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The effects of training upon the increase of transactive behavior

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THE EFFECTS OF TRAINING UPON THE INCREASE OF TRANSACTIVE BEHAVIOR

by

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ABSTRACT

THE EFFECTS OF TRAINING UPON THE INCREASE OF TRANSACTIVE BEHAVIOR

by

Lewis Alexander Brooks

Advisor: Professor David J. Bearison

Sixty boys and sixty girls in the first and second grades of public and parochial elementary schools, following pre-test with a score not exceeding two on a spatal relations task adopted from that used in Bearison, Magzamen, and Filardo (1986) were randomly assigned to six groups of ten dyads, composed of either two males, two females, or one male and one female. Subjects in one group of each described composition received training on the use of an interaction strategy of providing an explanation for any disagreement expressed with respect to statements or actions expressed by partner during interaction, together with instruction as to the benefits to be gained by use of such an interaction strategy, while those in corresponding control groups of like composition received neither training nor instruction.

All subjects otherwise received identical treatment with respect to length of exposure to both the training task and the transfer task. All dyadic interactions were

videotaped, and subjects' use of eight interaction strategies during both dyadic pre-test and dyadic post-test was tabulated and proportion scores derived. These were regressed upon subjects' dyadic post-test and individual post-test structural index scores, representing the number of correctly placed houses on the spatial-relations task, to determine the relationship between the interaction strategies used and the structural index scores achieved. Additionally, subjects' individual and dyadic post-test scores were analyzed to investigate the effects of training upon task performance.

Results showed that while both experimental and control subjects showed increases in structural index scores, differences on this measure between the two groups were not significant as to the dyadic post-test. On the individual post-test, however, experimental subjects in male-male and female-female dyads significantly exceeded their corresponding controls, while no significant differences were found between mixed-dyad experimental and control subjects. On the comparison of the individual pre-test and post-test structural index scores, experimentals and controls combined showed significant difference favoring the individual post-test structural index scores. Sizeable increases were found in the expression of justified disagreements by experimental

subjects, and a significant relationship was found between the expression of verbal-enactive disagreements with explanation and the structural index score, with a linear regression line for this interaction strategy.

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Chapter I

Introduction

The belief that knowledge is rooted in social origins can be traced as far back as Baldwin (1897). Mead (1934) assigned a preeminent role to social interaction in the acquisition of learning, and Vygotsky (1962, 1978) provides a description of development that depends entirely upon the character of the social interaction of the parties. The characteristics of the sociodialogical process differ markedly, however, from one theory to another. In social learning theory, for example, the process is largely imitative (Bandura, 1977), while in Vygotsky's theory the process consists of the gradual relinquishment of "other-direction" by the expert and the assumption of self-direction by the learner through the mechanism of interior speech (Vygotsky, 1962). Piaget (1977, 1985) provides an explanation of development that is based upon the notion of sociocognitive conflict, that is, the confrontation of opposing systems of reasoning and opposing constructions of reality. Because the present study investigated questions raised in connec-tion with Piaget's theory, it is appropriate to consider the central tenets of Piaget's theory at somewhat greater length than those of the other theories referred to in this theoretical overview.

Theoretical Background

The purpose of the present study was to increase success in joint problem-solving activity by training subjects to use a specific interaction style, to give explanations for all disagreements, however expressed. Piagetians refer to this as a "conflict behavior". In the discussion of Piaget's theory, the focus will be upon that aspect of the theory that deals with the process of sociocognitive conflict.

Piaget (1977, 1985) provides an explanation of cognitive development based upon progression from lower to higher stages in an invariant universal sequence. This development involves qualitative changes in intellectual state within the individual. The cognitive end-state is always one of *equilibrium*, which represents a relative harmony between the existing knowledge structure and present experience. *Equilibration* "refers to a process that leads from a state near equilibrium to a qualitatively different state at equilibrium by way of multiple *disequilibria* and *reequilibrations* (Piaget, 1985, p. 3; emphasis supplied). But not all reequilibrations result in qualitative change.

> Reequilibration often amounts to nothing more than returning to previous states of equilibrium without creating new equilibrated forms...The

> reequilibrations most fundamental to development result in equilibria that not only are new but are also better than previous equilibria (p. 3).

Piaget also speaks of *optimizing equilibrations*, by which he means those that produce "better" equilibria. The process of equilibration is first set in motion by a *disequilibrium*, where existing knowledge structures are unable to provide a satisfactory explanation for current experience. The process is further borne along by attempts of the organism at *assimilation* of the novel aspects of the experience, defined as "the incorporation of an external element...into a sensorimotor or conceptual scheme of the subject" (p. 5). If this attempt in the search for equilibrium is unavailing, the organism attempts *accomodation*, in which the existing knowledge structure undergoes major modification in order to produce a structure capable of providing a satisfactory explanation of the novel experience. But although "disequilibria alone force the subject to go beyond its current state...they do not always lead to progress. They do so only when they give rise to developments that surpass what has previously existed and go on to specific reequilibrations" (p. 10).

Conflict is conceived as playing a kind of "triggering role" in the overall process:

> Conflicts constantly arise between subject and object...However, they are much more frequent during the initial stages of...individual development and...involve something very general having to do with the subject's methods of reasoning (p. 12).

The cognitive conflict central to Piaget's theory can be produced by intra-individual perturbations that are induced entirely by the disequilibrating effect of information of an apersonal origin (Piaget, 1958; 1965). Piaget assigns a superior role, however, to the effects of inter-personal perturbations created by social interaction, in which there is a conflict between the perspectives of self and others.

> It is by a constant interchange of thought with others that we are able to decentralize ourselves and...to coordinate internally relations deriving from different viewpoints (Piaget, 1950/1981, p. 164).

And further:

> It is in fact very difficult to understand how the individual would come to group his operations in any precise manner, and consequently to change his intuitice representations...without interchange of thought...The grouping is therefore by its very

> nature a coordination of viewpoints and, in effect, that means a coordination between observers, and therefore a form of cooperation between several individuals (p. 164).

Bearison (1991) further elucidates this position thusly:

> The key, then, to the social foundations of cognitive development is in the social origins of decentration as they arise from mutually conflicting interpersonal centrations which are more explicit, synchronous, and, hence, demanding of verification and reconciliation...

The central tenets of Piaget's theory are thus seen to focus upon development as a process brought about mainly through social interaction, in which cognitive conflict obliges the participants in the interaction to de-center and reorganize their knowledge structures, thus producing qualitative changes of a superior character.

Research Findings

Investigators studying social interaction and cognitive change in problem-solving contexts have focused on such Piagetian tasks as conservation (Piaget, 1950), balance-beam tasks (Inhelder & Piaget, 1952), moral judgment tasks (Piaget, 1932), spatial-relations tasks (Piaget & Inhelder, 1952; Doise, Mugny, & Perret-Clermont, 1975), and

coordination of perspective tasks (Piaget & Inhelder, 1956), among others. This diversity in the nature of the tasks and the expression of consistent patterns of behavior, together with a consistent pattern of results, has provided a more secure support for the findings themselves on the one hand, and the conclusions drawn from them on the other. At the same time researchers have gravitated toward the investigation of questions central to, but not fully answered by explicit elements of the theory, some of which will be addressed here.

a. *Disparity question.* One of the earliest interests of Piagetian researchers had to do with the "disparity question", that is, the optimal developmental difference between partners in the interaction for the achievement of what Piaget referred to as "optimizing equilibrations".

Piaget identified four main stages of development, further divided into several sub-stages. The disparity question focuses upon how close the interactors should be to each other in terms of cognitive stage position in order to produce the maximum amount of cognitive gain.

Turiel (1969) argued the superiority of a one-stage disparity, but recent researchers have tended to favor lower disparity conditions. Berkowitz, Gibbs, and Broughton (1980) found that a one-third stage difference yielded the

best results, but also found cognitive gains for 20% of dyads in a no-disparity condition in their study. Damon and Killen (1982) found that no-disparity dyads showed substantially the same cognitive gains as subjects in various levels of disparity-condition dyads. Kruger and Thomasello (1986) found that pairings with age-mates--a no-disparity condition--resulted in substantially higher rates of transactive statements. Berkowitz and Gibbs (1983) found further support for an earlier finding (Berkowitz et al., 1980) that a one-third stage disparity condition was optimal for advancement.

Walker's (1983) investigation followed the lines of a traditional factorial, with four levels of the disparity condition: pro-con-one, pro-con-zero, con-one, and pro-one. (*Pro* and *con* respectively indicate the pro and contra positions taken by the parties to the interaction; the numbers represent the degree of stage-disparity between subjects in each dyad). It can be seen that some dyads exhibit both stage and position differences, while others show only stage differences, with both parties taking the same position on the subject under discussion. As in the Berkowitz studies, the stimulus material consisted of moral judgment dilemmas. Piaget's theory predicts the efficacy of pro-con +1, con +1, and pro +1, since all these involve con-

flict between levels of reasoning of the separate members of the dyads. Pro-con-zero, however, represents a somewhat unique case in that it is a no-disparity condition and thus requires the emergence of higher-stage reasoning from a conflict of inconsistencies within the subject's own stage of reasoning.

Walker found that the greatest increases were achieved by subjects in pro-con +1 and con +1 conditions--both disparity conditions--which was fully in accord with expectations. However, impressive, though lesser, gains were also achieved by pro +1 and pro-con-zero subjects (i.e., those in no-disparity conditions).

b. *Conflict process.* Ames and Murray (1982) noted that "although peer conflict and interaction have been shown to promote cognitive development...ithas never been clear what aspects of the conflict situation produce growth" (p. 894).

In their study of the interaction process, Damon and Killen (1982) found that a rejecting and conflicting style of interaction was inversely associated with advancement, and that discussion to consensus was consistently associated with cognitive gains.

Berkowitz and Gibbs (1983) examined the interaction process and concluded that in order to be effective for purposes of development, the interaction should be "trans-

active" in character, and to evidence "reasoning that operates on the reasoning of another", rather than consist of a mere succession of statements. They left unsettled, however, the question as to what kinds of behaviors should be considered "transactive".

The role of sociocognitive conflict in advancing development has been described by Bearison (1982) as one in which the individual, confronted by the arguments of others, is obliged to re-examine his own thinking and to reorganize it so that it retains an internal logic and consistency sufficient to rebut challenges raised against it. When one's own thinking is found to be inadequate before these challenges, a reformulation of one's position may be required in order to insure that it continues to possess logical consistency and coherence. Conflict is experienced when the lack of coherence of one's own thought is first realized and the process of reorganization is set in motion.

Bearison and his colleagues compared performances on spatial relations task-solving by subjects working individually and in dyads (Bearison, Magzamen, & Filardo, 1986). They examined the interactive process in order to identify important aspects of the process that distinguished those dyads which benefitted from the interaction from those which did not. The task was an adaptation from that used in Doise

et al. (1975) and Mugny and Doise (1978), in which subjects recreated a village scene from a model panel onto a copy panel set at a 90° angle to the model panel. Subjects between five and seven years old were randomly assigned to the dyadic (experimental) and individual (control) conditions, but were matched to produce intra-stage difference ranging from a virtual no-disparity condition to a moderately high disparity condition. A major purpose of the study was to identify the various types of conflict behavior expressed during the interaction and to determine which kinds were expressed most often in successful dyads. Five kinds of conflict strategies were coded:

1. Verbal disagreement with explanation.
2. Verbal disagreement without explanation.
3. Enactive disagreement.
4. Verbal disagreement with explanation, plus enactive.
5. Verbal disagreement without explanation, plus enactive.

Among the most important findings was that "... we were able to identify critical aspects of the process of social interaction that distinguished some experimental subjects (i.e., dyads) who made significant cognitive gains and those who failed to do so" (p. 68). They concluded that

> it appears that sociocognitive conflicts require more than the expression of task-relevant contradictions. Disconfirming statements must be justified during interactions if they are to facilitate some effective type of cognitive reorganization (p. 69).

Their findings lent support to a conclusion that what may often be lacking in the no-disparity dyad is a consistent interaction method embodying a disconfirmation-with-justification type of behavior.

An additional finding of the same study was that male dyads expressed more verbal-disagreements-with-explanation than female dyads. Since they also found that this type of conflict behavior accounted for cognitive gains more than any other single conflict behavior, such a pattern suggested that the process of sociocognitive interaction is different for males and females.

c. *Gender differences.* In a subsequent study Bearison and Filardo (1986) re-examined the videotaped interactions of the earlier study and coded them for instances of interpersonal agreements. They reasoned that the earlier finding of fewer verbal-disagreements-with-explanation for girls may have been due to greater task orientation on the part of the boys and more active efforts to maintain social affiliation on the part of the girls, consistent with the explanation

advanced by Gilligan (1982). Had that hypothesis been correct, then girls would have been expected to express a greater number and proportion of interpersonal agreements than boys. Additionally, they sought to determine if interpersonal agreements would be positively correlated with cognitive gains.

