Impact Of Cooperative-Team Learning On Performance And Retention

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Executive Summary

Three studies were conducted. Two investigated the impact of cooperative team learning, compared with traditional Navy instruction, on the independent functional ability to master technical information and use it to perform a conceptually complex job, the failure rate within Navy training programs, and the social integration of heterogeneous trainees into cohesive work groups characterized by esprit-de-corps. One investigated the impact of goal and resource interdependence on performance and attitudes of ROTC students.

The first study involved teaching a class of 13 air traffic control trainees the Charts and Publications Unit. Seven of the trainees were in the Navy, 5 were in the Marines, and 1 was in the Coast Guard; 23 percent were commissioned and 77 percent were enlisted. For the Charts and Publications Unit the class was taught utilizing cooperative team learning instructional strategies. The instructor was given training in how to use cooperative-team learning. The Unit lasted for 4 1/2 days for 7 to 8 hours per day. The performance for the class was compared with the achievement and success rate of 50 other classes (49 previous and 1 subsequent) studying the same unit.

The second study utilized two classes of air traffic control trainees studying the Charts and Publications Unit. Of the 22 trainees, 18 percent were Black, 14 percent were Hispanic, and 68 percent were white. All were enlisted. The classes were temporally adjacent in the sequence of instruction (i.e., one class had just finished the weather block of instruction and the second class was due to enter the weather block) and one entered the Charts and Pubs Unit out of sequence (the weather block is not a prerequisite for Charts and Pubs). Members of the two classes were randomly assigned on a stratified random basis (taking into account class, branch of service, sex, ethnic background, ability, and previous academic success) to one of two conditions--cooperation based on positive goal interdependence and cooperation based on intergroup competition. The two instructors, each of whom had been given training in cooperative team learning, were rotated so that each taught each condition 1/2 of the time.

The results from the two studies indicate that cooperative-team learning, compared with traditional instruction, results in:

1. Greater learning of technical information.

2. Greater independent functional ability to perform job functions.

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3. A zero failure rate (compared with an average of 2.14), even with trainees who had failed previous units and were judged to be incapable of the academic requirements of the training program. The lack of failure indicated that the attrition from the training program would be considerably lowered if cooperative-team learning became widely used by instructors.

4. Greater esprit-de-corps indicated by a greater perception of joint goals and interests, greater interaction among classmates, and greater inclass peer help, assistance, and encouragement within class periods.

5. More positive perceptions of the competence of the instructor.

6. Greater effort to learn and a perception of the material to be learned as being less difficult.

These findings indicate that the independent functional ability to learn and perform a job within the Navy is effected by the way in which individuals are trained. Being trained in cooperative teams increased both factual learning of the information required to do the job and the person's ability to actually carry out job responsibilities. In addition, cooperative learning experiences decreased the failure rate to zero and, by reducing attrition, the expense of training may be lowered by reducing the probability that trainees will fail and be dropped from the training program. The isolation of Navy trainees, moreover, was reduced with greater esprit-de-corps being experienced and a greater willingness to help and assist fellow trainees. Finally, it should be noted that the experience of working together as part of a team makes the training program more realistic. If and when trainees become air traffic controllers, they will be expected to perform as part of a team. Being trained as part of a team will facilitate their ability to work cooperatively with others on the job.

The third study compared two ways of structuring cooperation: goal interdependence (the perception that one can achieve one's goal if and only if all other group members achieve their goals) and resource interdependence (the perception that resources are divided so that each group member has only a portion of the resources needed for the task to be completed). In previous research studies these methods have been assumed to be equivalent. Subjects were 30 undergraduate university students in a ROTC military history course. The study lasted for four 50 minute class periods in which 20 minutes was lecture, 20 minutes was groupwork, and 10 minutes was a quiz. Interaction within the cooperative groups was observed daily. An attitude questionnaire were given immediately following the study. A final exam was given five weeks

after the study ended. The results indicated that goal interdependence produced higher achievement, more effective interaction, and greater perceptions of peer and instructor academic support. The implications are that (1) goal interdependence tends to produce motivation to help and assist other group members because each member benefits from the success of others, (2) while resource interdependence tends to produce motivation to obtain resources from others but does not motivate efforts to give resources to other team members.

On the basis of these results it may be concluded that:

1. Navy instructors should be trained to use cooperative-team learning procedures that emphasize goal interdependence.

2. A series of field evaluations should occur to progressively refine the procedures for using cooperative-team learning within Navy training programs.

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Individuals enrolled in Naval training programs are required to learn extensive amounts of technical material and the procedures required to use the technical information in job situations. The job situations typically require the individuals to work as part of a team and involve situations within which other people's lives may depend on what the individuals do. The effectiveness of instructional strategies in promoting the mastery of technical information, the ability to use it in performing a "job," and the ability to function as part of a team are of considerable importance. Within this report two studies are reported that compare the relative impact of cooperative-team instruction with the traditional methods of instruction in a Navy training program.

Types Of Interdependence

In any training program, instructors may structure academic lessons so that trainees are (a) in a win-lose struggle to see who is best, (b) learning individually on their own without interacting with classmates, or (c) learning in pairs or small groups helping each other master the assigned material (Deutsch, 1962; Johnson & Johnson, 1987). When lessons are structured competitively, trainees work against each other to achieve a goal that only one or a few trainees can attain. Students are graded on a curve, which requires them to work faster and more accurately than their peers. In a **competitive** learning situation, trainees' goal achievements are negatively correlated; when one trainee achieves his or her goal, all others with whom he or she is competitively linked fail to achieve their goals. Trainees seek outcomes that are personally beneficial but also are detrimental to the others with whom they are competitively linked. They either study hard to do better than their classmates or they take it easy because they do not believe they have a chance to win.

Instructors can structure lessons individualistically so that trainees work by themselves to accomplish learning goals unrelated to those of their classmates. Individual goals are assigned each day, trainees' efforts are evaluated on a fixed set of standards, and rewards are given accordingly. Each trainee has a set of materials and works at his or

her own speed, ignoring the other trainees in the class. In an **individualistic** learning situation, trainees' goal achievements are independent, the goal achievement of one trainee is unrelated to the goal achievement of others. Trainees seek outcomes that are personally beneficial and they ignore as irrelevant the goal achievements of their classmates.

For the past 45 years competitive and individualistic goal structures have dominated American education. Trainees usually come to Navy training schools with competitive expectations. Attempts have been made to reduce academic competition by switching from a norm-referenced to a criteria-referenced evaluation system. In both competitive and individualistic learning situations instructors try to keep trainees away from each other. "Do not copy!" "Move your desks apart!" "I want to see how well you can do, not your neighbor!" are all phrases that instructors commonly use in their classrooms. Trainees are told to isolate themselves from each other, ignore classmates, and focus only on their own work. Many trainees compete within individualistic situations, even though the structure does not require it.

There is a third option. Instructors can structure lessons cooperatively so that trainees work together to accomplish shared learning goals. Trainees are assigned to small groups and instructed to learn the assigned material and to make sure that the other members of the group also master the assignment. Individual accountability is checked regularly to ensure all trainees are learning. A criteria-referenced evaluation system is used. In a **cooperative** learning situation, trainees' goal achievements are positively correlated; trainees perceive that they can reach their learning goals if and only if the other trainees in the learning group also reach their goals. Thus, trainees seek outcomes that are beneficial to all those with whom they are cooperatively linked. Trainees discuss material with each other, help one another understand it, and encourage each other to work hard.

