGT]; see Slavin, 1977) or on quizzes (as in Student Teams and Achievement Divisions [STAD]; see Slavin, 1978b). A team's score was a combination of the scores obtained by its members in the tournament or on the quiz.

In the individual reward condition, students typically practiced the academic material individually and received individual grades based on their own work. In many studies, students were allowed to work with other students during the practice sessions, but were not encouraged to do so. In other studies, students were not allowed to work with others.

Many of the studies comparing group-reward-group-work to individual-reward-individual-work found that students in the group condition showed a higher frequency of peer-tutoring, on-task behavior, and total participation than did students in the individual condition (Slavin, 1977, 1978a, Note 1; DeVries & Edwards, 1973; DeVries, Edwards, & Wells, Note 8, Note 9).

Some studies, however, found that reward structure interacted with two other factors. One factor was differential weighting of teammates' scores. DeVries, Ed-

TABLE I
***Factors Varied in Studies Comparing Individual and Group Reward Structures***

| Factor | Description |
|---|---|
| Reward Structure | |
| Individual | Students receive scores based on their own performance. |
| Group | Group's score is based on the performance of all members. All members of the group receive the same score. |
| Interaction Structure | |
| Individual | Students work individually without interaction with others. Variation: Students are allowed, but not encouraged, to work with others. |
| Group | Students are assigned to groups and are encouraged to interact with each other. |
| Weighting of Scores | |
| Unweighted Group Score | Group's score is unweighted average of members' scores. |
| Weighted Group Score | Group's score is weighted average of members' scores, with lowest scores weighted most. |
| Weighted Individual Score | Individual's score is weighted combination of individual's score and group average (e.g., 33% individual, 67% group). |
| Comparison Group | |
| Entire Class | Individual or group's performance is evaluated relative to performance of entire class. |
| Achievement Divisions | Performance is evaluated relative to homogeneous strata within class. |
| Self | Performance is evaluated relative to individual's or group's previous performance. |

wards, and Wells (Note 8, Note 9) and Edwards and DeVries (Note 4) introduced differential weighting into their team reward conditions. In one condition, the team score was the unweighted average of its members' scores. In the other condition, teammates' scores were weighted inversely according to rank such that low scores were weighted most heavily. The heavy weighting of low scores was designed to encourage students to help the low-achieving members of the team. Edwards and DeVries (Note 4) introduced a third condition that used the weighting system of the second condition, but was noncompetitive in that the weekly class newsletter did not report team rankings and teams were compared only to their past performance. The three studies yielded different results. DeVries, Edwards, and Wells (Note 9) found more helping in the weighted condition than in the unweighted condition; DeVries, Edwards, and Wells (Note 8) found no differences in behavior between the weighted and unweighted conditions; and Edwards and DeVries (Note 4) found a complex relation between reward structure and weighting system. Students in the team reward, equal weighting condition helped one another most; students in the team reward, differential weighting, noncompetitive condition helped one another least; and the frequency of helping in the team reward, differential weighting, competitive condition and individual reward conditions fell in the middle.

The other factor added to the basic design (group-re ward-group-work vs. individual-reward-individual-work) was the comparison group, the group against which a student's performance was evaluated. Slavin (1978a, Note 1) used a factorial design

to separate the effects of reward structure and comparison group. Reward structure (team vs. individual) was crossed with comparison group (comparison with entire class vs. comparison with equals). For on-task behavior, Slavin reported significant main effects of reward structure and comparison group: students in the team condition were on task more than students in the individual condition, and students in the comparison-with-equals condition were on task more than students in the entire-class-comparison condition. For helping behavior, however, there was an interaction between reward structure and comparison group. Whereas students in the team condition helped each other more than did students in the individual condition, the effects of the comparison group depended on the reward condition. In team reward, the frequency of helping behavior was about equal in the comparison-with-equals and entire-class-comparison conditions. In individual reward, however, students in the entire-class-comparison condition helped each other more than did students in the comparison-with-equals condition. Slavin (1978a) described the reason for the low frequency of helping behavior in the comparison-with-equals, individual reward combination: "Because students did not know which students were in their divisions, they were possibly reluctant to tutor anyone for fear that their own rank in their division would suffer" (p. 535). Such speculations could easily be confirmed in future studies by means of a questionnaire or interviews with students.