Contrary to expectations, they found that boys in fact expressed a significantly greater proportion of confirmations (agreements) than girls, and that confirmations were positively related to cognitive gains. The combined findings of the two studies thus showed that both confirmations, and disconfirmations-with-explanation are positively related to cognitive gains, and that boys show higher rates of both behaviors than girls. It thus appears--on the surface at least--that boys benefit more than girls from sociocognitive interaction of the consensus-producing type in problem-solving activity, and that unless some way can be found to engage girls more actively in this kind of interaction under these kinds of task conditions, they cannot be expected to show success rates equal to those of boys.

d. *Balanced vs. unbalanced interaction.* Damon and Phelps (1987) speak of the "central dimensions of peer discourse" as being equality and mutuality of engagement. Equality has to do with the authority relationship between the interacting parties. By definition, a "peer"

relationship is one between equals, as distinguished from one between, say, child and parent, teacher and student, and employer and employee. In the first two examples, age alone is sufficient to establish asymmetry in the relationship; in the third example it is the difference in the amount of power wielded by the two parties, such that one is more likely to feel constrained in his actions than the other. Mutuality of engagement, on the other hand, speaks primarily to "extensive, intimate, and connected engagement" (p. 8) between the interacting partners. It belabors the obvious to say that asymmetrical relationships tend to limit the amount of mutuality of engagement that can be expected to emerge during interaction. It should be no less obvious, however, that interaction between peers may be equally lacking in mutuality of engagement. The question of balance in peer interaction is simply a measure of the degree of mutuality of engagement characterizing the interaction.

The most recent decade has seen the emrgence of studies of peer interaction processes for the purpose of identifying key contributors to the process of change. Damon and Killen (1982), in a training study of distributive justice concepts, found that childen who disagreed with one another the most showed the least amount of change, while those who were receptive to the ideas of others showed the most change. Bearison et al. (1986), in their study of spatial-relations

concepts in young children, found that large amounts of conflict produced little gain, but that moderate conflict was positively related to change. A close reading of both studies makes it clear, however, that the unproductive conflict to which they refer is that which is obstinate and unyielding and for which no rational justification is offered. Obviously, any interaction characterized by such behavior cannot be expected to show much in the way of "mutuality of engagement" (Damon & Phelps, 1987).

Balance in interaction requires that both parties vary their roles, alternately offering their own ideas and criticizing those of their partner. Both parties participate in an active way, offering their own ideas and constructively analyzing those of the other. For it is such "interactions that draw children in to the logic of the problem [that] facilitate intellectual progress" (Damon & Phelps, 1987).

Communication Training Studies

Training studies have been widely used by Piagetian researchers. Subjects have been trained to conserve quantities (Bearison, 1969; Brainerd, 1974; Siegel, Roeper, & Hooper, 1968); and to improve communication skills (Fry, 1966, 1969; Shantz & Wilson, 1972; Chandler, Greenspan, & Barenboim, 1974). The training of subjects in communication

skills is of particular interest in terms of the present study, which undertook to train subjects in a specific style of interpersonal communication in order to improve success rates in cooperative problem-solving activity.

The utility of training necessarily requires that certain outcomes result. Campione (1987) observed that

> demonstratons that performance on a specific task can be improved...is not particularly overwhelming. Therefore, the immediate and standard questions concern the maintenance of and generalizability of the instructed routines.
>
> If the answers are negative, the instructional effects, although theoretically interesting, remain of dubious practical significance.

The effectiveness of the training in the studies to be reviewed must then be judged against these criteria.

Fry (1966) attempted to train subjects to adjust their communications to meet the needs of the listener, an ability commonly called "referential communication" ability. Piaget (1957) had pointed out that young children fail to consider the needs of the listener by differentiating their own knowledge from that of others because of their egocentrism. This had been shown to be the case even when the difference in knowledge on the part of the listener was

dramatically emphasized by blindfolding the listener in the presence of the speaker, who would then narrate a description of an event or condition outside the knowledge and view of the listener (Flavell, 1961; Bearison & Cassel, 1975). In the Fry study subjects were required to focus upon some discriminating features of a number of cards in a series where all cards possessed some features in common. The subjects had to so describe the card as to enable the listener to later choose the target card from the series. Trained subjects did tend to be briefer and to include lesser amounts of irrelevant information, but the information conveyed was usually inadequate to make possible a reliable discrimination on the part of the listener. Fry (1966) thus failed to meet any of the criteria for a successful training study.

A later study (Fry, 1969) had subjects take turns playing the role of speaker or listener in a group situation in which the speaker had to give directions to the listener as to how to perform a particular task in one instance, and in another to describe a card in a series of similar cards with sufficient specificity to enable the listener to select the target card as in Fry (1966). Trained subjects were able to recognize the differing needs of the listener and adjusted the communicated information accordingly. However, the training effects were not generalized to tasks other

than those used in the training, thus once again falling short of the criteria set forth in Campione (1987).

Shantz and Wilson (1972) attempted to increase communication proficiency by using training procedures that focused primarily upon making the needs of the listener more salient to the training subject. Their procedure was similar to that employed by Fry (1969), in that it required a speaker to provide a description of a design adequate to enable a listener to reproduce the design accurately and in entirety. Next the speaker was made to describe the design to another subject, but this time only in such detail sufficient to enable the listener to select the design from among a group in which some possessed features common to all the designs in the series. Subjects took different roles, as in Fry (1969), first as speaker and then as listener, to enable them to experience a dependence upon receiving adequate communications from others, with the thought that this would make them especially vigilant in making certain that as speakers they would communicate adequate information to others.

The results showed significant training effects, in that only experimental subjects showed significant gains. Experimental subjects showed an increase in the communication of useful information that was three and one-half times

greater than that shown by control subjects, and a small decrease in the communication of useless information as against an *increase* in the communication of useless information by control subjects five times greater than the decrease on the part of the experimental subjects. However, transfer effects were so modest as to provide virtually no support for a conclusion of generalization.

A study by Chandler, Greenspan, and Barenboim (1974) utilized training in role-taking and referential communication skills for the purpose of improving the social adjustment of institutionalized emotionally disturbed children. They reasoned that developmental deficits in role-taking and referential communication skills could be remedied through a training program that would then show "measurable improvements in social competence." Subjects were residents of an institution for emotionally disturbed children and ranged in age from 9-14 years (M = 11). One group, numbering sixteen subjects, met for two hours a week for ten weeks and received role-taking training. As part of their training these subjects undertook to make video films to be used in training others deficient in role-taking skills to overcome their deficits. The experimenters reasoned that this medium would aid the subjects to emancipate themselves from their own egocentrism. A second group, also sixteen in number, met during the same time frames and received referential

communication training markedly similar to that in Shantz and Wilson (1972). A third group of sixteen subjects served as the control group and received no training of any kind. Both the referential communication experimental subjects and the role-taking experimental subjects showed significant training effects on post-training measures. About one year after completion of the training phase of the study, institutional caregivers were asked to rate the expermental subjects in terms of positive behavioral change. Improvements in pre- to post-test scores on the training measurement instrument were found to be positively associated with improvements in social adjustment on the rating scale used by the caregivers. The authors themselves concede, however, that a number of uncontrollable institutional and familial forces operating upon the subjects could also be seen as bearing heavily upon any change in behavior, so that it would not be possible to establish a clear linkage between the training and subsequent behavioral change. Over and above that, however, the use of rating scales of any kind, and especially non-standard rating scales, gives rise to the possibility of extensive subjectivity on the part of the raters as well as wide variability in the criterial judgments of those raters that calls into question the amount of reliance that can prudently be placed upon such measures. Finally, there is no indication that any such ratings had

been made immediately prior to the training, which would make it impossible to make a direct comparison of pre- and post-intervention behavioral ratings.

Metacognitive Training Studies

The beginning of research on what today we call metacognition is generally traced to the work of Flavell and his associates (Flavell, Friedrichs, & Hoyt, 1970; Flavell, 1971), and is defined as "knowledge and control of [one's] own cognitive system" (Brown, 1987). However, work by both Baldwin (1909) and Thorndike (1917), to name but two examples, would be considered metacognitive in nature by psychologists today, clear evidence that interest in developing greater subject control over cognitive performance is not at all new. The metacognitive character of the present study is clearly evident in its aim to influence subjects to consciously alter communicative style in order to improve cognitive performance.

The problems in achieving success in metacognitive training studies have tended to be two-fold in nature. The first, generally referred to as a "production deficiency" problem, describes those cases where the trainees do in fact learn the instructed behavior, but for some reason fail to employ it in cases where its use is clearly indicated. The second is a problem common to all training studies, that of

failure to generalize the trained behavior to tasks other than that on which the training was given. The first of these problems can be seen as peculiar to metacognitive training studies, while the second applies to training studies in general (Bearison & Isaacs, 1975).

Early researchers such as Brown and Campione speculated that an important explanation for this "production deficiency" might be found in the fact that the trainees were unconvinced of the usefulness of the trained behavior and therefore failed to make a deliberative effort to make use of it. Kennedy and Miller (1976) had found that by giving repeated advice about the usefulness of a rehearsal strategy they were able to increase subjects' use of that strategy. A more direct test of the benefits of "informed" versus "blind" training is provided in a study by Brown, Campione, and Day (1980), in which subjects who were informed about the usefulness of the trained strategy showed a higher use of the strategy than subjects who received training but no information about usefulness. Similarly, Ringel and Springer (1980) succeeded in getting third-graders trained in a memorization strategy to transfer the strategy to a new task after the experimenter explained the benefits of use of the strategy as part of the training. Approaches to solving the generalization problem in metacognitive training studies have typically relied upon simply instructing the subjects

about generalizability as part of the training, or upon instructing the subjects in multiple contexts as a direct demonstration of generalizability (Belmont, Butterfield, & Borkowski, 1978). The younger the subjects, the greater the preference shown for verbal instruction as opposed to demonstration.

Summary

The results of recent research indicate that cognitive performance can be improved in dyadic interaction (Ames & Murray, 1982), even in no-disparity dyadic conditions (Walker, 1983), and that improved performance is related to the frequency of transactive behavior (Berkowitz & Gibbs (1983). Among the more important transactive behaviors is justified disagreement, which has been found to be positively related to successful cognitive performance (Bearison et al., 1986). Confirmations is also a significant transactive behavior, in that it, too, is positively related to successful cognitive performance (Bearison & Filardo, 1986).

Efforts to train subjects in modification of communication style have a mixed record of success, with the most notable success having been achieved in studies in which subjects were advised as to the efficacy of the trained behavior in enhancing performance outcomes (Ringel & Springer, 1980).

Chapter II

Conceptualization of the Present Study

The present study undertook to train subjects engaged in cooperative problem-solving activity to give explanations for disagreements relevant to problem-solving. The purpose of the training was to make explained disagreement a general feature of the interaction style of the subjects. Since Bearison et al. (1986) found this behavior to be significantly associated with cognitive gains, its incorporation into the interaction style was expected to increase the likelihood of creating "optimizing equilibrations" (Piaget, 1985) and thus result in significant cognitive gains for those who incoporated the trained behavior into their general interaction style.

An additional purpose of the present study was to extend the findings in Damon and Killen (1982), and Walker (1983), that low-disparity conditions between interacting partners are capable of producing significant cognitive gains. The present study sought to demonstrate that the likelihood of such gains being realized is significantly increased by the use of a beneficial interaction style, and that explained disagreement increaes the productiveness of the interaction.

The present study also sought to provide an experimental test of the finding of a relationship between explained disagreement and cognitive achievement in Bearison et al. (1986) by demonstrating that training could increase the frequency of occurrence of this behavior in problem-solving interactions, with a corresponding increase in cognitive achievement.

The present study also sought to overcome, or at least to reduce, the gender differences found in Bearison and Filardo (1986), by training girls to modify their interaction style so as to increase the frequency of occurrence of explained disagreement in problem-solving interactions, in that this behavior has been shown to be significantly associated with cognitive gains in boys.

Description of the Present Study

The present study used an equal number of male and female subjects, assigned to three control groups and three experimental groups. Subjects in all groups were paired in dyads as follows:

Control Group: Male Dyads

Control Group: Female Dyads

Control Group: Mixed Dyads

Experimental Group: Male Dyads

Experimental Group: Female Dyads

Experimental Group: Mixed Dyads

The present study utilized spatial-relations task items adopted from Bearison et al. (1986). All subjects were initially pre-tested individually on two trials of the spatial-relations task. Subjects who correctly placed more than one house in either of the two trials were eliminated from further participation and replaced by another subject of the same gender, so that only unsuccessful subjects on the individual pre-test participated in the study.

Following randomized assignment to dyadic groups, subjects were then dyadically pre-tested on items of the spatial-relations task, with the dyadic pre-test being videotaped for all groups. Training, consisting of instruction and practice in giving explained disagreements, was given only to the three experimental groups. The practice task for training consisted of balance-beam items adopted from Damon and Phelps (1987), following Siegler (1976). At the conclusion of the training, experimental group subjects were instructed as to the potential benefit to be realized from use of the trained interaction strategy.

Immediately thereafter all groups were dyadically post-tested on additional items of the spatial-relations task. All dyadic interactions were videotaped. Finally, an individual post-test was administered to all subjects on items of the spatial-relations task. The individual post-test performances were not videotaped.

Participation of the various groups in the different phases of the study is shown in Table 1.