Cooperative team learning is the most important of the three ways of structuring learning situations, yet it is currently the least used. One reason is that cooperative learning situations are difficult to structure, and must include five essential elements (Johnson & Johnson, 1987; Johnson, Johnson, & Holubec, 1986).

1. **Positive interdependence** is the perception that one is linked with others in a way that one cannot succeed unless the other's do (and vice versa) and, therefore, that their work benefits one and one's work benefits them. It ensures a common fate and mutual causation. An instructor may structure positive interdependence through mutual goals, rewards, resources, tasks, and roles.

2. **Face-to-face promotive interaction** exists when trainees orally explain to each other how to solve problems, discuss with each other the nature of the concepts being learned, teach one's knowledge to classmates, and explain to each other the connections between present and past learning. There are cognitive activities and interpersonal dynamics that only occur when trainees get involved in explaining the answers to assignments to each other. This face-to-face interaction is **promotive** in the sense that trainees help, assist, encourage, and support each other efforts to learn.

3. **Individual accountability** exists when the performance of each individual trainee is assessed so that the group knows who needs more assistance in completing the assignment and so that each member perceives that he or she must fulfill their responsibilities in order for he or she and the group to be successful. Giving individual tests on the material being learned or randomly selecting one trainee to explain an answer or present the group's work are common ways to ensure that individual accountability exists. Cooperative team learning is aimed at maximizing the ability of each individual trainee to perform.

4. Groups cannot function effectively if trainees do not have and use the needed **social skills**. These skills have to be taught just as purposefully and precisely as academic skills. Many trainees have never been required to collaborate in learning situations and, therefore, lack the needed social skills for doing so. Collaborative skills include leadership, decision-making, trust-building, communication, and conflict-management skills.

5. Groups need specific time to discuss how well they are achieving their goals and maintaining effective working relationships among members. Groups need to describe what member actions are helpful and unhelpful and make decisions about what actions to continue or change. Such **group processing** enables learning groups to focus on group maintenance, facilitates the learning of collaborative skills, ensures members receive feedback on their participation, and reminds trainees to practice collaborative skills consistently. Some of the keys to successful processing are allowing sufficient time for it to take place, making it specific rather than vague generalities, maintaining student involvement in processing, reminding trainees to use their collaborative skills while they process, and ensuring that clear expectations as to the purpose of processing have been communicated (Johnson & Johnson, 1984).

Although a great deal is known about cooperative learning (Johnson & Johnson, 1983, in press), there is a need to validate its use in specific job training programs aimed at creating independent functional ability on performance as well as cognitive tasks, retention of all trainees in the program, and social integration of all trainees into peer support groups.

Procedural Learning

Procedural learning occurs when trainees study technical material to learn (a) conceptually what a set of technical procedures are and (b) how to perform the technical procedures within a job situation. Learning technical procedures (such as operating and maintaining machines and equipment, piloting aircraft, driving tanks, or being an air-traffic controller) has been a concern for industry and the military for some time. While procedural learning begins with inputting, comprehending, and retaining technical information, the ultimate goal of procedural learning is for trainees to be competent in performing some task.

Training manuals have three important characteristics. **First**, the type of technical information found within training manuals is usually based on the results of detailed behavioral and functional task analyses of jobs to be performed (Duffy, Curran, & Sass, 1983). Training manuals thus emphasize concrete objects and actions rather than the abstract concepts typical of academic texts. **Second**, technical material is densely written. Space is usually limited and, therefore, there is an absence of examples or analogies to make points or explain statements. The emphasis is on reorganizing, encoding, and applying large amounts of material. There is usually an established sequence of steps from which minimal deviations are expected during the completion of the task. All the information contained in the instructions is usually necessary for successful completion of the task described. **Third**, visual presentations in the form of pictures, charts, and diagrams are often an integral and necessary part of the information communicated (Stone & Crandall, 1982). Thus, technical training differs from academic learning in terms of the goals of the learning experience, the density of the written material, and the importance of visual presentations.

There are only a few studies that have compared cooperative, competitive, and individualistic instruction on procedural learning. Martino and Johnson (1979) compared cooperative and individualistic instruction on learning how to swim. Students taught cooperatively learned how to perform more swimming skills than did students taught individualistically. Johnson, Bjorkland, and Krotee (1984) found that subjects

taught the golf skill of putting performed better when they were taught cooperatively than when they were taught competitively or individualistically. Three of our studies have focused on a comparison of cooperative, competitive, and individualistic instruction on performance on a computer-assisted problem-solving task involving map reading and navigational skills (Johnson, Johnson, & Stanne, 1985, 1986; Johnson, Johnson, Stanne, & Ross, 1985). A related study examined the teaching of map reading skills (Yager, Johnson, & Johnson, 1985). The results of these studies indicate that cooperative, compared with competitive and individualistic instruction, resulted in greater quantity and quality of daily achievement, more successful performance on the problem-solving computer task, more on-task and less social verbal interaction, increased status of female group members, and greater retention of the information learned. Finally, Dansereau and his colleagues (O'Donnell, Dansereau, Rocklin, Hythecker, Lambiotte, Larson, & Young, 1985) have conducted a series of studies indicating that technical information is better learned through cooperative than individualistic learning procedures.

The first purpose of the first two studies, therefore, was to compare the efficacy of cooperative and traditional instruction on procedural learning.

Group-To-Individual Transfer

One of the objectives of many Naval training programs is to promote **independent functional ability**. It is intended that trainees will be able to transfer what they learn to similar situations and novel situations that require flexibility of thought and application. There is some disagreement as to whether cooperative learning experiences do or do not promote group-to-individual transfer. **Group-to-individual transfer** occurs when individuals performing within a cooperative group demonstrate mastery of the material studied on a subsequent test taken or task performed individually.

An assumption made by proponents of cooperative-team efforts is that individuals learning within cooperative teams will perform better in subsequent individual testing than will individuals who learned individualistically or competitively by themselves. This assumption has been both supported and disconfirmed by previous research. There are a number of studies that indicate that the superior performance of cooperative learning groups does **not** result in later superior student achievement in individual testing situations (Beane & Lemke, 1971; Klausmeier, Wiersma, & Harris, 1963; Laughlin & Barth, 1981; Laughlin & Sweeney, 1977; Lemke, Randle, & Robertshaw, 1969; Taylor & Faust, 1952). Other studies, however, indicate that trainees learning in

cooperative groups do perform better in later individual testing situations (Gabbert, Johnson, & Johnson, 1986; Johnson, Brooker, Stutzman, Hultman, & Johnson, 1981; Yager, Johnson, & Johnson, 1985; Yager, Johnson, Johnson, & Snider, 1985).

The discrepancy between the results for these two groups of studies may be caused by the way in which cooperative learning was implemented and/or the complexity of the task. Cooperative learning can be expected to promote group-to-individual transfer only if its essential features (positive interdependence, face-to-face promotive interaction, individual accountability, social skills, and group processing) are clearly implemented (Johnson & Johnson, 1983, 1987, in press; Johnson, Johnson, & Holubec, 1986). Unless group members recognize that it is a "sink or swim together" learning situation in which each member must master the assigned material while interacting skillfully with groupmates to promote own and other's learning, cooperative learning has not been truly implemented. Second, group-to-individual transfer can be expected only if the learning task is complex and challenging. Many of the tasks included in the previous studies that found an absence of group-to-individual transfer were simple factual-recognition tasks such as quizzes and final examinations. There is evidence (e.g., Gabbert, Johnson, & Johnson, 1986; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981) that on higher-level tasks cooperative learning tends to have a considerable achievement advantage while on low-level tasks the situation in reversed. One of the purposes of this study, therefore, is to examine the relative efficacy of cooperative and individualistic/traditional learning on group-to-individual transfer on memory and performance tasks.