*Interaction structure held constant.* Whereas the studies in the first category examined the effects of reward structure and interaction structure jointly, four studies varied reward structure while holding interaction structure constant. Students in both the individual and group reward structure conditions were instructed to work in groups. One study used complex combinations of individual and group rewards; working with others was encouraged in all conditions (Wodarski, Hamblin, Buckholdt, & Ferritor, 1973; also see Buckholdt & Wodarski, 1978). The four reward conditions were (1) 100 percent individual, in which students were rewarded for their own performance, (2) 67 percent individual/33 percent group, in which 67 percent of a student's reward was based on his or her performance and the remaining 33 percent was based on the average of the lowest four scores in the group, (3) 33 percent individual/67 percent group, in which 33 percent of a student's reward was based on his or her performance and 67 percent was based on the average of the lowest four scores in the group, and (4) 100 percent group, in which students were rewarded only on the basis of the average of the four lowest scores in the group.

All four studies showed similar results. Students in the group reward condition helped each other more than did students in the individual reward condition (DeVries & Edwards, 1974; DeVries & Mescon, Note 2; DeVries, Mescon, & Shackman, Note 3). In Wodarski et al.'s study, as the proportion of group reward increased, so did the frequency of helping behavior. As in Slavin's (1978a) study, students in the 100 percent individual reward condition showed a low incidence of tutoring, even when they were encouraged to help each other.

These results are not surprising. As in Slavin's study, students in the individual condition were competing against each other for individual rewards and so were not motivated to help each other. The instructions to work together would not be expected to override students' tendencies to ignore one another and to obstruct each other's goal accomplishment, tendencies often ascribed to individuals in competitive situations (see, e.g., Davidson, Agreen, & Davis, 1978; Johnson & Johnson, 1974).

***Reward structure crossed with interaction structure.*** **Compared to nine studies that** either confounded reward structure and interaction structure or held interaction structure constant, only one study was designed to separate the effects of reward structure and interaction structure. Slavin (1978b, 1978c) compared student behavior across four conditions: (1) team reward with peer tutoring, (2) team reward without peer tutoring, (3) individual reward with peer tutoring, and (4) individual reward without peer tutoring. The team-reward-peer-tutoring condition resembled the group conditions in the previous studies. In the team-reward-no-tutoring condition, students sat in their groups but were instructed to work individually. In the individual-reward-tutoring condition, students were encouraged to work with other students, but received rewards based on their own performance. In the individual-reward-no-tutoring condition, students worked alone. Slavin examined two behavior variables: the frequency of on-task behavior and the frequency of helping behavior. As Slavin had hypothesized, students in the team reward conditions were on task significantly more of the time than were students in the individual reward conditions. Contrary to Slavin's expectations, however, students in the no-tutoring conditions were on task more of the time than were students in the tutoring conditions. On the helping variable, students in the team reward conditions helped each other more than did students in the individual reward conditions. Although Slavin did not compare helping behavior in the tutoring and no-tutoring conditions, such information would be useful for confirming the effectiveness of the instructions for working with others.

The results of Slavin's (1978b, 1978c) study suggest that group reward is a more salient motivating force to promote student cooperation than is encouragement to work with others. Merely instructing students to work with each other will not produce much cooperative behavior if helping another student does not affect one's grade (or other reinforcement), or if helping another student is perceived as increasing the changes of receiving a poorer grade or smaller reward.

***Reward structure and group productivity: An addendum.*** **All the studies examining** reward structure had one feature in common. The achievement of every individual contributed to his or her reward, regardless of the reward structure. Unlike these studies, research conducted by Deutsch (1949, 1960a, 1960b), which is usually cited in reviews of reward structures, focused not on individual achievement but on *group productivity.* Because the rules governing interaction in groups trying to increase each other's understanding may differ from those governing interaction in groups trying to obtain the best solution to a task, the resulting interaction in Deutsch's studies was different from that in the studies reviewed above.

Deutsch (1949, 1960a, 1960b) compared interaction in cooperative and competitive classroom groups instructed to solve puzzles and human relations problems. In the cooperative condition, each group was judged according to the quality and quantity of ideas it produced for each problem. Every member of the group received the same grade. In the competitive condition, each member of the group was graded according to the quality and quantity of his or her own ideas in relation to those of the other members of the group. Consistent with the results of the studies reviewed above, Deutsch found that students in cooperative groups worked together more, were more cooperative, and participated more equally than did students in competitive groups. Unlike the other studies, however, students in cooperative groups showed greater subdivision of labor, to avoid duplication of each other's efforts, than did students in

competitive groups. As Deutsch (1960a) noted, "[Division of labor] permitted the members to divide up the job into its different aspects and allowed the various members to work on these components simultaneously" (p. 436).

Although division of labor was an efficient way for Deutsch's groups to complete their task, this strategy may be counterproductive for learning. A person who consistently performs the same aspect of a task might not learn how to do other aspects of it. If a reward structure based on achievement encourages participation by all group members on all aspects of a task, it would be expected to produce more learning than a reward structure based on the quality of the group product. A systematic study of this question still remains to be accomplished.