Theoretical and Research Guides to the Present Study

One of the aims of the present study was to demonstrate anew that dyadic inter-action is efficacious for cognitive advancement, and that dyadic performance is capable of accomplishments superior to those of individual performance, even when both partners are non-knowers (Piaget, 1985; Bearison et al., 1986; Berkowitz & Gibbs, 1982). Individual pre-test before dyadic interaction and individual post-test following dyadic interaction are capable of providing a test of this contention.

A further aim of the present study was to increase expression of the trained behavior in the interaction style of experimental subjects. Experimental dyads should thus show an increase pre- to post-training, and should also show significantly higher expression of the trained behavior than control dyads.

An expectation of the present study was that experimental dyads would score significantly higher structural index scores on the dyadic post-test compared with the dyadic pre-test; would score significantly higher structural index scores on the dyadic post-test compared with control

Table 1

Participation of Groups[a] in the Different Phases of the Study

Group	Pre-test (S-R) Ind.	Pre-test (S-R) Dyad	Training (B-B)	Post-test (S-R) Ind.	Post-test (S-R) Dyad
Control: Males	x	x		x	x
Control: Females	x	x		x	x
Control: Mixed	x	x		x	x
Experimental: Males	x	x	x	x	x
Experimental: Females	x	x	x	x	x
Experimental: Mixed	x	x	x	x	x

[a] n = 20 for each group

S-R = Spatial Relations Task
B-B = Balance Beam Task

dyads on the dyadic post-test; and would score significantly higher structural index scores on the individual post-test compared with control subjects on the individual post-test.

Hypotheses

1. Both experimental and control subjects will show a significantly higher individual post-test score compared with the individual pre-test score.

2. Experimental subjects will show a significantly higher individual post-test score compared with control subjects' individual post-test score, using the individual pre-test score as covariate.

3. Experimental dyads will show significantly higher dyadic post-test scores compared with their own dyadic pre-test scores.

4. Experimental dyads will show significantly higher dyadic post-test scores compared with control dyads' dyadic post-test score, using the dyadic pre-test score as covariate.

5. Experimental dyads will express a significantly higher proportion of explained disagreements in interaction during the dyadic post-test compared to interaction on the dyadic pre-test.

6. Experimental dyads will express a significantly higher proportion of explained disagreements in interaction during

the dyadic post-test compared with control dyads during the dyadic post-test.

The present study also undertook to investigate the following questions, for which no hypotheses were offered:

a. What will be the nature (linear, curvilinear) of the relationship between explained disagreements and structural index scores on the dyadic and individual post-tests?

b. Will there be a decrease in gender differences in the pro-portion of explained disagreements for experimental dyads after training?

c. Will experimental subjects in mixed-gender dyads perform as well as experimental subjects in same-gender dyads on the individual post-test?

d. Will there be gender differences in structural index scores for female dyads compared with male dyads on the dyadic post-test; or for experimental female subjects compared with experimental male subjects on the individual post-test?

Chapter III

Methods

Subjects

Subjects (N=120) consisted of an equal number of males and females enrolled in first-grade and second-grade classes of five public and parochial schools of the Lower Hudson Valley Region of southeastern New York, mainly of middle- and lower middle-class background. Except for five Asians and seven Blacks, subjects were Caucasian. While the representation of Blacks in the sample was less than the proportion of Blacks comprising the total student body, the representation approximated the proportion of Blacks in the grade levels of interest at the parochial schools. That this was not true in the public school part of the sample is explained by the fact that participation required consent of the parents, and parents of Black students did not consent to participation in the same proportion as parents of white students.

In the letter sent by the respective school principals to the parents, a general explanation of the nature of the study and the activity the children would perform was provided; no information was provided however, as to the objectives of the study. At the first four schools subject selection took place in the following manner: students were

administered an individual pre-test on a spatial-relations task. Students scoring more than 1 on either of the two trials were eliminated from further participation. As a result the number of males and females participating in the study was not necessarily equal within all schools, although the number of students of both genders participating always comprised an even number in order to permit the forming of dyads. The students thus obtained were randomly assigned to one of the six dyadic conditions, subject to requirements of gender, in such manner that all schools were represented at least once in each dyadic condition. In the case of the fifth school, students were similarly qualified by scoring not more than 1 in each of two trials and then were randomly selected for assignment to dyadic conditions not yet filled as a result of prior random selection and assignment. In the final sample, none of the original four schools was represented less than once nor more than three times in any of the six dyadic conditions.

Materials

Spatial-relations task. Two cardboard panels, approximately 50 cm. x 40 cm., with sheets of graph paper affixed thereto and marked in millimeter squares, as described in Bearison et al. (1986), were used in all pre-tests and post-tests, both individual and dyadic. On each sheet

in the same location, an irregularly shaped piece of blue transparent plastic ("mark") was affixed to serve as the reference-point, set off to one corner of the panel. With each panel was a set of color-distinctive toy houses of correspondingly equal size; that is, the red house on the model panel was the same size as the red house set to the side of the copy panel, and the same was true with respect to the blue and yellow houses as well. On the model panel the houses were already positioned when the model panel was first exhibited to the subject(s). To the immediate right of the copy panel, which was positioned at an angle of 90° to the model panel with the "mark" rotated 180° from the corresponding "mark" in the model panel, an identical set of toy houses to be used in the reconstruction of the depiction in the model panel was placed, as shown in Figure 1. During the individual and dyadic pre-tests and post-tests, the orientation of the copy panel relative to the model panel remained throughout as shown in Figure 1.

The various rotations and orientations of the model panel in pre-tests and post-tests were adopted from Bearison et al. (1986) and are shown in Figure 2.

Balance-beam task. A balance-beam with interval-scale positions set at equal distances from the fulcrum on both sides was used in conjunction with the dyadic training phase of the study. The task was adopted from Siegler

Figure 1

Model and Copy Panels Showing Position of Subjects During Task

(From Bearison, Magzamen & Filardo, 1986)

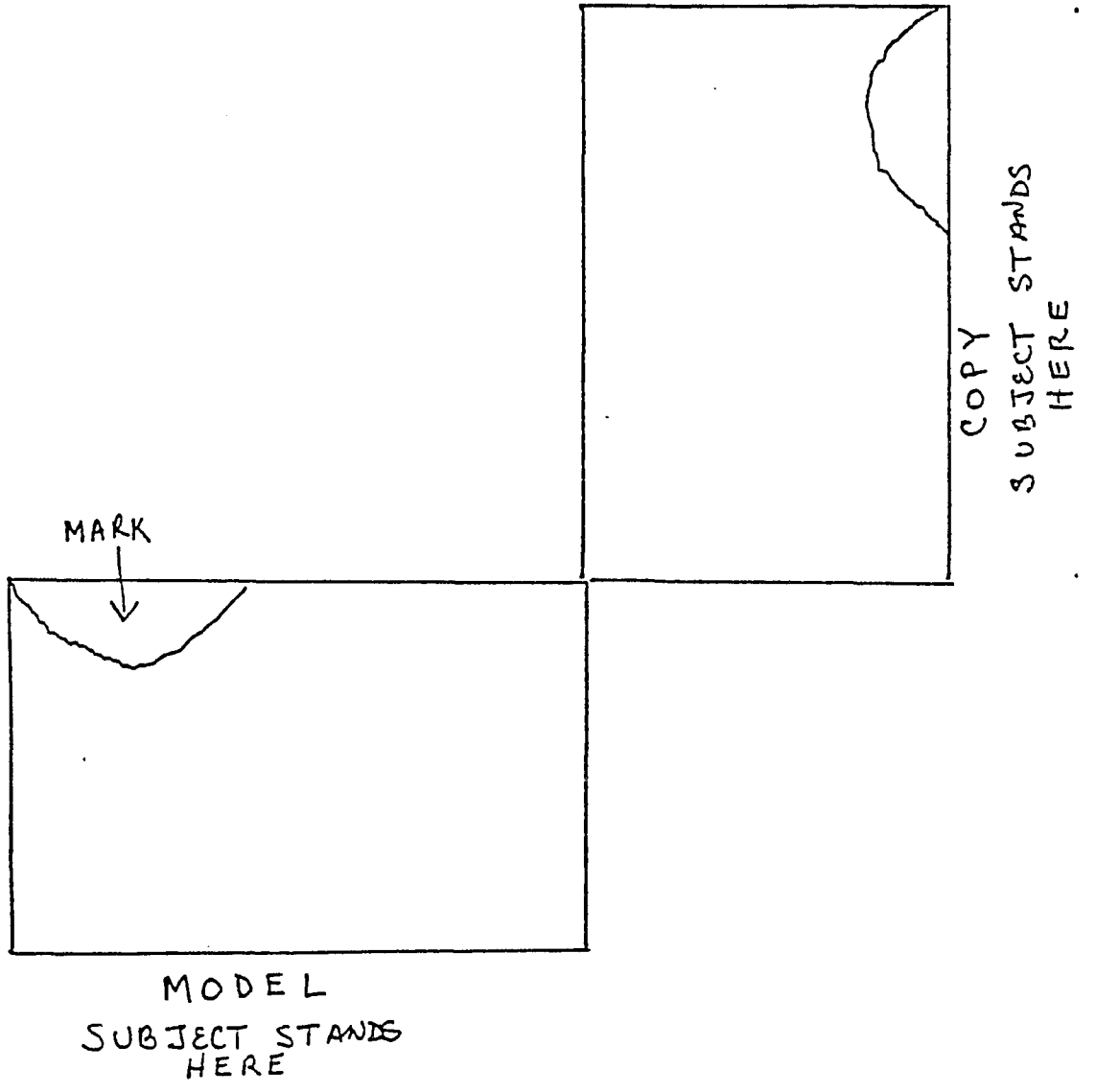
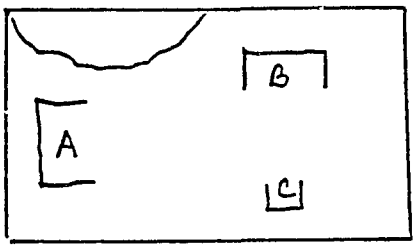
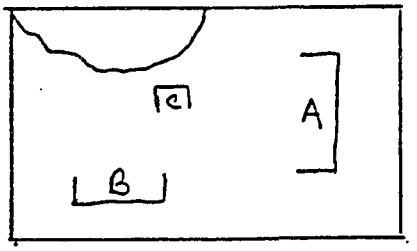


Figure 2

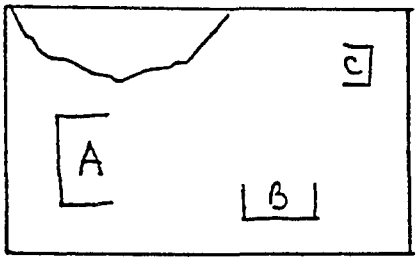
Orientations of the Model Panel As Seen By Subjects



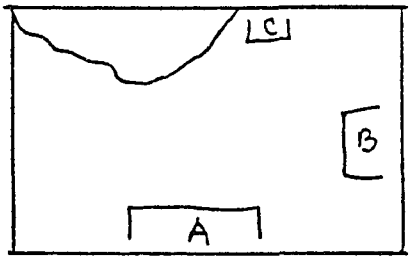
(a)



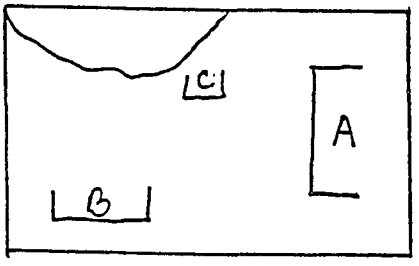
(c)



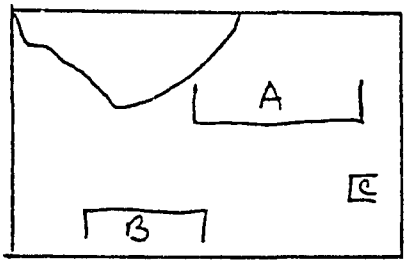
(d)



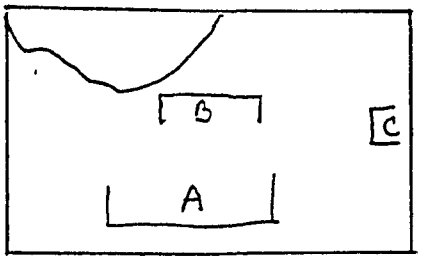
(g)



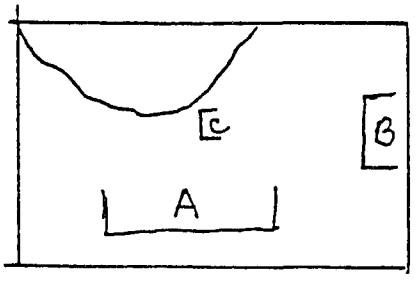
(h)



(m)



(n)



(o)

(1976; 1981), Martin (1983), Tudge (1985; 1986), and Phelps et al. (1987). The construction of the apparatus was such that it allowed for the positioning of weights of equal measure at equidistant points on both arms of the beam, which was held level by blocks so that no change in the attitude of the beam was possible until such time as the experimenter removed the support holding the beam in place at a level attitude. The balance-beam as used is shown in Figure 3.