Attrition And Social Integration

Attrition is a problem for Naval training schools, as each trainee represents a significant investment of resources. When trainees do not complete a course of study there is no return on the investment. Factors such as errors in daily work, poor retention of information, and low-achieving trainees contribute to the attrition in Naval training programs. In a study of the NATTC air traffic control course, McCormick (1987) found that 33 percent of the trainees fail to complete the course. She suggested that the reasons for the attrition included having too low a qualifying score, low reading skills, inadequacy of ASVAB predictions for success, and lack of motivation to become an air traffic controller. The most important factor, however, may be the social integration of all trainees into support teams that help and assist each other and hold each other accountable for correctly completing the assigned work.

A number of studies have indicated that it is the quality and closeness of relationships, not the number, that determine persistence within a training program and continued membership within an organization (i.e., reenlistment) (Durkheim, 1961; Tinto, 1975). Social isolation is definitely related to dissatisfaction with education in technical fields such as engineering (Lantz, 1982). Peer group associations and friendships appear to be most directly related to individual social integration (Tinto, 1975). Social isolation results in alienation from the Navy and, consequently, in failure to reenlist. There are a number of studies that indicate cooperative learning experiences, compared with competitive and individualistic ones, result in more positive, committed, and caring relationships with peers (Johnson & Johnson, 1983, in press; Johnson, Johnson, & Maruyama, 1983). We have conducted a series of studies on relationships between minority and majority students and between handicapped and non handicapped students who participate in cooperative, competitive, or individualistic lessons (Johnson & Johnson, 1983, 1986, in press; Johnson, Maruyama, & Johnson, 1983). A set of three studies was conducted on the integration of low-achieving, isolated trainees into math and science classes (Lew, Mesch, Johnson, & Johnson, 1986a, 1986b; Mesch, Lew, Johnson, & Johnson, 1986, 1988). The results of these studies indicate that the highest rates of the socially withdrawn students' appropriate social interaction with peers, acceptance and liking by peers, positive attitudes toward math and science, and achievement were obtained when the learning situation was structured cooperatively (as opposed to individualistically) and when specific group rewards were given for engagement in social skills and teamwork.

A purpose of the first two studies was to examine the impact of cooperative learning on trainees' (a) failure rate and (b) relationships with peers and the instructor.

Research Questions

The three purposes result in five specific questions being investigated:

1. Does cooperative-team or traditional instruction promote the greatest learning of technical information?

2. Does cooperative-team or traditional instruction promote the most competent use of technical information to perform a "job"?

3. Does cooperative-team or traditional instruction promote the lowest rate of academic failure?

4. Does cooperative-team or traditional instruction have differential effects on interaction among trainees and interaction between the instructor and the trainees?

5. Does cooperative-team or traditional instruction have differential effects on trainees' perceptions of esprit-de-corps?

Methods 1

Sample

Subjects were 13 trainees (14 had originally been in the class but one left for medical reasons) in the Air Traffic Controller Training School at the Naval Technical Training Center in Memphis, Tennessee. Seven trainees were in the Navy, 5 were in the Marines, and 1 was in the Coast Guard. One of the marines was a female. Trainees ranged in age from 18 to 30 years. Three of the Marine trainees were officers and the Coast Guard trainee was a petty officer (i.e., 23 percent of the trainees were commissioned and 77 percent were enlisted). There were no minorities represented in the class. Trainees were randomly assigned to teams stratifying for branch of service, academic ability, and rank. One officer was randomly assigned to each team. There were two teams of three members each and two teams of four members each. The comparison condition consisted of 585 Navy trainees from a 1 1/2 year period with 49 classes from the 14 months prior to the study and 1 class subsequent to the study.

Procedure

A class of trainees was selected to participate in the study. Trainees typically start as a "class" and complete the Air Traffic Controller Training in a given number of weeks. The NATTC air traffic control curriculum is primarily technical material. It includes publications and charts, weather boards, NOTAMS, airport facilities diagrams, the operation of radar equipment, and so on. The air traffic control course consists of 16 weeks of lessons grouped into blocks. Testing occurs immediately after instruction of the block. A practice test is given and then the unit examination. Testing typically consists of two parts, one of memory and one of application. Neither the instructor nor the trainees are permitted to see the examination before it is administered. Trainees are required to pass each part of the examination at a 70 percent level or better.

Remediation and retesting happens the same day for those who initially fail. A second failure may result in a referral to an Academic Review Board (ARB) or being dropped from the program. FAA exams are administered early in the course in order to eliminate early unsuitable trainees and thus minimize Navy training expenses.

The study lasted 4 1/2 days for 7 to 8 hours a day depending on their other duties. One instructional unit, entitled Charts and Pubs, was utilized for the study. The unit focused on the use of charts and publications by military air traffic controllers. Trainees were required to learn how to identify the correct document to use to control any given air traffic situation. The usual Naval Technical Training Center curriculum, lessons 2.9 and 2.10, was adapted to include team activities and assignments.

At the beginning of the course each trainee was assigned a set of materials to use in class and for homework. Each day there were seven instruction periods, beginning at 7 am and ending no later than 4:15 p.m. Each class period lasted 50 minutes and was followed by a 10 minute break. Lunches ranged from 1 hour 10 minutes to two hours. Each day trainees would typically listen to lectures given by the instructor, fill in a standardized student guide, complete in-class worksheets, and complete homework questions. The role of the student was to master the material in order to pass a two-part test at the end of lesson 2.10. One part of the test was closed book and one part was open book. Trainees were required to learn the content of the charts and publications and the appropriate procedures for using them.

The instructor was a veteran Air Traffic Control trainer who had received over 30 hours of instruction and coaching in the use of cooperative learning methods. The instructor was, in addition, given a daily script to follow in implementing cooperative learning. Two research assistants observed trainee oral interaction on a daily basis. They observed the teams in random order for 2 minutes each, rotating around the classroom so as to observe each team an equal number of times. Interrater reliability for the observers was 87 percent.

Independent Variable

The independent variable was cooperative-team versus traditional instruction. An air traffic control training school "class" of trainees was taught using cooperative-team methods. Within the cooperative condition trainees were randomly assigned to teams on a stratified random basis. Each trainee was given the instructional task of learning the material in the Charts and Pubs Unit. In addition, each team was given the

cooperative goals of making sure that each team member mastered the material in the unit and passed both parts of the unit examination, and making sure that on the unit examination the class averaged over 84 percent correct on the test with no failures. Trainees were further informed that should any member of their team fail to pass the tests, the entire team would return to school for remediation with the failing trainee. Remediation permits the failing student an opportunity to review the material under the guidance and tutelage of an instructor, and retake the parts of the examination they failed that same evening. As further incentives, trainees were told that teams who achieved an average of 84 percent with no failures would be excused from having to clean the school and, if the class as a whole averaged over 84 percent correct on the examination with no failures, their instructor and two other instructors would be required to do the cleaning for them. Each trainee was individually accountable to take and pass the examination.