*Summary.* The results of the studies examining the impact of reward structure on group interaction suggest that rewarding students for the achievement of others in addition to their own achievement promotes cooperation among students and attention to the task. Furthermore, the reward structure seems to have a greater impact on group interaction than do the instructions for interaction among group members. These conclusions must be tempered, however, by the findings of interactions among reward structure, weighting system and comparison group. When weighting of scores and comparison group were taken into account, group reward conditions did not always produce the greatest amount of helping behavior. To disambiguate factors influencing interaction, then, further studies of interaction in cooperative groups should systematically manipulate, or at least make explicit, instructions for interaction, weighting of scores, and comparison group.

### *Summary of Predictors of Interaction*

Student interaction may be partially predicted from characteristics of the individual and of the group, and reward structure. Of all the predictors examined here, student ability and reward structure had the most consistent relations with student interaction. High-ability students gave more explanations than low-ability students. Rewarding students for the achievement of all group members consistently promoted helping behavior. Instructing students to work with others was not always effective unless accompanied by group rewards. The few studies examining group ability composition found significant effects on interaction, but because they used different rules for composing groups, no general conclusion can be drawn. Finally, multiracial groups tended to inhibit the participation of minority students, but this effect was overcome by manipulating students' expectations about each others' competence. For future research, a more productive analytic strategy for relating inputs to interaction may be to predict interaction from several individual and group characteristics simultaneously.

## General Discussion

The research on the role of student interaction as a predictor of achievement or as an outcome in its own right suggests that student interaction may be an important link between characteristics of the individual, group, setting, and achievement. As has become evident, however, the existing studies conducted to date fail to form a cohesive body of research. Reasons for the lack of cohesiveness are (1) methodological, including noncomparable designs, lack of detailed or appropriate observation procedures, inappropriate unit of observation, and simplistic analytic strategies, and (2) substantive, including overly general and inappropriate measures of student

interaction. Each of these problems and suggested remedies will be considered briefly in this section, as well as other topics for further research.

### *Methodological Issues and Suggestions*

*Comparability of designs.* A major obstacle to forming general conclusions about the impact of student interaction on achievement and the impact of input characteristics on interaction is the marked variation in the designs of the studies reviewed here. All the studies differed on at least one of the following factors, and often on four or more: grade level (elementary, junior high, high school), subject matter (science, social studies, language arts, reading, mathematics—including algebra, geometry, fractions, computation, probability), group size (two to five), group composition rule (ability, race; homogeneous, heterogeneous, random, no rule), reward structure (intragroup cooperation, intergroup competition, intragroup competition, individualistic), instructions for interaction among group members (encouraged, allowed, not allowed), and duration of the study (1 week to 1 year). Furthermore, many studies did not mention all these factors, leaving the reader uncertain about the design. Researchers finding inconsistent results with previous research often provided disclaimers citing differences in one or more of the factors just listed, for example, grade level or subject matter. Such disclaimers are not enough; the effects of these factors on interaction in groups need to be tested empirically. At the very least, conditions should be reported in sufficient detail to allow comparisons across studies and to guide replication.

*Observational procedures.* One major difficulty with evaluating the results of studies investigating interaction in groups is their lack of detailed descriptions of the observation procedures. Many research reports merely listed the observation variables. Others presented definitions and examples or cited existing observation instruments. Few, however, provided enough detail to determine comparability of observation procedures and variables across studies, or to guide replication.

Another problem concerns the appropriateness of the observation procedures, even when specified in detail. A common observation procedure was a time-based rotating sampling system in which students were observed sequentially for intervals of 3 to 30 seconds. In most cases, the observation interval for each student was too short for recording sequences of interchanges among students or between student and teacher, or for obtaining much information on the content of those interchanges. Thus, the data on interactive behavior consisted of periodic "snapshots" of verbal interaction, rather than continuous records of interaction. This limitation has implications for the relevance of the observation variables used in most studies. A significant result in several studies was that achievement depended not on isolated events but on sequences of interaction including, for example, responses to students' questions or errors. Observation procedures that would capture more of the rich detail in group discussions might include extensive note taking and audiotaping or videotaping.

Several studies used student questionnaires, instead of independent observations, to elicit students' recollections of their own roles and other group members' in group interaction. Students' self-reports cannot substitute for observations of group interaction for two reasons. First, although self-reports may yield global information about interaction, such as the identification of "helpers" in a group, they cannot provide details of specific interchanges among students. Second, the accuracy of

students' reports about interaction and their correspondence with independent observations has not been investigated.