Signalling device. Each subject in the three experimental groups used a signalling device during training that resembled a wheel, with a hub and radiating arms stretching out from the hub, but lacking the outer rim that forms the circumference of a wheel. At the outer extremeties of the radiating arms were distinctively colored hemispheric disks of pliant plastic material which, when squeezed or indented by the act of depressing them, simultaneously emitted an audible signal and a flashing red light rotating sequentially from one bulb to another in a circle. This signalling device is depicted in Figure 4. The use of the signalling device is explained under Procedures.

Procedures

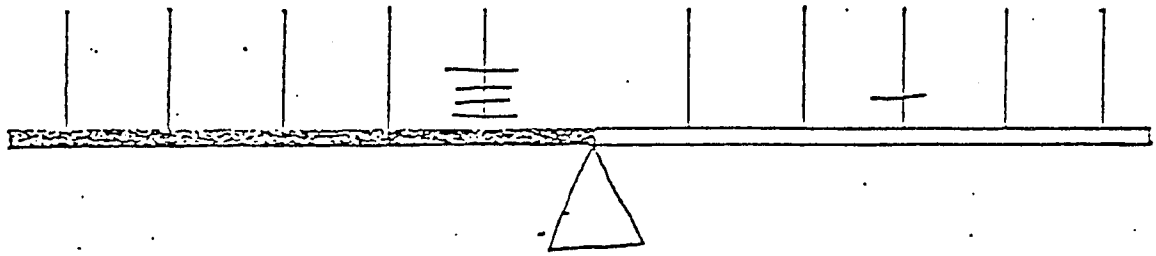
Individual Pre-test. All subjects were initially tested on an individual pre-test, consisting of two arrangements of

Figure 3

Balance-Beam

Adopted from Phelps et al., 1987

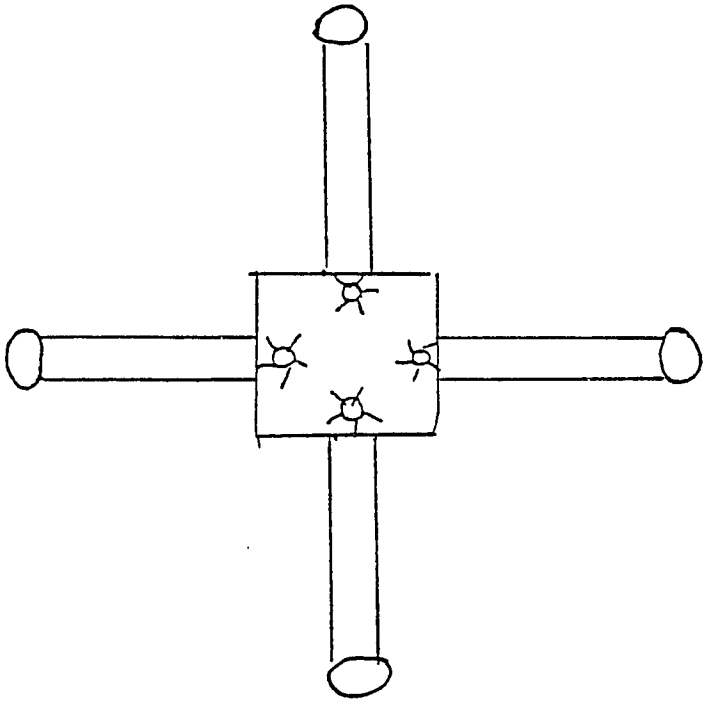
S E T U P T H E B A L A N C E L I K E T H I S :



W H I C H S I D E W I L L D R O P W H E N
Y O U R E M O V E T H E B L O C K S ?

Figure 4

Signalling Device



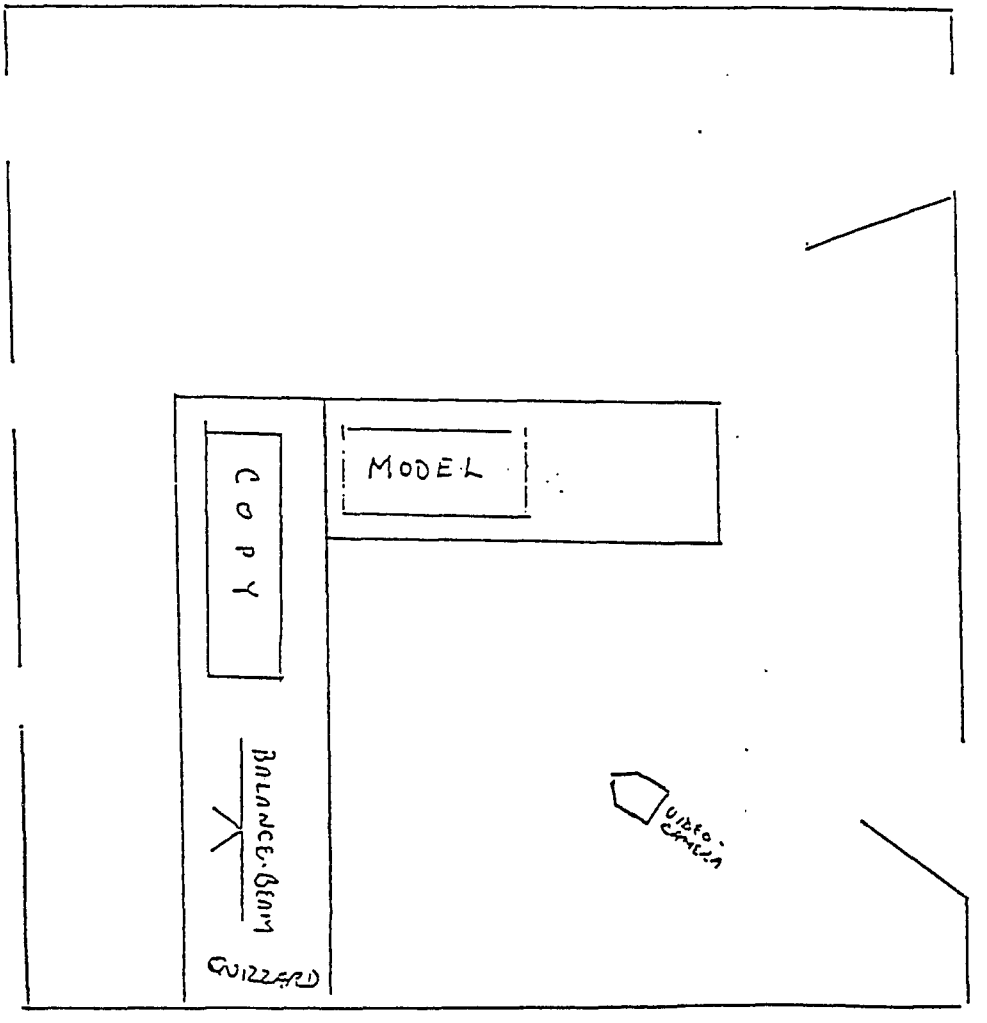
the spatial-relations task adopted from Bearison et al. (1986), and identified as arrangements (a) and (n) in Figure 2 (p. 34). The order of presentation was counter-balanced across subjects.

Subjects were individually brought into the test area, a classroom measuring approximately 45 feet in length by 27 feet in width for the largest, and approximately 37 feet by 22 feet for the smallest. The rooms were familiar to the students because they were used in one case as a music room for all students in the school, and in another case as an activity room by students in the lower grades. In one of the schools a section of the library was used. A typical arrangement of the room is depicted in Figure 5. In all cases the test materials were set at the far end of the test area. Following a brief period during which the experimenter established rapport with the subject, the experimenter led the subject to the area where the task materials were already set up on a table, with the model panel in orientation (a) as depicted in Figure 2 (p. 34). Each subject was then given the following instructions, corresponding to those given in Bearison et al. (1986):

Figure. . 5

Diagram of the Typical Arrangement

of the Test Area



> This is the way it looks where (a boy/girl) went swimming in the lake here. This is called a model. Here (pointing) is where he is swimming with his friends. And these are houses all around the lake. When he finishes swimming, he comes out of the lake and sees the houses like this. Now, you can spend as much time looking at this model as you want, but you must not touch or move anything on it, all right? Now, let's go around and stand in front of the copy here. What I want you to do is to put the houses on the copy so that when he comes out of the lake, he will see the houses exactly the same way that he sees them coming out of the lake in the model there (indicating). You can go back and look at the model as much as you want, and you can change anything on the Copy if you decide that it doesn't look right the way you have it. Do you understand? But remember, you mustn't touch or move anything on the model.

The instructions were repeated in full before the presentation of the second arrangement, but were discontinued if the subject insisted that he knew what to do. Subjects

who correctly positioned more than one item in either of the two trials were eliminated from further participation. Seventeen subjects were eliminated and replaced by other qualifying subjects.

Dyadic Pre-test. Subjects were randomly assigned to dyads in six groups of ten dyads each, with gender distribution as follows:

(1) Control Group: Male Dyads

(2) Control Group: Female Dyads

(3) Control Group: Mixed Dyads

(4) Experimental Group: Male Dyads

(5) Experimental Group: Female Dyads

(6) Experimental Group: Mixed Dyads

Subjects were brought to the test area in pairs, according to group, as determined by the random assignment to the groups indicated above. The procedure, including the instructions, was in every respect identical to that in the Individual Pre-test, except that the instructions were modified to satisfy the requirements for dyads, and was adopted from Bearison et al. (1986), as follows:

> **Now, when you put the houses down on the copy panel [indicating], you must both agree as to where each house belongs and how it should face. Do you both understand that? Good. You can take as much time as you**

> **want, but you must not touch or move anything on the model [indicating], and when you work on the copy you can discuss it with each other as much as you want. But you have to agree just how the houses should be. Do you have any questions?**

Two arrangements, identified as (m) and (o) in Figure 2 (p. 34), were presented on the model panel in counter-balanced order. The activity during the Dyadic Pre-test was videotaped. All subjects were administered the Dyadic Pre-test in pairs.

Dyadic Training. Training was given only to dyadic subjects in the experimental groups.

The investigator presented the signalling device and explained and demonstrated its operation, had each subject demonstrate knowledge of how to use it, and then said:

> **The three of us are going to have a little talk about something and we will practice using the signalling device during our talk. Listen carefully. If you [indicating] , say something and I don't agree with it, I will press my button on the signalling device. What do you think will happen? That's right [pressing it], it will make a sound and the light will come on. Now this is the really important part. When I press the**

> **button, I have to give a reason why I don't agree, do you understand? And the same will be true if you [indicating] disagree with something I say, or you disagree with something he says, you must--- What must you do? That's right: you will press your button and then say why you don't agree. Is that clear to both of you? Okay, this is what we will talk about:**
>
> **I think we should stop having the whole summer off from school and have regular classes the way we have them the rest of the year. [In actual practice a number of different topics were used, since the only purpose was to elicit disagreements and practice presses of the button on the part of each of the dyadic subjects.]**

The investigator sustained the discussion to provoke as many disagreements as possible so that subjects received ample practice in the expression of disagreement, the use of the signalling device, and the expression of a reason for disagreement. The investigator took care to use the signalling device when expressing disagreement and to give a reason for each disagreement. The investigator also prompted and admonished subjects who failed to use the signalling device or failed to provide a reason for disagreement. Once satisfied that the subjects fully understood the use of the

signalling device and were expressing reasons for disagreements, the investigator then proceeded to the next phase of the training, saying:

> **All right, I can see that both of you understand very well what you are supposed to do: You are to press your button on the signalling device if you don't agree, and say why you don't agree. Now the two of you will get some practice by yourselves. I want to show you what you'll be doing next.**

After presenting the balance-beam and weights, the experimenter continued, as in Martin (1983):

> **Do you know what this is? [Most said it was a scale]. Well, yes; it is kind of like a scale, only we call it a balance-beam. What does it remind you of? That's right; it reminds you of a see-saw. And it works just like a see-saw. I want both of you to look very carefully at how the weights are arranged on both sides of the balance-beam. Now each of these weights weighs exactly the same. Now when I take my hand away, one of three things can happen: it can tip to the right side, like this; or to the left side, like this; or it can stay even, like this. I want both of you to agree what the balance-beam**

> **will do, just the way you agreed on where the houses should go. I will accept only one answer and it has to be one that both of you share. You should discuss it out loud. If one of you says something and the other doesn't agree, then you will . . .That's right; you will press your button on the signalling device and say why you don't agree. Is there anything you don't understand?**

The investigator then presented 10 items from the balance-beam task in Phelps et al. (1987). During the practice sessions on the balance-beam items, the investigator admonished and prompted the subjects whenever one of them failed to press the button on the signalling device or furnish a reason during the course of expressing disagreement. Following the completion of the 10 items, the experimenter made the following statement, following the practice of Ringel and Springer (1980):

> **There is a very good reason you've been practicing to give a reason every time you disagree, and that's because we know it will help you to do things a lot better when you work together if you remember to always say why you disagree, not just in what you're doing now, but in almost everything. So no**

matter what you are doing, remember to give a reason every time you disagree with someone, and you'll find you'll do much, much better. Will you remember to do that? Good.

The entire activity during the training was videotaped.