Three types of cooperative-team activities were conducted during the class sessions. **Informal cooperative activities** were short, 3 minute discussions during the lectures about the information being covered. Examples included having trainees (1) turning to the person nearest them during a lecture and clarifying a point being made in the lecture and (2) forming a post-lecture triad and identifying the three most important points in the instructor's lecture. **Formal cooperative activities** were carefully structured assignments that required team members to work together to complete the assignments successfully. An example would be to complete an in-class assignment ensuring that each team member suggested possible answers to the questions, come to consensus on the best answer to the question, and ensure that each member understood the question and the answer and is able to explain both to the instructor. To ensure cooperative interaction, trainees were assigned roles, essential materials were divided among group members, or the participation of each member was required in a class presentation. Finally, the teams were required to function as **base groups** by devising study plans that ensured each member completed the homework each night, learned the assigned material, studied, received help and support when it was needed, and was prepared to pass the examination at the end of the unit.

The control condition consisted of the traditional lecture/individualistic instructional methods used in the 49 previous and 1 subsequent (50 total) classes in the Air Traffic Control Training School. These 50 air traffic controller classes contained 589 trainees and were taught over the previous 2 years. Traditional lecture and individual assignment instructional methods were used in these classes. The traditional instructional procedure required that staff must lecture and have trainees complete (a) a structured notebook, (b) practice questions for each lesson in class, and (c) practice questions for

each lesson in the evening as homework. While trainees were told that they "should" study together in the evening, the individualistic instructional structure used within the class did not provide any procedure or guidance in doing so.

Dependent Variable

There were two dependent variables: achievement on a final examinations and the number of trainees failing the examinations. The **achievement test** was administered by the Navy on lessons 2.9 and 2.10 of the air traffic control curriculum. The specific content of the test was known only to testing personnel in the school and was not available to trainees, instructors, or research staff. The test has two parts. The first part required trainees to respond to multiple choice items from memory. This closed-book examination consisted of 30 items. The second part required trainees to respond to 20 items, and was completed using the charts and publications in the trainee's "Nav Bags." Trainees had up to two hours to complete both parts of the examination.

The **attrition rate** was determined by how many trainees failed the examination (i.e., obtained a score less than 70 percent correct).

A number of attitude scales were given to the trainees. They completed the scales at the end of the study, responding once for the Charts and Pubs Unit and once for all the previous units they had completed. The **Cooperation Scale** consisted of 5 items dealing with liking to help others learn and the value of working cooperatively. The **Goal Interdependence Scale** consisted of 5 items dealing with the need to make sure every group member has learned the material being studied and completed the assignments. The **Individualistic Learning Scale** consisted of 5 items dealing with learning independently from classmates and working on one's own. The **Peer Academic Support Scale** consisted of 4 items dealing with trainees being caring about how much one learned and wanting to provide help and assistance. The **Instructor Academic Support Scale** consisted of 5 items dealing with the instructor caring about how much one learned and wanting to provide help and assistance. The internal reliability (i.e., Cronbach Alpha) of these scales ranged from 0.81 to 0.87. In addition to the attitude scales, trainees were asked to rate the "professionalism" of the instructor, how challenging the course material was, and how hard they had to work to complete the unit.

Analyses

One-tailed t-tests were used to determine the significance of the differences between conditions. The mean values for the 50 comparison classes were treated as population values (mu and sigma).

Experimental Check

Each cooperative session was observed daily to verify that the conditions were being taught appropriately.

Results 1

The examination consisted of two parts. The first part was a closed-book, multiple-choice, recognition-level examination. The second was an open-book, procedural-learning, problem-solving, higher-level reasoning examination. From Table 1 it may be seen that trainees in the cooperative condition significantly outperformed trainees in the traditional classes on both the recognition-level exam, $t(12) = 9.18$, $p < .01$, and the problem-solving exam, $t(12) = 2.10$, $p < .05$. In terms of the total score, trainees in the cooperative condition had an average score of 90.91 percent correct on the 50 item examination while the other 50 classes of trainees averaged 82.50 percent correct, $t(12) = 6.56$, $p < .01$. The range of percentage correct in the cooperative condition was 82 to 98, while the range for the previous 50 classes was from 46 to 100.

No trainees failed the examination as compared with an average of 2.14 failing trainees over the past 50 classes. In the subsequent units, furthermore, no trainees failed, demonstrating that the cooperation among members of the class continued to benefit the trainees academically.

A number of attitude scales were given to the trainees. From Table 2 it may be seen that compared with the previous units, trainees perceived the Charts and Publications Unit to have greater goal interdependence, $t(12) = 1.79$, $p < .10$, to be less individualistic, $t(12) = -3.63$, $p < .01$, to have more peer academic support, $t(12) = 1.79$, $p < .05$. In addition, the instructor was perceived to be more professional, $t(12) = 1.90$, $p < .10$, the material was perceived to be less difficult, $t(12) = 1.76$, $p < .10$, and trainees felt they had worked harder and were more exhausted, $t(12) = 1.90$, $p < .10$.

Methods 2

Sample

Subjects were 22 trainees in the Air Traffic Controller Training at the Navy Technical Training Center in Memphis. Two classes of air traffic control trainees studying the Charts and Publications Unit were utilized. The classes were temporally adjacent in the sequence of instruction (i.e., one class had just finished the weather block of instruction and the second class was due to enter the weather block) and one entered the Charts and Pubs Unit out of sequence (the weather block is not a prerequisite for Charts and Pubs). Subjects were randomly assigned to two sections of the unit, stratified for "class," sex, branch of service (Navy or Marine), and ethnic background. Twelve trainees were assigned to the cooperative 1 condition and ten trainees to the cooperative 2 condition.

These trainees were fairly representative of the military in general. Ages were relatively homogeneous but typical for the Air Traffic Control School, as were years of previous schooling (graduated from high school only) and academic ability (11th-grade reading level on the average). Fifty percent of the trainees were in the Navy and 50 percent were Marines. Eighteen percent were female and 82 percent were male. Trainees ranged in age from 18 to 25 years with an average age of 20. Eighteen percent of the trainers were female, 18 percent were Black, 14 percent were Hispanic, and 68 percent were white. All trainees were enlisted.

Procedure

Two "classes" in the Training School were selected randomly to participate in the study on the basis of when it was possible to coordinate the schedules of the personnel from the Training School and the University of Minnesota. Trainees typically start as a "class" and complete the units in a given number of weeks. The unit used in this study, Lessons 2.9 and 2.10 (**Charts and Pubs**) usually follows lesson 2.8 (**Weather**). For purposes of this study, the class just entering 2.8 and the class just completing lesson 2.8 were combined so that two sections of **Charts and Pubs** could be instructed simultaneously (the information unit 2.8, **Weather**, is not a prerequisite to the **Charts and Pubs** unit).

The procedure for the second study was the same with the exception that two instructors were involved rather than one and there were two different conditions implemented. One of the instructors had been involved in the previous study. The other instructor received over 35 hours of training and coaching in how to structure cooperative learning. Both instructors had extensive Naval training in the instruction of the Air Traffic Control Curriculum, had been air traffic controllers, and had taught in the "school house" for more than six months. The instructors worked from prepared daily scripts that specified the instructions they were to give each condition and directions on how to supervise daily activities. The two instructors rotated between conditions to control for possible instructor effects, so that each instructor taught each condition one-half of the time.

Two research assistants observed trainee oral interaction. Observers rotated so that they observed each condition and team approximately an equal number of times. Their interrater reliability was over 90 percent.

Independent Variable

The independent variable was cooperation, intergroup competition, and traditional instruction. The operationalization of the **cooperative condition** was identical to that in Study 1.

The **intergroup competition condition** began as an individualistic/traditional condition in which trainees would listen to lecture information from their instructor, fill in a standardized guide, complete in-class worksheets, and complete homework assignments on their own without in-class interaction with their classmates.