Although students' self-reports may not be an adequate substitute for independent observations, they may provide valuable information about students' evaluations of group interaction (e.g., whether students find explanations to be understandable or helpful) and about the forces facilitating or inhibiting interaction in a group. Observations may show that some students participate very little, but may not reveal the reasons for the lack of participation. Students' self-reports, on the other hand, can provide clues about a variety of influences on their behavior, including, for example, perceptions of their relative ability or status in the group, personality characteristics of other group members, group norms, and group-related and non-group-related influences on motivation. Used together, independent observations and student self-reports may provide a complete picture of interaction in small groups.

*Unit of observation.* A common procedure used in observations of group interaction is to record the frequency of a certain behavior (e.g., helping) in a group without tying this information to specific group members. Information at the group level has limited utility, however, for predicting and understanding the impact of the group experience on the achievement of individual members. For example, a high frequency of helping in a group may not be beneficial for the achievement of all group members if explanations are not directed to those who need it most. Furthermore, even a high correlation between the frequency of helping behavior in a group and achievement sheds no light on the effects of giving help separate from those of receiving help.

Interestingly, many studies do initially obtain data on the behavior of individual students, as in the rotating sampling systems described earlier, but then collapse the data into group indices for analysis. Maintaining data on individual students' behavior throughout the analysis will provide richer and more accurate information on the impact of students' experiences in the group on their achievement.

*Analytic strategies.* Future studies predicting student interaction from characteristics of the individual, group, and setting should consider complex relations among them. Most investigators have studied each characteristic in isolation. Characteristics of individuals, groups, and settings have rarely been examined in the same study. Individual characteristics may be susceptible to misinterpretation when isolated from group characteristics. The research on individual ability and ability group composition suggests that low-ability students, for example, may have different experiences in heterogeneous and homogeneous groups. In heterogeneous groups, low-ability students tend to receive explanations from high-ability students, whereas in homogeneous groups, they may not receive any explanations. The picture will surely become more complicated when various reward structures are introduced. It is not yet known, for example, how the effects of ability group composition and reward structure might interact. Perhaps group rewards, which tend to promote helping behavior, will counterbalance the tendency among some homogeneous ability groups to discourage helping. The results presented in this review may have to be reinterpreted when additional variables are taken into account simultaneously.

### *Substantive Issues and Suggestions*

*Observation variables.* The problem of overly general observation variables clouds the interpretation of the relationship between student interaction and input variables

and achievement. Reiterated more than once in this review is the importance of examining specific categories of student interaction instead of general measures such as the number of utterances or the number of seconds spent talking. The research summarized in this review suggests that some interaction variables are positively related to achievement (e.g., giving help, receiving help), others are negatively related (e.g., off-task behavior, passive behavior), while still others may not relate to achievement at all. Analyses failing to distinguish between these variables are not likely to produce strong or consistent results.

*Psychological interpretation.* Psychological interpretations of input-process-outcome relations need to be delineated. *How* interaction in groups promotes learning is not well understood, nor have many hypotheses been advanced. Mediating variables linking interaction to achievement, and input characteristics to interaction, could be investigated explicitly. Evidence of cognitive processes, such as cognitive restructuring, that may occur when students give help or receive it might come from analysis of explanations and responses to explanations (e.g., rewording or reorganizing material, giving examples or elaborated descriptions) or from stimulated recall of cognitive processes using video or audiotapes of group interaction. Self-reports from group members may provide evidence of socioemotional variables, such as motivation, anxiety, and satisfaction, that may mediate the effects of participation on achievement.

Further, research is needed to clarify which mechanisms operate on the group as a whole and which are tied to specific experiences in group interaction. If, for example, increased student morale plays a major role in increasing achievement, then individuals may benefit from the group experience regardless of their own rate of participation. If increased understanding, rather than increased morale, is responsible for greater achievement, then participation by every student in the group may be necessary. Most likely, many factors mediate the input-interaction-achievement relations simultaneously in any group setting.

*Stability of interaction.* Longitudinal studies of group interaction are needed to determine how students' experiences in the group change over time. Even though many studies observed classroom interaction over several months, no investigator discussed changes in interaction patterns. The large and varied literature on group development suggests that group processes evolve in stages as group members become familiar with each other and with the group task (see, e.g., Bales, 1950; Bennis & Shepard, 1956; Bion, 1961; Mills, 1964; Schutz, 1958; Tuckman, 1965). Whether the same development patterns characterize groups in educational settings remains to be explored, as does the impact of such developmental changes on achievement.

In conclusion, the evidence from studies of student interaction in small groups is not sufficiently consistent at this time to warrant an unqualified conclusion that analysis of interaction patterns will resolve all discrepancies among studies investigating learning in cooperative groups. But the evidence is strong enough to defend the importance of interaction for learning in groups. Furthermore, it may be most fruitful to consider input characteristics of the individual, group, and setting, interaction in the group, and achievement as a system of relationships.

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