Balance-Beam Task: Control Group Dyads. Ten balance-beam items adopted from the task in Phelps et al. (1987) and identical to those presented to Exerimental Group Dyads during the training were presented to the dyadic subjects in Dyadic Control Groups 1, 2, and 3. The instructions given were identical to those given to dyadic subjects in Dyadic Experimental Groups as to the nature and operation of the balance-beam and the need for agreement in predicting the attitude of the balance-beam. However, nothing was said about providing reasons for disagreement as was done in the case of the three Experimental Groups, and none of the dyadic subjects in the three Control Groups ever saw or had explained to them the use of the signalling device, nor were they told of the benefits of providing reasons for disagreements during dyadic activity.

The entire activity during work on the balance-beam task was videotaped for all dyads in the three Control Groups.

Dyadic Post-test. The Dyadic Post-test was administered immediately following the balance-beam task to dyads

in all groups, both Experimental and Control, and consisted of arrangements (g) and (h) of the spatial-relations task adopted from Bearison et al. (1986) and depicted in Figure 2 (p. 34). Dyadic partners were the same as in the Dyadic Pre-test. Prior to the Dyadic Post-test the investigator removed the signalling device which had been used during the training of dyads in the three Experimental Groups. The investigator customarily gave no explanation for the absence of the signalling device, but advised the dyadic subjects that they were to "do exactly asbefore", except that they would not be required to give the disagreement signal when disagreeing, as had been done during work on the balance beam activity. Instructions were otherwise the same as in the Dyadic Pre-test, except that when both subjects in the dyad indicated that they were already adequately familiar with the instructions, the instructions were discontinued.

All interactions during the Dyadic Post-test were videotaped for all groups, both Experimental and Control.

Individual Post-test. Immediately following the Dyadic Post-test,subjects were individually administered the Individual Post-test, consisting of arrangements (c) and (d), counterbalanced, of the spatial-relations task adopted

from Bearison et al. (1986), as depicted in Figure 2. The Individual Post-test was administered to all subjects, from both the Experimental and Control Group dyads. The administration and instruction corresponded in every respect to that in the Individual Pre-test. Since subjects worked alone, no mention was made of the need for agreement. Because there were no interaction behaviors to be observed, owing to the individual condition of the subjects, none of the performances were videotaped.

Measures

Following Bearison et al. (1986), the accuracy of the copies in the spatial-relations activity was measured by a *structural index score*. Likewise, *interaction scores* of the subjects in the dyadic activities represented the number of observations of specific interaction strategies.

Structural index score. Following the procedure used in Bearison et al. (1986), this score represented the accuracy of the placement of a house in the spatial-relations scene in terms of the orientation of the front side of the house relative to the mark. Transparent graph paper was used to verify accuracy, as in Bearison et al. (1986). A placement was deemed correct and received a structural index score of 1 if the house faced and was parallel within 30^{o} with the same edge of the base on the

copy as on the model. The position of the house in terms of distance from the mark, or from another house in the scene, or from any edge of the base, did not affect the score on this index. Because there were three houses in each scene, the structural index score for any given scene had a range of 0 to 3. Since two spatial-relations arrangements were presented in the pre- and post-test phases of the study, the total possible structural index score for single subjects in individual conditions, and dyads in the dyadic conditions, ranged from 0 to 6.

Interaction scores. These scores applied only to the dyadic interactions and were obtained by viewing videotapes made of the dyadic interactions and scoring them according to a coding system to indicate the occurrence of task-relative transactive behaviors between dyadic partners. Codings (a) through (e) were adopted from Bearison et al. (1986); (f) from Bearison and Filardo (1986); and (g) from Ausch (in preparation). Coding (h) was devised for this study in order to examine the possible inverse relationship between persistent, unjustified reiteration of previously stated positions and performance scores (in this case, the structural index score), first raised by Damon and Killen (1982), and later by Bearison et al. (1986).

Verbal disagreements without explanation. Any orally expressed statement that contradicts an immediately

preceding statement or a prior action of the other member of the dyad.

Verbal disagreements with explanation. Any orally expressed statement that contradicts an immediately preceding statement or a prior action of the other member of the dyad in which the contradicting statement is supported by a task-relevant explanation (e.g., "I don't think so, because you have the short side pointing the wrong way"; but not, "I just don't like it that way", or "It just doesn't look right that way").

Gestural disagreements. Shaking the head No to an action or proposal of one's partner, or indicating by pointing to a different arrangement and indicating assent to that arrangement.

Enactive disagreements. Changing an arrangement previously made by one's partner.

Verbal-enactive disagreements. Verbal disagreement, as defined under that heading above, accompanied by a displacement, as defined under enactive disagreements above. Since virtually all such disagreements coded included some kind of explanation, it was found to be unnecessary to include separate categories for this behavior.

Confirmations. Verbalizations or gestures (e.g., head nod) which supported a partner's task-relevant statements or activities. Repeated confirmations of the same statement or activity were counted only once, and confirmations of one's own statements or activity were not counted at all under this category.

Commands. Statements directing one's partner to make a specific placement.

Reaffirmations. Reiteration of a previous statement or disagreement, whether verbal or gestural, without offering an explanation (where none had been provided in the previous instance), or without enlarging upon or modifying an explanation previously given. Reaffirmations amount to blind, insistent positions that make no appeal to the reasoning of the other, but simply attempt to overwhelm by the force of repetition and intensity.

In addition, all interaction strategies coded above were further coded to indicate whether they constituted the immediate response of that subject to the disagreement-with-explanation of the other member of the dyad, for the purpose of determining how disagreements with explanation influenced the behavior of one's partner.

Inter-rater reliability. Reliability of the scoring of the protocols was determined by two independent coders scoring interactions from the protocols of randomly-selected dyads from two of the ten dyads in each of the six dyadic groups for a total of twelve, representing twenty per cent of dyads. All of the protocols were scored across all of the dyadic conditions, i.e., Dyadic Pre-test, Training (limited to Experimental Condition dyads), Balance-Beam Task, and Dyadic Post-test. The frequency of inter-rater agreements was summed and divided by the total number of agreements plus disagreements (No. of Agreements / No. of Agreements + No. of Disagreements) after Bearison et al. (1986).

The inter-rater reliability for all interaction strategies combined was .93, with reliability for individual interaction strategies ranging from .80 (five behaviors coded) to 1.00 (seventy-seven behaviors coded).

Chapter IV

Results

Two general types of data were generated from the procedures used in this study, Structural Index Scores and Proportion Scores for the Interaction Strategies. Structural Index Scores were defined as the number of correct placements on the spatial-relations task by individual subjects or subjects in dyads. Interaction Strategies Scores referred specifically to the behaviors of dyadic members during dyadic activity on the spatial-relations task.

Structural Index Scores: Individual Subjects

Following the Individual Pre-test on the spatial-relations task, subjects were randomly assigned to one of three dyadic groups (same-gender/male, same-gender female, or mixed-gender) and one of two conditions (control or experimental). This resulted in the creation of six groups of ten dyads each: Male-Male Control; Female-Female Control; Male-Female Control; Male-Male Experimental; Female-Female Experimental; and Male-Female Experimental. The Means and Standard Deviations of structural-index scores for the groups thus formed are shown in Table 2 for the Individual Pre-test, Dyadic Pre-Test, Individual Post-test and Dyadic Post-Test.

Table 2

Mean Structural Index Scores and (Standard Deviations) by Group for Individual and Dyadic Pre-test and Post-test

	Individual		Dyadic	
	Pre-test	Post-test	Pre-test	Post-test
Group				
Male Controls	.60 (.75)	1.85 (1.93)	1.20 (1.23)	2.70 (1.70)
Female Controls	.75 (.97)	1.90 (1.74)	1.20 (1.55)	2.60 (2.01)
Mixed Controls	.85 (.75)	2.15 (2.03)	1.80 (1.63)	2.80 (2.10)
Male Experimentals	.90 (.88)	3.45 (2.39)	3.40 (1.78)	3.80 (2.39)
Female Experimentals	1.00 (.79)	3.50 (2.37)	2.00 (2.40)	3.20 (2.70)
Mixed Experimentals	1.15 (.75)	3.10 (2.31)	3.50 (2.46)	3.70 (2.45)

Although assignment to the six dyadic groups had been carried out randomly, it was observed that subjects in all three dyadic groups in the control condition scored substantially lower on the Individual Pre-test Structural Index Score than subjects in the corresponding dyadic group in the experimental condition. To determine if these observed differences were significant, a one-way ANOVA was carried out on the the Individual Pre-test Structural Index Score for Male-Male Control and Experimental Dyads, for Female-Female Control and Experimental Dyads, and for Male-Female Control and Experimental Dyads. In all three instances, the observed differences in the means for the respective groups were found not significant.

However, because of the absolute size of these observed differences in the means, a decision was made to use the Individual Pre-test Structural Index Score as a Covariate in analyses testing the effects of interaction or changes in subjects' performances on post-interaction tasks.

Structural Index Scores: Individual Subjects

A 2 (Gender: Male, Female) x 3 (Group: Same-Gender/Male, Same-Gender/Female, Mixed-Gender) x 2 (Condition: Control, Experimental) ANCOVA, using Individual Pre-test Structural Index Score as the Covariate, was carried out on the Individual Post-test Structural Index Score. A Main Effect was found only for Condition: F (1, 111) = 6.20,

$p < .01$. A post-hoc Newman-Keuls Test showed that Experimental subjects in Male-Male Dyads scored significantly higher on the Individual Post-test Structural Index Score compared to Control subjects in Male-Male Dyads: $M = 3.45$ vs. 1.85, $p < .05$.; and that Experimental subjects in Female-Female Dyads scored significantly higher on the Individual Post-test Structural Index Score compared to Control subjects in Female-Female Dyads: $M = 3.50$ vs. 1.90, $p < .05$. No significant differences were found between Male Experimental and Control subjects in Mixed-Gender Dyads on the Individual Post-test Structural Index Score, nor between Female Experimental and Control subjects in Mixed-Gender Dyads on the Individual Post-test Structural Index Score.

There were no significant interactions.

A *t*-test for dependent samples was carried out comparing the mean structural index score of all subjects on the Individual Pre-test with the mean structural index score of all subjects on the individual post-test to investigate the general effect of dyadic interaction upon individual cognitive performance without regard to condition. Piaget (1985) suggests that dyadic interaction should benefit subjects generally, without regard to other forms of intervention being used. Results showed a significant difference between the Individual Pre-test and Individual Post-test means, favoring the Post-test ($M = .88$, $SD = .79$ vs. $M =$

2.66, SD = 2.22, resectively), $t_{119} = 9.57$, $p < .0001$.

A 2 (Gender: male, female) x 2 (Condition: control, experimental) ANCOVA wwas carried out on the Individual Post-test Structural Index Score, using the_Individual Pre-test Structural Index Score as covariate. Again, a significant main effect was found for condition, F (1, 115) = 8.93, $p < .01$. Analysis by post hoc Newman-Keuls test showed that experimental condition subjects scored significantly higher compared with control condition subjects on the individual post-test structural index score, controlling for pre-test differences (M = 3.35 v 1.97, $p < .05$).

There was no main effect for gender. Following training, there was no significant difference between female subjects and male subjects in the experimental condition on the individual post-test structural index score (M = 3.40 v 3.35).

There was no significant interaction effect gender by condition on the Individual Post-test Structural Index Score.

Structural Index Scores: Dyadic Subjects

Following random assignment of subjects to the six dyadic groups, all dyads were administered a Dyadic Pre-test, consisting of arrangements m and o from the spatial-relations task adopted from Bearison et al. (1986), as shown

in Figure 2 (p. 34). The Means and Standard Deviations of the structural-index score for the six dyadic groups on the Dyadic Pre-test are shown in Table 2 (p. 54).

It was noted that for each of the three Control condition groups the Mean Structural Index Score on the Dyadic Pre-test was less than for the corresponding Experimental condition groups. To determine whether or not the differences were statistically significant, a one-way ANOVA was carried out on the six levels of the Group variable with the Dyadic Pre-test Structural Index Score as the Dependent Variable. There was a significant effect for Group: F (5, 54) = 2.97, $p < .05$. A post hoc comparison by the Newman-Keuls method showed that Experimental condition dyads in Male-Male groups had significantly higher Dyadic Pre-test Structural Index Scores than corresponding Control condition dyads in Male-Male groups (M = 3.40 vs. 1.20; $p < .01$). No other differences were found to be statistically signifi-significant. On the basis of this finding, it was decided, as in the case with the Individual Post-test Structural Index Scores, to use Dyadic Pre-test Structural Index Scores as the Covariate in analyzing Dyadic Post-test Structural Index Scores on the spatial-relations task.

A 2 (Condition: Control, Experimental) x 3 (Group: Male-Male, Female-Female, Male-Female) ANCOVA, with the

Dyadic Pre-test Structural Index Score as the Covariate was carried out to analyze the Dyadic Post-test Structural Index Score. The Means and Standard Deviations for the Dyadic Post-test Structural Index Score for the six groups is shown in Table 2 (p. 54). No significant Main Effects or Interactions were found.