The study suffered from a classic **John Henry effect** in which the trainees in the individualistic/traditional condition felt they were receiving a less desirable treatment and, therefore, engaged in a concerted cooperative effort to compensate for their inferior instruction (see Cook & Campbell, 1979). The "John Henry" story describes a steel driver who, when he knew his output was to be compared to that of a steam drill, worked so hard that he outperformed the drill and died of overexertion. Within the experimental research literature, the John Henry effect refers to the situation in which the members of the control condition are aware of the nature of both the experimental and control conditions, believe that they are receiving the less desirable treatment (i.e., are underdogs) and, therefore, are motivated to reduce or reverse the expected effect. There are a number of reasons to believe that a "John Henry" effect took place in this

study. **First**, the first day of class, after the initial coffee break during which members of both conditions conferred with each other informally, a number of trainees in the individualistic/traditional condition complained to the instructor that they were receiving an inferior type of instruction and that they were being set up to fail. Since each condition was made up of one-half of each class, and the classes had studied together for several weeks prior to the research study, members of each condition knew exactly what was taking place in both conditions. **Second**, members of the individualistic/traditional condition complained that all the smart trainees had been placed in the cooperative condition and that they were in the "dummies" condition (in actual fact the two conditions were carefully balanced for previous achievement and academic ability). This reflects a perception by the members of the individualistic/traditional condition that they were the underdogs. **Third**, members of the individualistic/traditional condition organized cooperative study groups to meet in the evening to work extra hard to ensure that they outperformed the cooperative condition on the final test. **Fourth**, there was a strong natural leader (one of the highest academic achievers in the individualistic/traditional condition) who made a personal commitment to ensuring that all members of the condition passed the examination. **Fifth**, members of the individualistic/traditional condition perceived the research, the research team, and the cooperative condition as an "enemy" to be beat. They developed an internal cooperative goal to "beat" an outside enemy.

Sixth, during the debriefing session and interviews members of the individualistic/traditional condition stated (1) there was a competition between the classes, (2) the cooperative condition was expected to do better, (3) being placed in the individualistic/traditional condition meant that the staff expected them to fail, (4) competition between the classes was an incentive, (5) they were determined to win by doing better than the cooperative condition, and (6) if they did not score well on the examination she was letting the class down. **Seventh**, they stated that compared with the instructors and that peers could better explain the material in an understandable way, understand the problems a trainee was having in understanding the material. Finally, they stated that you learn by helping classmates and that it was frustrating when a classmate said he or she was going to fail and, therefore, one immediately provided help and assistance.

In essence, despite the individual work during the class sessions, the individualistic/traditional condition became a second cooperative condition in which the intergroup competition created a sense of positive interdependence (i.e., "we sink or swim together") and a commitment to help each other learn and achieve.

The **traditional condition** in the study was the comparison group of the 50 classes taught by the traditional procedure.

Dependent Variables

The operationalization of the achievement and attrition variables were the same as in Study 1. The Cooperation Scale, Goal Interdependence Scale, Individualistic Learning Scale, Peer Academic Support Scale, and Instructor Academic Support Scale were given. Their descriptions appear in the description of Study 1. In addition, trainees were asked to write out from memory the five-step strategy for solving air traffic control problems.

Analysis

One-tailed t-tests were used to determine whether differences existed among conditions. The mean values for the 50 comparison classes were treated as population values (mu and sigma).

Experimental Check

Each class session was observed daily to verify that the conditions were being taught appropriately. In the cooperative 2 condition the instructor followed the script and appropriately structured team study activities during class sessions. In the cooperative 3 condition the instructor followed the script and appropriately structured individual study activities during class sessions. What could not be directly observed was study time outside of class. At the conclusion of the study trainees were asked to write down the names of individuals they had studied with outside of class. In the cooperative 3 condition, six members reported studying with other trainees (several of whom were in the cooperative 2 condition) and 4 trainees reported studying alone. Other trainees, however, listed 1 of these individuals as a study partner. When asked about the discrepancy, the trainee reported that she had helped, tutored, and encouraged other trainees but she did not consider that studying together.

Because the two classes were randomly assigned to new "classes" on a temporary basis, considerable resistance to the study and the instructional procedures was observed in both conditions. Trainees resented being separated from their classmates and

participating in the study. These feelings contrasted with the feelings of trainees in Study 1, as those trainees did not seem to care about their participation in a study.

Results 2

The examination consisted of two parts. The first part was a closed book, multiple-choice, recognition-level examination. The second was an open-book, procedural learning, problem-solving, higher-level reasoning examination. From Table 2 it may be seen that while the difference was in the expected direction, there was no significant difference between the cooperative conditions and the traditional classes on the recognition-level exam, $t(21) = 1.96$, $p < .05$. On the problem-solving examination, however, the cooperative conditions significantly outperformed the traditional, $t(21) = 3.34$, $p < .01$.

In terms of total score, trainees in the cooperative 2 condition had an average score of 87.33 percent correct on the 50 item examination while the cooperative 3 condition averaged 87.60 percent correct. Since there was no significant difference between the two conditions, their results were combined and tested against those of the other 50 classes of trainees (adjusted for those trainees who failed the exam and retook the unit and the test), who averaged 82.69 percent correct, $t(21) = 2.91$, $p < .01$. The percentage correct ranged from 74 to 98 for the cooperative conditions compared with a range of 46 to 100 for the traditional classes.

No trainees failed the examination as compared with an average of 2.17 failing trainees over the past 50 classes. These results are even more noteworthy, as three of the trainees in the study had failed at least one previous unit exam and would have normally been dropped from the Class and the School. Due to the need to keep the "n" as high as possible in this study, they were continued through the unit. Two randomly ended up in the standard cooperative condition and one was assigned to the intergroup competition condition. Since all three passed the Charts and Pubs examination, they demonstrated that they could in fact do the academic work to become an air traffic controller. One trainee in the cooperative condition was dropped from the course immediately following the study (the decision had previously been made to drop the trainee but implementation was delayed until after the study was over) and the trainee in the intergroup competition condition was dropped later in the course. In addition, one trainee in the intergroup competition condition had previously isolated herself from her classmates. The instructors had predicted that she would fail the course.

After working cooperatively with classmates she became much more outgoing with peers and did quite well during the rest of the course.

When the two cooperative conditions were compared on the attitude scales, it became apparent that the two groups did not differ on how cooperative they perceived their class to be or on how supportive and encouraging they perceived their classmates and instructors to be. The condition in which the class time was structured individualistically perceived their class time as being more individualistic, $t(21) = 8.53$, $p < .01$, and they perceived less positive goal interdependence structured by the instructor, $t(21) = 4.30$, $p < .01$. The two cooperation conditions did not differ significantly in the degree to which they memorized the five-step strategy for solving air traffic control problems.

Discussion

Although a great deal is known about cooperative learning (Johnson & Johnson, 1983, in press), there is a need to validate its use in specific job training programs aimed at creating (a) independent functional ability on performance as well as cognitive tasks, (b) retention of trainees, and (c) social integration of trainees into peer support groups, regardless of sex, ethnic membership, and other sources of heterogeneity. More specifically, the first question investigated was whether or not cooperative-team instruction promoted higher achievement on the closed book test on factual information than did traditional instruction. In both studies, and in all three cooperative conditions, greater learning of technical information was obtained than in traditionally taught classes. The range of scores, furthermore, considerably narrowed, from 70 to 100 percent correct instead of 37 to 100 percent.

The second question dealt with whether cooperative-team or traditional instruction promoted the most competent use of air traffic controller charts and publications. The second part of the unit examination was an open-book, problem-solving, higher-level reasoning examination that required trainees to solve actual air traffic control problems as well as to conceptually understand the charts and publications they were working with. This required higher-level reasoning and performance learning. The range of scores, furthermore, decreased to 70 to 100 percent correct from 30 to 100 percent.

An important achievement issue is whether or not group-to-individual transfer takes place. The results of these studies indicated that what is learned within cooperative

teams does in fact transfer to situations in which trainees have to perform as individuals. This is true for both the factual-recognition multiple-choice test and the higher-level, problem-solving, job-performance test. Since most previous research on group-to-individual transfer examined transfer to lower-level objective exams, the results of the present studies extend that previous work to job performance situations that require problem-solving and higher-level reasoning. The first conclusion is that cooperative learning results in higher achievement in both learning of technical information and the ability to use it on the job.

The third question investigated was whether cooperative-team or traditional instruction promoted the lowest rate of failure and attrition. While the average failure rate for the charts and publications unit was 2.14 trainees in a class, each of the three classes who participated in team learning had no failures. This represents a significantly higher success rate and a considerable savings of resources by the Navy. This greater success rate may be especially important for female and minority Navy personnel participating in the air traffic controller training.

The superiority of team over traditional training may be best illustrated by the three trainees who had failed previous units. These "marginal" trainees not only did better academically when they were part of a cooperative team effort, but the academic performance of one continued to be satisfactory in subsequent units after the study was over. The peer support, encouragement, and assistance inherent in team learning may result in higher success rate and greater retention of trainees who would be marginal under traditional instruction. It could be hypothesized that if cooperative learning had been implemented throughout the course, the other two trainees may have successfully completed it. The second conclusion is that cooperative learning creates the conditions under which people can and will succeed, thereby resulting in greater retention of individuals trainees within the program, including minority and female trainees.

The fourth question investigated was whether cooperative-team or traditional instruction had differential effects on interaction among trainees and interaction between the instructor and the trainees.

The fifth question investigated was whether cooperative-team or traditional learning promoted the greatest feelings of esprit-de-corp. In the first study, trainees compared the cooperatively taught unit with the previous units taught traditionally. The attitude results in the first study indicated that trainees in the cooperative conditions perceived their learning goals to be more positively interdependent and perceived themselves as working together more during the Charts and Publications Unit than during the

previous units. Trainees perceived greater peer support and encouragement for learning and, very marginally, tended to see the instructor as more supportive and encouraging of their learning. These results corroborate previous findings that cooperative-team learning promotes greater peer and instructor academic support than does individualistic or competitive learning (Johnson & Johnson, 1983, 1989). It is significant that in the first study the instructor was viewed as being more professional than the previous instructors, that the material was viewed as being less difficult, and that they worked harder to complete the unit. There are a number of previous studies that found that instructors are liked better and perceived in more positive ways when individuals learn cooperatively than when they learn competitively or individualistically (Johnson & Johnson, 1974, 1983, 1989). The results of this study corroborate these previous findings. The third conclusion is that more supportive relationships developed within the team learning condition, indicating greater esprit-de-corps.

Self-efficacy is a combination of perceived difficulty of the task and the effort exerted to achieve. High self-efficacy is indicated by perceiving the task as being of moderate to high difficulty and commiting effort to succeed. Since the Charts and Publications Unit is usually perceived to be difficult, the results indicate that the help, assistance, and encouragement received from peers in the cooperative learning groups increase each trainee's conviction that he or she is capable of mastering the material and procedures. This finding corroborates previous research on the impact of cooperative learning on motivation to achieve (Johnson & Johnson, 1989). One important dynamic of cooperative learning groups, furthermore, is accountability to groupmates that one is in fact doing the work required for the group to succeed. The finding that trainees felt that they had to work harder in the cooperative groups than they did when they worked alone corroborates the previous research indicating that many individuals will in fact work harder to achieve a group goal than to achieve an individual one (Johnson & Johnson, 1983, 1989). The fourth conclusion is that cooperative efforts result in higher self-efficacy and greater motivation to achieve.

Finally, it should be noted that the experience of working together as part of a team makes the training program more realistic. If and when the trainees become air traffic controllers they will be expected to perform their jobs as part of an air traffic control team. Team learning may have greater transfer to the real world as it increases the correspondence between the training situation and the actual real-life work situation. The fifth conclusion is that cooperative learning makes the learning situation more realistic.

In summary, the results of this study indicate that the independent functional ability to perform a job is effected by the way in which individuals are trained. Being trained in cooperative teams increased both factual learning of the information required to do the job and the person's ability to actually carry out job responsibilities. In addition, there was an absence of failures, a finding indicating that the use of cooperative-team learning in Navy training programs may reduce expenses by lowering the probability of training individuals who never end up being qualified for the job. In addition, the social support resulting from the team interaction reduces the isolation of trainees, increases the effort they expend in learning the assigned material, reduces the perceived difficulty of the work, and creates a positive impression of the instructor. In other words, the use of cooperative-team learning in Navy training programs results in trainees better knowing the information required to do their job, more able to perform their job, more willing to do their job, and more helpful and supportive to fellow trainees.

On the basis of the results of these research studies, two conclusions can be made. First, the consistency of the results justifies a program of instructor training in how to utilize cooperative groups within Navy training courses. Second, a series of field evaluations should take place in order to progressively refine cooperative learning procedures for Navy personnel and the various training courses within which it is utilized.

Impact Of Positive Goal And Resource Interde pendence On Achievement, Interaction, And Attitudes

The productivity and achievement of any group is strongly affected by the degree of positive interdependence existing among its members (Johnson & Johnson, 1989; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981). From the research comparing cooperative, competitive, and individualistic efforts it is generally conclud ed that groups in which there is a high level of positive interdependence will tend to outperform groups having a low level of positive interdependence. Despite the amount of evidence supporting this conclusion, very little research has focused on the relative impact of different types of positive interdependence. A number of different types of interdependence have been identified. But they have not been clarified conceptually and differentiated empirically. The assumption seems to have been that all types of positive interdependence are equivalent. Two ways in which positive interdependence may be structured within small learning groups are: (1) **goal interdependence** (the perception that one can achieve one's goal is and only if all other group members achieve their goals), and (2) **resource interdependence** (the perception that resources are divided so that each member has only a portion of the resources needed for the task to be completed). The purpose of this study was to compare the relative impact of positive goal interdependence and positive resource interdependence on achievement, verbal interaction within cooperative groups, and perceptions of task-related support.

The assumption of equivalence between types of positive interdependence--that is does not matter a great deal whether a team situation is structured through positive goal interdepend ence or through positive resource interdependence--may be mis guided. Some distinction may be made theoretically. When goals are positively interdependent, individuals will act to promote each other's success out of recognition that they will benefit from doing so. When there is mutual dependence on each other's resources, individuals benefit only from obtaining resources from each other, not from each other's success. Thus, it may be expected that members of cooperative groups characterized by high goal interdependence will give each other more help and assist ance, be more concerned with the relationships among group members, and will perceive each other as being more supportive and encouraging.

There is some reason to believe that positive goal and resource interdependence will have different effects on achievement. There is considerable evidence that positive goal interdependence promotes higher achievement than do competitive or in-

dividualistic efforts (Johnson & Johnson, 1979; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981). Resource interdependence in and of itself does not seem to impact achievement. An example of positive resource interdependence are the studies by Aronson and his associates (1978). They used a "jigsaw" procedure in which each group member was given part of the information necessary to complete the group's work, but the group members were given grades on the basis of their individual performance. Aronson and his associates tended to find no differences in achievement between jigsaw and traditional instruction.