Proportion Scores of Interaction Strategies

The coded interaction strategies described under Measures were computed as to frequency from the videotapes made during the dyadic pre-test and post-test for the six dyadic groups and the frequencies obtained were converted to proportion scores by dividing the frequency of scores for each interaction strategy by the sum of frequency scores for all interaction strategies combined. The Enactive Disagreements strategy was collapsed into the Verbal-Enactive Disagrements strategy because examination of the videotapes showed that virtually all enactive disagreements included verbal explanation. The Means and Standard Deviations for the interaction strategies by group, for the dyadic pre-test are presented in Table 3, and for the dyadic post-test in Table 4. Prior to entering into statistical analysis the proportion scores for the eight interaction strategies were transformed by the arc-sine method.

Table 3

Mean and (Standard Deviation) of Proportion of Strategies During Interaction of the Dyadic Pre-test

	Control			Experimental		
Strategies	M/M	F/F	M/F	M/M	F/F	M/F
Verbal Disagreements w/Explanation	.09 (.10)	.02 (.03)	.05 (.08)	.26 (.12)	.31 (.21)	.21 (.17)
Verbal Disagreements w/o Explanation	.08 (.05)	.15 (.11)	.15 (.09)	.08 (.06)	.13 (.13)	.08 (.08)
Verbal-Enactive Disagreements	.28 (.09)	.38 (.15)	.26 (.11)	.26 (.10)	.14 (.09)	.24 (.14)
Gestural Disagreements	.03 (.03)	.01 (.04)	.05 (.10)	.01 (.01)	.00 (.01)	.02 (.05)
Commands	.16 (.11)	.10 (.07)	.08 (.08)	.10 (.07)	.07 (.06)	.07 (.07)
Confirmations	.19 (.07)	.23 (.13)	.37 (.19)	.24 (.11)	.27 (.28)	.32 (.15)
Reaffirmations	.17 (.14)	.10 (.14)	.04 (.07)	.07 (.10)	.07 (.13)	.06 (.12)

M=Male F=Female

Note: Vertical columns total less than 1.00 where there are no expressed behaviors by a dyad in the group.

Table 4

Mean and (Standard Deviation) of Proportion of Strategies During Interaction on the Dyadic Post-test

	Control			Experimental		
	M/M	F/F	M/F	M/M	F/F	M/F
Strategies						
Verbal Disagreements w/Explanation	.08 (.09)	.03 (.05)	.03 (.07)	.29 (.36)	.10 (.17)	.14 (.17)
Verbal Disagreements w/o Explanation	.15 (.18)	.06 (.10)	.09 (.17)	.03 (.07)	.05 (.16)	.00 (.00)
Verbal-Enactive Disagreements	.27 (.24)	.53 (.29)	.45 (.45)	.33 (.38)	.45 (.48)	.44 (.33)
Gestural Disagreements	.02 (.05)	.00 (.00)	.01 (.04)	.02 (.05)	.00 (.00)	.07 (.21)
Commands	.12 (.12)	.22 (.33)	.18 (.22)	.25 (.41)	.00 (.00)	.14 (.22)
Confirmations	.21 (.32)	.01 (.03)	.10 (.18)	.06 (.12)	.00 (.00)	.10 (.17)
Reaffirmations	.16 (.22)	.16 (.21)	.03 (.11)	.01 (.04)	.10 (.21)	.10 (.21)

M=Male F=Female

Note: Vertical columns total less than 1.00 where there are no expressed behaviors by a dyad in the group.

ANOVA on Proportion of Individual Interaction Strategies

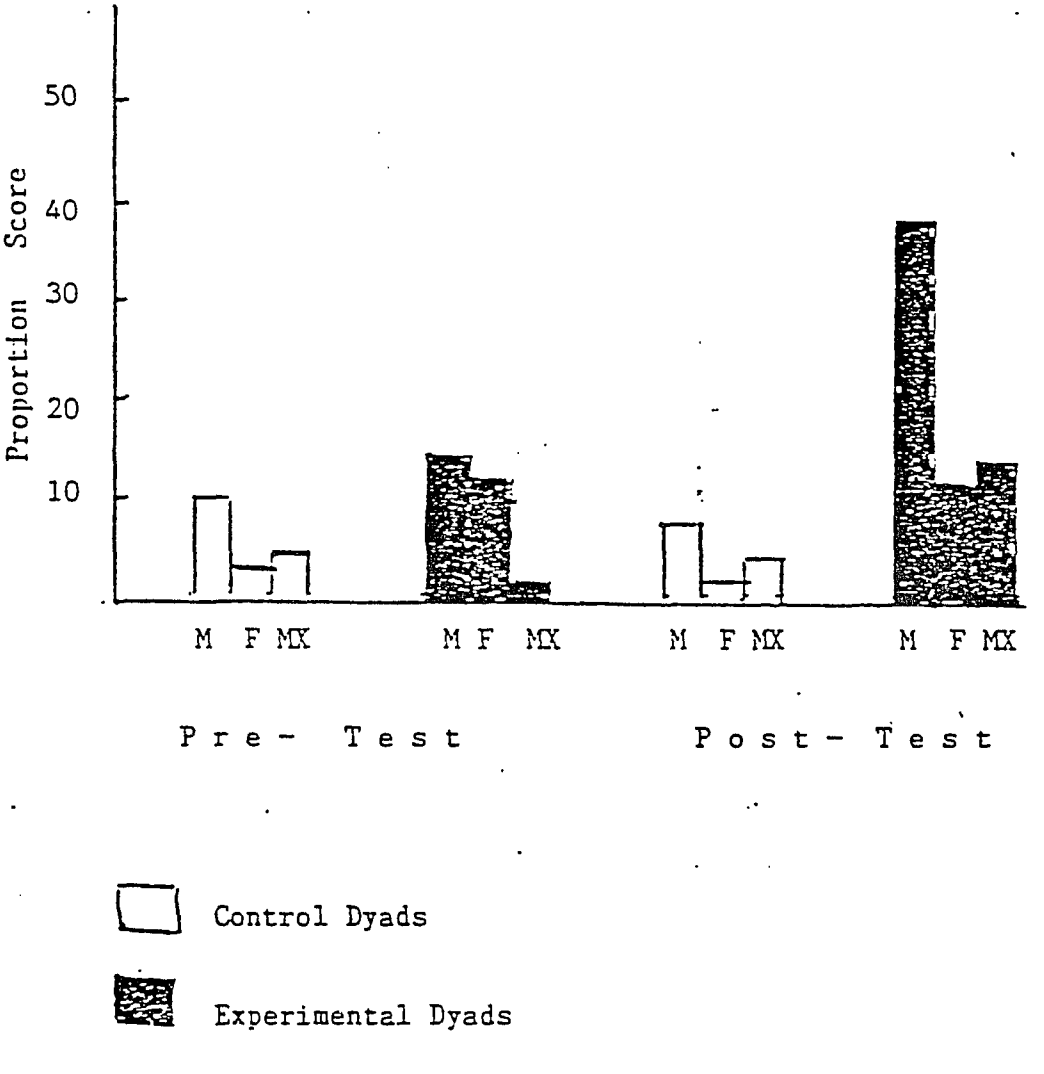
A 3 (Group: Same/Male, Same/Female, Mixed) x 2 (Condition: Control, Experimental) ANOVA was carried out individually on each of the eight interaction strategies for behaviors expressed during the dyadic pre-test. There were no significant main effects or interaction effects for any of the interaction strategies expressed during the dyadic pre-test.

A 3 (Group: Same/Male, Same/Female, Mixed) x 2 (Condition: Control, Experimental) ANCOVA was carried out individually on each of the eight interaction strategies for behaviors expressed during the dyadic post-test, using behavior expressed during the dyadic pre-test as covariate. There was a significant main effect for Condition on the Verbal Disagreements with Explanation interaction strategy, F (1, 53) = 8.06, p < .01. Post hoc analysis by the Newman-Keuls method showed that on the Verbal Disagreements with Explanation interaction strategy, Experimental dyads expressed a significantly higher proportion of this strategy compared to Control dyads (M = .18 v .05, p < .05). A comparson of experimental and control groups on use of this strategy is shown in Figure 6 for the Dyadic Pre-test and Dyadic Post-test.

There was a significant main effect for Condition on the Verbal Disagreements Without Explanation interaction

Figure 6

Proportion of Verbal Disagreements With Explanation By Group on Dyadic Pre-test and Dyadic Post-test



strategy, F (1, 53) = 6.89, p < .01. Control dyads expressed a significantly higher proportion of this interaction strategy compared with Experimental dyads (M = .10 v .03). There were no significant effects on any of the other interaction strategies expressed during the dyadic post-test.

Regression Analyses of Interaction Strategies on Dyadic and Individual Post-test Structural Index Scores

A Regression Analysis was carried out regressing stepwise and hierarchically Condition of the dyad during the interaction phase of the study and the proportion scores of the seven interaction strategies on the Dyadic Post-test structural index score, using the Dyadic Pre-test structural index score as covariate. None of the independent variables was found to be a significant predictor of the Dyadic Post-test structural index score. The Inter-correlation Matrix for the variables entered is presented in Table 5.

A regression analysis was carried out regressing stepwise and hierarchically gender, group, condition, the interaction strategies expressed by the subject himself or herself during dyadic interaction, and the interaction strategies expressed by the subject's partner during dyadic interaction, on the Individual Post-test structural index score, using the Individual Pre-test structural index score as covariate.

Table 5

Inter-Correlation Matrix for Variables Regressed on

Dyadic Post-test Structural Index Score

	CORRELATIONS					
variable	GROUP	PRETEST	POSTTEST	CONDITN	PCTPSVEN	PCTPSGES
GROUP	1.00000	.07043	.00000	.00000	.16407	.11131
PRETEST	.07043	1.00000	.61806	.38609	.00569	.20752
POSTTEST	.00000	.61806	1.00000	.19816	-.12004	.15072
CONDITN	.00000	.38609	.19816	1.00000	-.01054	.10625
PCTPSVEN	.16407	.00569	-.12004	-.01054	1.00000	-.05086
PCTPSGES	.11131	.20752	.15072	.10625	-.05086	1.00000
PCTPSCNF	-.07097	.07059	.09973	-.14046	-.33955	-.09677
PCTPSCOM	-.03819	.17371	.13078	-.08181	-.35989	-.11104
PCTPSAFF	-.04362	-.25138	-.10497	-.12583	-.10342	-.04336
PCTPSDEX	-.21223	-.02969	-.13771	.33420	-.36882	.01345
PCTPSDIS	-.13893	-.14992	.04951	-.27434	-.31660	-.05016

Table 5 (continued)

Inter-Correlation Matrix for Variables Regressed on

Dyadic Post-test Structural Index Score

	CORRELATIONS				
variable	PCTPSCNF	PCTPSCOM	PCTPSAFF	PCTPSDEX	PCTPSDIS
GROUP	−.07097	−.03819	−.04352	−.21223	−.13893
PRETEST	.07059	.17371	−.25138	−.02969	−.14992
POSTTEST	.09973	.13078	−.10497	−.13771	.04951
CONDITN	−.14046	−.08181	−.12583	.33420	−.27434
PCTPSVEN	−.33955	−.35989	−.10342	−.36882	−.31660
PCTPSGES	−.09677	−.11104	−.04335	.01345	−.05015
PCTPSCNF	1.00000	−.01508	−.19207	.04813	.10682
PCTPSCOM	−.01508	1.00000	−.23144	−.17789	.06463
PCTPSAFF	−.19207	−.23144	1.00000	.03330	−.13326
PCTPSDEX	.04813	−.17789	.03330	1.00000	.03713
PCTPSDIS	.10682	.06463	−.13326	.03713	1.00000

The Multiple R was significant, $R = .56$, $F\ (18, 101) = 2.57$, $p < .01$. Condition of the subject during the dyadic phase of the study, favoring the Experimental Condition, was a significant predictor, $B = .24$, $t_{101} = 2.34$, $p < .05$; and the subject's own Verbal-Enactive Disagreements with Explanation strategy expression was also a significant predictor, with increases in use of the Verbal-Enactive Disagreements With Explanation strategy resulting in increases in the Structural Index Score on the Individual Post-test, $B = .22$, $t_{101} = 2.27$, $p < .05$. No other interaction strategies expressed by the subject or subject's partner entered significantly into the regression equation. The Inter-correlation Matrix for the variables entered is presented in Table 6. The linear effect for the subject's own Verbal-Enactive Disagreements with Explanation strategy use on the Individual Post-test structural index score is depicted in Figure 7.