Given that the assumption that all types of positive interdependence are equivalent is unwarranted, and given that goal and resource interdependence may effect achievement differently, three hypotheses may be made:

1. Goal interdependence will promote higher achievement and group to individual transfer than will resource interdependence.

2. Goal interdependence will promote greater perceptions of peer academic help and support than will resource interdependence.

3. Goal interdependence will promote more task and maintenance oriented interaction than will resource interdependence.

Methods

Sample

Subjects were 30 undergraduate students enrolled in two sections of the U. S. Military History course at a large midwestern university. Within each of the two sections, students were randomly assigned to two experimental conditions and then to groups (stratifying for sex, military status, minority status, and year in school). The two conditions were positive goal interdependence without resource interdependence ($n = 13$) and no goal interdependence with resource interdependence ($n = 17$). The unequal sample sizes were due to late registration of students and students dropping the course during the first week of the course.

Procedure

The Military History course was scheduled two days per week for 45 minutes each class period. The same instructor was as signed to teach both sections, and received 20 hours of training by research personnel. The study was conducted during the first six class periods of the quarter. During the first class period the instructor explained the course syllabus, class procedures, and introduced the research personnel. Students were told that the purpose of the research was to examine a variety of effective learning methods during the first few weeks of the class. During this class period, students completed consent forms and all pre-measures.

The experimental conditions were implemented during the next four class sessions. The lesson content for the four sessions includ ed: (1) Leadership Traits I, (2) Leadership Traits II, (3) Principles of War, and (4) Battle Analysis. The format for each class was the same. The instructor lectured for approximately 20-25 minutes at the start of each class. Then, group lesson materials were handed out, and groups met in assigned areas of the classroom. All group conditions were conducted simultaneously in the same classroom which was sufficiently large to allow for space between conditions. Instructions appropriate to each condition were provided with group materials. The instructor moved among all conditions to answer questions and to insure that conditions were being implemented appropriately. Students who declined to participate in the study met in a small room adjacent to the classroom, and completed all assignments individually. At the end of the class period, students completed a quiz on the day's lesson content. All quizzes were completed individually. The final was given five weeks after the study ended.

Independent Variable

The independent variable was (a) positive goal interdependence and (b) positive resource interdependence. In the **goal interdependence** condition each group of three was required to learn all of the information for the daily tests. Individual grades were contingent on group performance, as the group average on each test was assigned as the individual grade. Each group member received all of the necessary information for each lesson. No instructions were given on how to share the information, and the instructor discouraged "jigsawing" material as a strategy. Group members were assigned roles (checker, summarizer, and encourager) and received written information about important group social skills (i.e. paraphrasing, active listening, praising, and offer ing information). In the **resource interdependence** condition the information

required to complete the lesson was divided into three parts and each subject was given a different part. Thus, in order to complete the lesson, 2/3 of the information had to be obtained from the other group members. While subjects were required to learn all of the materials provided, they were rewarded according to their individual performances on all tests.

Dependent Measures

The **achievement** measures were four quizzes involving short-answer total recall questions given each session. The first quiz required the listing of five leadership traits. The second quiz required the listing of three successful leaders and one unsuccessful leader and describe the characteristics that made each successful or unsuccessful. The third quiz required the identification of four principles of war in a given scenario and the military attack used in the scenario. The fourth quiz required the identification of the five major sections of the simplified battle analysis and describe what is included in the second section. The highest score possible on each quiz was 10 points. A **final exam** of multiple choice and short answer questions that involved recall of the material learned and application to a variety of situations.

The **Classroom Life Scales** measured students perceptions of peer academic support (2 items), instructor academic support (2 items), academic self-esteem (3 items, Alpha = 0.61), goal interdependence (5 items, Alpha = 0.83), resource interdependence (3 items, Alpha = 0.84), and cooperation among group members (4 items, Alpha = 0.73).

The **verbal interaction observations** measured students task-oriented comments (verbal statements concerning the subject matter of the lesson), management-oriented comments (verbal statements about classroom structure, rules, directions, or plans for future class or group work), and social comments (verbal statements concerning the expression of a person's feelings and emotions and interactions about nontask and nonmanagement subjects).

Experimental Condition Checks

All conditions were observed daily to see that the groups were implementing instructions. Students in the goal interde pendence condition perceived greater goal interdependence than did the students in the resource interdependence condition.

Students in the resource interdependence condition perceived greater resource interdependence than did the students in the goal interdependence condition.

Results

The achievement results may be found in Table 1. The results indicated that students in the goal interdependence condition scored higher on the second and fourth quizzes than did the students in the resource interdependence condition ($t(27) = 2.17$, $p < 0.04$ and $t(26) = 2.77$, $p < 0.01$, respectively). On the retention test, similar results were found, $t(28) = 1.83$, $p < 0.08$.

For the classroom life scales (see Table 1), students in the goal interdependence condition perceived more peer academic support, more teacher academic support, and more cooperation than did the students in the resource interdependence condition.

For the verbal interaction observations (see Table 2), students in the goal interdependence condition made more task-information comments, more task-elaboration comments, more management-information comments, fewer social comments, more task-agree statements and more comments to the instructor than did the students in the resource interdependence condition.

Insert Tables 1 and 2 About Here

Discussion

The overall results indicated that goal interdependence tended to produce higher achievement, more constructive interaction among group members, and more perceived academic support from peers and the teacher than did resource interdependence.

In the past research on cooperation, there has been an assumption that all types of positive interdependence are equivalent. Thus, in his studies on cooperative efforts, Aronson used resource interdependence as if it were the same as goal interdependence. He considered them equivalent ways of producing cooperation. Very little research

has examined the issue of whether all types of positive interdependence are in fact equivalent. The present study compared the relative impact of positive goal and resource interdependence on achievement, perceived support for task-related efforts, and actual verbal interaction within cooperative teams.

The results indicated that positive goal interdependence tended to result in higher achievement and better retention of what is learned than did positive resource interdependence. The reason may be related to the type of motivation generated by each type of positive interdependence. Positive resource interdependence motivates individuals to obtain resources from other team members but does not motivate them to give resources to other team members. Positive goal interdependence, on the other hand, produces motivation to help and assist other group members because each member benefits from the success of the others.

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Table 1

Comparison Of Cooperative And Traditional Learning On Achievement And Retention Measures

	Coop 1	Coop 2	Coop 3	C 2&3	Trad*
Closed Book Scores	93.59	86.94	87.67	87.27	83.52
Open Book Scores	86.54	87.92	87.50	87.73	81.44
Total Exam Scores	90.77	87.33	87.60	87.46	82.69
Attrition	0	0	0	0	2.14

*Adjusted for trainees who retook one or more units.

Closed Book:

Coop 1 vs. Traditional, $t(12) = 9.18$, $p < .01$
Coop 2 vs. Traditional, $t(11) = 1.27$, $p < .12$
Coop 3 vs. Traditional, $t(9) = 1.45$, $p < .10$
Coop 2&3 vs. Traditional, $t(21) = 1.96$, $p < .05$

Open Book:

Coop 1 vs. Traditional, $t(12) = 2.10$, $p < .05$
Coop 2 vs. Traditional, $t(11) = 2.68$, $p < .05$
Coop 3 vs. Traditional, $t(9) = 1.96$, $p < .05$
Coop 2&3 vs. Traditional, $t(21) = 3.34$, $p < .01$

Total:

Coop 1 vs. Traditional, $t(12) = 6.56$, $p < .01$
Coop 2 vs. Traditional, $t(11) = 1.94$, $p < .05$
Coop 3 vs. Traditional, $t(9) = 2.11$, $p < .05$
Coop 2 & 3 vs. Traditional, $t(21) = 2.91$, $p < .01$

Table 2

Comparison Of Cooperative And Traditional Learning On Range Of Achievement Scores

	Coop 1	Coop 2	Coop 3	Trad*
Closed Book Scores	87 - 100	77 - 100	70 - 100	37 - 100
Open Book Scores	70 - 100	70 - 95	70 - 100	30 - 100
Total Exam Scores	82 - 98	74 - 96	74 - 98	46 - 100

*Adjusted for trainees who retook one or more units.

Table 3

Study 1: Comparison Of Responses On Attitude Scales For Course Vs. Class

	Unit	Course	t	p
Cooperation-Team Learning	17.67	17.17	1.39	0.19
Positive Goal Interdependence	17.89	17.45	1.79	0.10
Individualistic Learning	9.58	10.58	-3.63	0.01
Peer Academic Support	13.39	12.85	2.50	0.05
Instructor Academic Support	18.42	17.42	1.59	0.14
Instructor Professionalism	3.23	3.00	1.90	0.08
Difficulty Of Material	3.31	3.62	-1.76	0.10
Effort Expended	2.23	2.00	1.90	0.08

Table 4

Study 2: Comparison Of Two Cooperative Conditions On Attitude Scales

	Coop 2	Coop 3	t	p
Cooperative-Team Learning	17.27	16.40	0.93	
Positive Goal Interdependence	13.08	10.50	4.30	0.01
Individualistic Learning	7.42	13.60	8.53	0.01
Peer Academic Support	16.64	17.40	-0.69	
Instructor Academic Support	17.92	19.00	-1.17	
5-Step Strategy	3.00	2.60	1.11	

Table 5

Comparison Between Conditions: ROTC Study

	Goal Interdependence			Resource Interdependence				
	Mean	sd	n	Mean	sd	n	t	p
Quiz 1	7.69	1.75	13	7.41	2.29	17	0.37	0.72
Quiz 2	8.67	0.99	12	7.59	1.50	17	2.17	0.04
Quiz 3	6.73	1.39	13	7.58	1.97	17	1.33	0.19
Quiz 4	8.08	1.78	12	5.49	2.92	16	2.77	0.01
Final	42.00	3.74	13	38.47	6.12	17	1.83	0.08
Peer Support	6.62	1.85	13	5.41	1.33	17	2.08	0.05
Instr Support	8.85	1.38	13	7.52	1.63	17	1.87	0.07
Self Esteem	6.62	1.85	13	5.41	1.33	17	2.08	0.05
Goal Interdep	21.15	2.30	13	17.53	4.58	17	2.47	0.02
Resource Inter	10.46		13	11.81		17	3.38	0.08

Previous research (Gabbert, Johnson, & Johnson, 1986) found that on low-level learning tasks, such as the simple memorization of facts and definitions, cooperation and individualistic learning did not differ significantly. On higher-level reasoning and problem-solving tasks, however, cooperation consistently produced higher achievement than did individualistic learning. There were two parts of the unit examination in this study. The first consisted of simple identification of facts and definitions. The second required higher-level reasoning in order to solve problems in which the air traffic controller charts and publications had to be utilized. The results of the two studies reported in this article indicated that

Table 6

Comparisons For Verbal Data

	Goal Interdependence			Resource Interdependence				
	Mean	sd	n	Mean	sd	n	t	p
Task Information	2.83	1.70	18	1.56	1.51	19	2.42	.02
Task Elaboration	.61	.87	18	.20	.32	19	1.92	.06
Task Questions	.35	.39	18	.66	1.82	19	.70	.49
Repetition	.07	.20	18	.03	.09	19	.84	.41
Accepts	1.01	.72	18	.68	.82	19	1.32	.19
Disagree	.09	.20	18	.04	.11	19	1.05	.30
Management Informa	.56	.55	18	.15	.23	19	3.05	
Management Questions	.03	.10	18	.13	.17	19	2.12	.04
Social	.12	.29	18	.71	1.22	19	2.01	.05
Task Agrees	.57	.60	18	.21	.38	19	2.20	.03
Task Reads	.34	.39	18	.30	.52	19	.20	.84
Other	.18	.25	18	.14	.22	19	.53	.60
Management Elabora	.01	.04	18			19	1.03	.31
Management Reads	.02	.10	18	.03	.12	19	.11	.92
Management Accepts	.04	.09	18	.08	.15	19	1.00	.33
Total Talks With The Teacher	.30	.50	18	.09	.19	19	1.74	.09

Appendix A

Distribution List

List 1

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Office of Naval Research
Detachment, Pasadena
1030 East Green Street
Pasadena, CA 91106

List 2

As provided by Office of the Chief of Naval Research

Appendix B

Listing of Technical Reports and Presentations

Most of the formal technical reporting of this data is yet to come as it is being written up at this time for publication in research journals. However, there have been several presentations of the material to a variety of audiences since the data were analyzed. The research has resulted in the following:

1. Two doctoral dissertations have been developed from the data, one at the University of Minnesota (Vasquez, June, 1989) and one at the University of Texas (Holubec, projected for Winter, 1990).
2. The research was debriefed with personnel at the Flight Control School and presented to the Office of Naval Research, Manpower Committee (June, 1989).
3. The data have been included in a major summary of research on Cooperative Learning, covering more than 400 studies and dating from the late 1800s to 1989 (Cooperation and Competition: Theory and Research, 1989).
4. The results have been shared with many audiences, especially those interested in adult learning.
   a. National Superintendents Conference on Cooperative Learning (February, 1989, Charleston, SC) is an example and data will be presented at a similar conference in December, 1989 (San Antonio).
   b. Part of a presentation to business trainers of major US companies through the Alliance for Learning, a non-profit collaboration of AT & T, DuPont, GM, and Sears Roebuck (August, 1989, Santa Fe).

Appendix C

Future Research Direction

There are three directions future research will take from this series of studies:

1. The next logical step would be to move the cooperative model into a longer term training and shift to a program evaluation design. It would be interesting to take a group through all fifteen weeks of the flight control school as a cooperative unit, shifting working groups each segment of the training so that they had all worked cooperatively with each other. The evaluation design and longer term implementation would allow for retention testing; application testing; the effects of cooperation on cohesion and commitment to the Navy; the potential of continued networking beyond training; and other variables.
2. A next series of studies to further probe the internal dynamics of cooperation would be useful theoretically and practically. The ROTC study indicated the importance of group-goal interdependence as compared to resource interdependence. Other targets for examination might be the processing component of a cooperative group where interactions are continually evaluated with ensuing planning for improvement. The internal variable of working in a cooperative group stretch from simple, but powerful, ones (i.e., group size) to much more complicated variables (i.e., group celebration of success.
3. This research suggests that it might be interesting to look at formal (structured in class) cooperative groups versus informal (structured outside of class, study groups). The dynamics that make some study-group situations very successful and others washouts could be part of this research.

c. The data will be part of presentations scheduled for the American Education Research Association (March, 1990, Boston); Association for Supervision and Curriculum Development (March 1990, San Antonio); and superintendents conferences (December, 1989, San Antonio, and April, 1990, Tucson).