Table 6

Inter-Correlation Matrix for Variables Regressed on Individual Post-test Structural Index Score

	CORRELATIONS					
variable	GENDER	GROUP	PRETEST	POSTTEST	CONDITN	PCT_DEXA
GENDER	1.00000	.00000	.07373	.00377	.00000	-.17469
GROUP	.00000	1.00000	.11171	-.01068	.00000	-.07689
PRETEST	.07373	.11171	1.00000	.39855	.17985	-.09461
POSTTEST	.00377	-.01068	.39856	1.00000	.31327	.00308
CONDITN	.00000	.00000	.17985	.31327	1.00000	.27501
PCT_DEXA	-.17469	-.07689	-.09461	.00308	.27501	1.00000
PCT_DISA	-.01962	-.09704	.03147	-.03773	-.18103	-.07423
PCTVEN_A	.14478	.04455	-.03720	.02552	-.01991	-.25084
PCTGESTA	-.09929	.11824	.04054	-.02249	-.09232	.05136
PCTCNFMA	-.00047	.00876	.12970	.05243	-.14242	-.11842
PCTCMNDA	.12148	-.08514	-.19518	-.25300	-.09098	.00730
PCTAFRMA	-.13247	-.07689	-.08574	.01155	.29770	.28947
PCTDEX_B	-.10032	-.09704	-.05100	-.12133	-.18103	.22946
PCTDIS_B	.12266	.04455	.03882	.02766	-.02054	-.20701
PCTVEN_B	-.00275	.11778	-.04480	-.06317	-.09636	.09674
PCTGESTB	-.24016	.11824	-.08696	.01715	-.09232	.11285
PCTCNFMB	-.07058	.00876	.11314	.00201	-.15804	-.11184
PCTCMNDB	.02510	-.08514	-.16975	-.25550	-.07125	.09412
PCTAFRMB	-.11012	.11778	.09612	.10352	-.05506	-.03179

	CORRELATIONS					
variable	PCT_DISA	PCTVEN_A	PCTGESTA	PCTCNFMA	PCTCMNDA	PCTAFRMA
GENDER	-.01962	.14478	-.09929	-.00047	.12148	-.13247
GROUP	-.09704	.04455	.11824	.00876	-.08514	-.07689
PRETEST	.03147	-.03720	.04054	.12970	-.19518	-.08574
POSTTEST	-.03773	.02552	-.02249	.05243	-.25300	.01155
CONDITN	-.18103	-.01991	-.09232	-.14242	-.09098	.29770
PCT_DEXA	-.07423	-.25084	.05136	-.11842	.00730	.28947
PCT_DISA	1.00000	-.18378	-.02370	-.00640	-.08915	.22946
PCTVEN_A	-.18378	1.00000	-.23748	-.28260	-.07528	-.20701
PCTGESTA	-.02370	-.23748	1.00000	-.08873	-.12550	.11285
PCTCNFMA	-.00640	-.28260	-.08873	1.00000	-.17342	-.11184
PCTCMNDA	-.08915	-.07528	-.12550	-.17342	1.00000	.09412
PCTAFRMA	.22946	-.20701	.11285	-.11184	.09412	1.00000
PCTDEX_B	.05722	-.23466	.22978	.05523	-.08502	-.07423
PCTDIS_B	-.18466	.28999	-.19028	-.09607	-.01563	-.25084
PCTVEN_B	-.05635	.13474	-.05485	-.06569	-.02682	-.03179
PCTGESTB	.23978	-.19028	.04417	.18054	-.13498	.05135
PCTCNFMB	.05923	-.09607	.18054	.19589	-.15413	-.11842
PCTCMNDB	-.08502	-.01563	-.13498	-.15413	.76442	.00730
PCTAFRMB	.00746	-.09215	-.06109	-.05813	-.03195	.09674

NOTE: Final Letter-A = Subject's Own Behavior

Final Letter-B = Subject's Partner's Behavior

Table 6 (continued)

Inter-Correlation Matrix for Variables Regressed on Individual Post-test Structural Index Score

	CORRELATIONS					
variable	PCTDEX_B	PCTDIS_B	PCTVEN_B	PCTGESTB	PCTCNFMB	PCTCNNDB
GENDER	-.10032	.12256	-.00275	-.24016	-.07858	.02510
GROUP	-.09704	.04455	.11778	.11824	.08876	-.08514
PRETEST	-.05100	.03982	-.04480	-.08696	.11314	-.16975
POSTTEST	-.12133	.02766	-.06317	.01715	.08281	-.25558
CONDITN	-.18183	-.02854	-.09535	-.09222	-.15804	-.07125
PCT_DEXA	.22946	-.20781	.09674	.11285	-.11184	.09412
PCT_DISA	.05722	-.18466	-.05635	.23978	.05523	-.08582
PCTVEN_A	-.18455	.38999	.13474	-.19028	-.05587	-.01553
PCTGESTA	.23978	-.19028	-.05405	.04417	.18854	-.13498
PCTCNFMA	.05523	-.09607	-.06569	.18854	.18589	-.15413
PCTCNNDA	-.08582	-.01563	-.02582	-.13498	-.15413	.76442
PCTAFRMA	-.07423	-.25084	-.03179	.05135	-.11842	.00730
PCTDEX_B	1.00000	-.18378	.00746	-.02378	-.00548	-.08915
PCTDIS_B	-.18378	1.00000	-.09215	-.23748	-.28258	-.07528
PCTVEN_B	.00746	-.09215	1.00000	-.06109	-.05813	-.03195
PCTGESTB	-.02378	-.23748	-.06109	1.00000	-.08873	-.12558
PCTCNFMB	-.00548	-.28258	-.05813	-.08873	1.00000	-.17342
PCTCNNDB	-.08915	-.07528	-.03195	-.12558	-.17342	1.00000
PCTAFRMB	-.05525	.13474	-.02820	-.05405	-.05569	-.02582

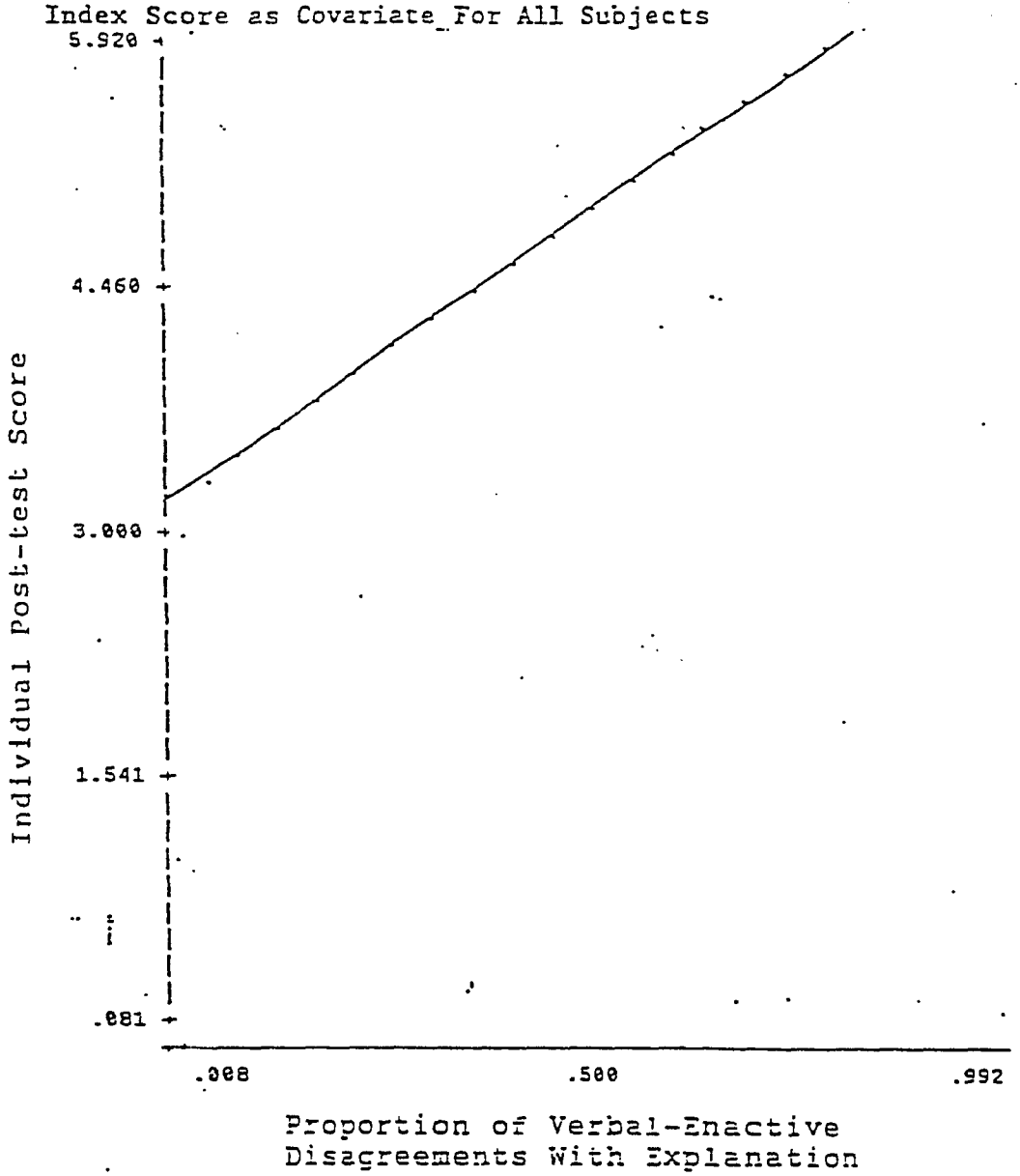
	CORRELATIONS
variable	PCTAFRMB
GENDER	-.11012
GROUP	.11778
PRETEST	.09612
POSTTEST	.10392
CONDITN	-.05586
PCT_DEXA	-.03179
PCT_DISA	.00746
PCTVEN_A	-.09215
PCTGESTA	-.06109
PCTCNFMA	-.05813
PCTCNNDA	-.03195
PCTAFRMA	.09674
PCTDEX_B	-.05635
PCTDIS_B	.13474
PCTVEN_B	-.02820
PCTGESTB	-.05405
PCTCNFMB	-.05569
PCTCNNDB	-.02582
PCTAFRMB	1.00000

NOTE: Final Letter-A = Subject's Own Behavior

Final Letter-B = Subject's Partner's Behavior

Figure 7

Regression of Subjects' Verbal-Enactive Disagreements With Explanation Proportion Score on Individual Post-test Structural Index Score With Individual Pre-test Structural Index Score as Covariate For All Subjects



Chapter V

Discussion

Substantiation of the Hypotheses

The present study had several major aims. One was to demonstrate the efficacy of dyadic interaction as a force in cognitive advancement, a finding earlier achieved in numerous studies (e.g., Berkowitz & Gibbs, 1983; Walker, 1983; Mugny & Doise, 1978). In the present study, both experimental and control subjects performed the spatial-relations task individually, both before and after dyadic interaction. When the individual pre-test mean structural index score, representing pre-dyadic performance, was compared with the individual post-test mean structural index score, representing post-dyadic performance, for experimental subjects as a group and control subjects as a group, the difference was significant for both groups.

Hypothesis #1 predicted that experimental and control subjects would show significantly higher individual post-test structural index scores compared with the individual pre-test structural index scores.

Hypothesis #1 was fully supported by the findings in the present study. The combined individual post-test structural index score for all groups significantly exceeded the combined individual Pre-test structural index score. Clearly, dyadic interaction was a significant force in

cognitive advancement for both experimental and control subjects.

The second aim of the present study was to increase the effectiveness of dyadic interaction in furthering cognitive advancement by increasing experimental dyads' use of justified disagreements, an interaction strategy found to be positively associated with cognitive gains (Bearison et al., 1986). It was expected that experimental dyads would show a significantly higher expression of justified disagreements interaction strategies on post-training dyadic interaction compared with pre-training dyadic interaction, and also a significantly higher expression on the dyadic post-test than control dyads; and that this significantly higher expression would result in significantly higher structural index scores on the dyadic post-test for experimental dyads compared with control dyads, as well as significantly higher dyadic post-test structural index scores compared with their own dyadic pre-test structural index scores. These expectations were embodied in Hypotheses #5, #6, #4, and #3, respectively.

Experimental dyads expressed a significantly higher proportion of explained disagreements during interaction on the dyadic post-test compared with control dyads (p. 61). Hypothesis #6 was thus fully supported by the results.

Hypothesis #5, however, was not supported by the

results. Differences in the expression of explained disagreements pre-training to post-training were not significant.

Hypothesis #4 likewise was not supported by the results. Although experimental dyads achieved a higher structural index score on the dyadic post-test compared with control dyads, the difference was found not to be significant when adjusted by the dyadic pre-test structural index score as the covariate.

A similar result was found with respect to Hypothesis #3. Although experimental dyads achieved a higher structural index score on the dyadic post-test compared with the dyadic pre-test, that difference was not significant. Hypothesis #3 was therefore not supported.

A further aim of the present study was to demonstrate that the cognitive gains achieved by subjects in experimental dyads during dyadic interaction would transfer after training to individual performance, such that experimental subjects would achieve a significantly higher structural index score on the individual post-test, compared with control subjects on the individual post-test, as predicted in Hypothesis #2. The hypothesized result was found on the analysis of the Individual Post-test Structural Index Scores. Hypothesis #2 was supported.

On the investigation of the ancillary questions, no significant relationship was found between the expression of explained disagreements and structural index scores on either the individual or the dyadic post-test. During pre-training dyadic interaction there was no significant difference between male and female dyads in the expression of verbal disagreements with explanation. Following training, experimental subjects showed a significant increase in the use of the verbal disagreements with explanation strategy compared with control subjects, but no significant difference was found between males and females in the expression of this strategy during post-training dyadic interaction.

There was no statistically significant difference between the individual post-test structural index scores of same gender experimental group subjects and mixed gender experimental group subjects. When adjusted by the dyadic pre-test structural index score as covariate, there was no statistically significant difference between dyadic post-test structural index scores of male dyads compared with female dyads, nor between experimental group males and experimental group females on the individual post-test structural index scores.

Summarizing, Hypotheses #1, #2, and #6 were all supported by the findings of the present study. Hypotheses #3,

#4, and #5 were not supported by the findings of the present study.

General Assessment of the Findings

The central questions in any consideration of dyadic interaction within the context of Piaget's theory have to do with the superior efficacy of inter-individually as opposed to intra-individually generated cognitive conflict in the first instance, and with the mechanisms that drive the process of inter-individually generated cognitive conflict as the second consideration. The accumulating evidence of research in recent years (e.g., Ames & Murray, 1982; Walker, 1983) suggests that for most researchers within the Piagetian approach the first question is well settled. Only within very recent years, however, has much attention been given to the second.

The present study was undertaken primarily for the purpose of investigating important questions raised in the theoretical writings and scholarly research of the past ten years bearing upon such important aspects of the conflict process as the identification of interaction strategies having significant impact upon cognitive gains (Bearison et al., 1986; Bearison & Filardo, 1986); the identification of interaction strategies that significantly interfere with the realization of cognitive gains (Damon & Killen, 1982; Bearison et al., 1986); and the degree of mutuality

optimally facilitative of productive interaction for the realization of cognitive gains (Bearison et al., 1986; Damon & Killen, 1982).

The present study, following Bearison et al. (1986), focused principally upon the interaction strategy of disagreements-with-explanation, an interaction strategy which was found in that study to be significantly positively associated with cognitive gains. The primary question sought to be answered by the present study narrowed down to (1) whether Bearison and his colleagues had identified a universally efficacious strategy, effective in dyadic interaction in general; and (2) whether it was possible to generally modify the interaction style of subjects to the end of generating significantly higher proportions of this interaction strategy, should it be found to be universally efficacious and not limited to the specifics of the Bearison et al. (1986) study.

The present study undertook to train subjects in the use of the disagreements-with-explanation interaction strategy. It is evident that subjects trained in the use of this strategy showed significant increases in the use of this strategy pre-training to post-training. In contrast, control dyad subjects, who did not receive training in the use of this interaction strategy, showed no change in the

use of this interaction strategy from the dyadic pre-test to the dyadic post-test. Thus, the initial question is satisfactorily answered: it is possible to increase the use of a specific interaction strategy by subjects through training.

In the present study, however, the investigators did not rely upon training alone to increase specific interaction strategy use. Rather, trained subjects were additionally instructed as to the benefits of use of the trained interaction strategy. Historically, one of the major shortcomings of training studies of this type has been the failure of trained subjects to utilize the training and to generalize it to tasks other than that on which the training had been given. The present study was carried out in such a way as to accomplish both objectives through the use of "informed" training on the one hand (Brown, Campione, & Day, 1980; Ringle & Springer, 1980), and also through the use of a "transfer task" in the dyadic post-test (Ringel & Springer, 1980). As a result, the measured increase in expression of the trained strategy by experimental dyad subjects reported above reflects both a use of the trained strategy and a generalization of the trained strategy to a task other than that on which the training had been given.

In the present study subjects were trained to express reasons for disagreements during dyadic interaction requiring consensus in predicting the attitude of a balance beam

following the placement of a number of weights on both sides of the fulcrum. During this training subjects were reminded by the experimenter to provide a reason for disagreement in those instances when they expressed disagreement without expressing a reason for disagreement. At the conclusion of the training they were told by the experimenter that the reason they had been trained to express reasons for disagreements was because persons who expressed reasons for disagreements performed much more successfully when doing something with another person than those who did not give reasons for disagreements. They were then observed for expression of disagreements with explanation on the dyadic post-test on the spatial-relations task.

The finding of a main effect for Condition on the Verbal Disagreements with Explanation interaction strategy, with experimental group dyads expressing a significantly higher proportion of this interaction strategy compared with control group dyads, was in complete accord with expectations. This result had been predicted as the outcome of training administered to experimental group dyads on this interaction strategy and the instruction as to the benefits to be gained from use of the strategy.

Although not explicitly offered, the assumption that offering explanations for disagreements results in higher

cognitive performance scores (in this case, structural-index scores) is central to the present study; without it, there would be no logical reason for instructing experimental dyad subjects in the use of this interaction strategy. The implicit argument of such a position is that the effect of the explanation is to either directly lead to cognitive reorganization in the partner to whom such explanation is offered, or to result in a subsequent expression on the part of the partner to whom offered that ultimately leads to cognitive reorganization in either or both of the partners.

What happened in the present study when subjects offered explanations for disagreements? Responses varied from counter-explanations (.36), questions (.13), to reaffirmations (.12). In a sizeable number of instances (.28) subjects made no response whatever to partner's explanation. However, when partner repeated the explanation--this occurred in slightly less than half the cases where no response was made in the first instance--subjects typically gave counter-explanations or expressed agreement with the explanation offered by partner. Reaffirmations tended to be over-represented in a quite small number of dyads and virtually non-existent in the remainder, whereas counter-explanations were more or less generally distributed across and within conditions and groups.

It is useful to examine the interactions of selected dyads for the purpose of following the role of the various interaction strategies. This dyad consists of two girls in the experimental condition interacting during the dyadic post-test. On the dyadic pre-test they achieved a score of 3; on the dyadic post-test they achieved a score of 5.

A (Picks up yellow house (c); undecided; starts to place it at top of panel opposite lake).

B Uh-uh; not there. (Lifts it, but unable to decide where it goes).

A Here (pointing to previous placement). Don't you see?

B No, not there. It's gotta face the blue one.

A Well, put the blue one--- (Tries to place blue house (a) opposite it)

B You see! It won't fit there.

A Well, it has to. You see (pointing to Model), it's on a long side (of the panel).

B Well--

A So it has to be here (placing it next to lake).

B No! (snatches it up). Can't you see it won't fit?

A Well, it has to. Look over there and---See, it's on the long side, you see?

B But there's no water near it.

A Well, uh--well--

B You see, the water's here (pointing) and the blue house is here (pointing).

A But it's the long side.

B Yeah, but away from the water. Let me--

A I'm going to do it.

B (Takes house and places it) Here. Now come look and see (pulling her by hand).

A (studying it). Well, I--I don't--

B But you--

A I'm gonna turn it like this...

B Well, uh--that's okay. You see now?

A Then the yellow one--

B I'll---No, let me--

A I'll do this one. (Sets down (c) with long side facing short side of Panel). But--no, I--shucks! This isn't right. I--What are you doing?

B This way (turning it with long side horrizontal and parallel to base). Well. I...

A Turn it more.

B How?

A The other way.

B No it doesn't go that way.

A Not like that. I mean this way (turning (c) so that the front faces the base of the Panel). See?

B Uh, well...

A I'm gonna do the red one. Let me.

B (gesturing) Over there?

A Well, it has to. There isn't anyplace else.

B Closer to the blue one.

A I'm gonna do this one.

B All right. You do it, then.

A (Places (b) with front correctly facing outer edge of Panel).

B Closer to the blue one (moving it).

A (Stares for about ten seconds, then shrugs).

Although the dyad has arrived at a correct placement of the houses, neither of the two girls at this point has a true understanding of the rule according to which correct placement is determined (i.e., orientation in reference to the lake). (A) believes that the length of the side of the panel provides an infallible basis for placement; but she ignores the fact that the panel has been rotated so that what is close to her on the Model Panel must be away from her on the Copy Panel. (B) arrives at the correct placement, but she is guided by how much space the blue house takes up. While this works for the blue house, which is quite large, it clearly would not work for either the red or yellow house, both of which fit easily into the space beside the lake. Observe, however, that on the Second Trial of the dyadic post-test, both girls appear to recognize the

preeminent importance of the lake as a reference point, while still failing to grasp the requirement for mental rotation. Here they show understanding of an important rule not shown on the First Trial, though, ironically, because of failure to use mental rotation, they achieve a lower score than on the First Trial.

B I'll do it now. You did it last one (picking up the blue house; puts it down to one side without placing it). No, this one (picking up yellow house). Uhhh, here (placing it correctly by the lake, but facing right, rather than toward lake).

A (picks up red house, then sets it down; turns yellow house so that the front faces the lake). Not, that way.

B But it's--(motions to lake).

A Yes, but, you see this (pointing to lake).

B I had it by the water before.

A Yes, but... (takes B by hand and walks her to stand in front of Model Panel; points to yellow house). See, it's turned that way (pointing).

B Well, I had it that way!

A You didn't.

B I did!

A But it wasn't like that. I made it that way, see.

B It always was like that.

A Uh-uh.

B Well it's right now.

A Yes; but I made it that way.

B (ignores it; picks up red house and places it about opposite the yellow house, faced correctly). Right?

A Well...

B Maybe it should be closer (moving it toward the center of the Panel, but still correctly oriented).

A (pushes it back some). That's too close. Now it's right.

B (makes to move it).

A Leave it!

B I wasn't going to move it. Only a little bit. Now the blue one--

A (picking it up). Here (placing it facing the outer edge, between the lake and the red house).

B That's too close.

A Leave it.

B But...(points to Model Panel; but neither girl moves from in front of Copy Panel).

A This is the way.

B I don't-- That looks like an awful lot of space.

A (points to yellow house) See?

B Uh... Okay.

A You see?

B I said okay.

A And the red house--

B (looks at researcher). All right.

A (nods affirmatively).

Here both girls accept the importance of the lake in orienting, but the further the house from the lake, the less importance they assign to the lake for orienting purposes. Thus, for the yellow house, which is beside the lake, the lake is recognized as the sole determinant of placement. For the blue house, however, they return to the rule of length-of-side. (B) appears to recognize something is wrong with the placement, but is unable to say what. Because of this, she readily yields when challenged by (A). Since there were only two trials on the dyadic post-test, we have no further opportunity to observe the resolution of her uncertainties in dyadic activity. Significantly, however, on the individual post-test, free from the influence of her partner, she apparently resolves the rule conflict according to her own understanding, scoring 5 in the two trials combined. Her partner scores 1, which is what she scored on the individual pre-test. Although (A) had shown a more correct understanding than (B) on the first trial, she shows evidence of decline on the subsequent trials after being permitted to prevail on erroneous judgment during the second trial on the dyadic post-test.

Relationship of the Interaction Strategies to Outcomes on the Dependent Measure (Structural Index Score)

Two general types of regressions of interaction strategy conflict scores on the structural index scores were undertaken, first on the dyadic post-test structural index score and then on the individual post-test structural index score. One purpose was to determine the relationship between dyadic interaction strategies and the dyadic post-test structural index score as evidence of the "transactive" character of the identified interaction strategies (Berkowitz & Gibbs, 1983). A second related purpose was to identify the individual subject's own interaction strategies and those of the subject's dyadic partner that most significantly contributed to the subject's individual post-test structural index score. These interaction strategies would likewise be "transactive". Comparison of the two groups of transactive behaviors would then reveal if any differences existed between strategies that would be transactive in the dyadic performance and those which would be transactive in terms of their effect upon individual performance.

Bearison et al. (1986) had found a curvilinear relationship between cognitive change scores and verbal disagreements with explanation interaction strategy, in which initial increases in expression of the strategy

resulted in corresponding increases in the cognitive change score. Beyond a point, however, increases in expression of the strategy resulted in reduced increases in cognitive change scores. In the present study, on all interaction strategies during the dyadic post-test the regression line either approached zero, or the number of cases available for the regression equation was too small to sustain a reliable regression equation for the sample as a whole.

When the subject's own interaction strategies were regressed on the subject's individual post-test structural index score, a significant positive linear relationship was found for the verbal-enactive disagreements with explanation interaction strategy. Verbal-enactive disagreements with explanation expressed by the subject during dyadic interaction were transactive (Berkowitz & Gibbs, 1983) in their effect upon the subject's subsequent performance on the individual post-test (Figure 8, p. 70). Such a finding is consistent with the expectations of transactive character found in Bearison et al. (1986), in their identification of this strategy for study of its transactive effects. While no such effects were found in their study, the finding in the present study lends further support to their position that explanation, by providing challenge and requiring consideration and response, possesses uniquely transactive character in dyadic interaction.

While at first glance these findings would seem to be in conflict with those in Bearison et al. (1986), especially with respect to the negative relationship for verbal disagreements with explanation interaction strategy of both the subject and the subject's partner, closer examination shows that the "conflict" may be more apparent than real.

It must be emphasized that the verbal-enactive disagreements with explanation interaction strategy, like the verbal disagreements with explanation interaction strategy, belongs to the class of "justification" conflicts. Instead of being a verbalized disagreement, it is a demonstrated disagreement, and therefore an elaborated version of the simpler interaction strategy, rather than an unrelated one. It is unreasonable to argue that the difference between the two is such as to be mutually exclusive; in fact, the verbal-enactive disagreements with explanation strategy includes every element of the verbal disagreements with explanation strategy, but simply adds a further element, that of demonstration. Accordingly, what is true as to the verbal-enactive disagreements with explanation interaction strategy does not of itself exclude the verbal disagreements with explanation interaction strategy.

The positive linear relationship between subject's own expression of the verbal-enactive disagreements with explanation interaction strategy on the one hand, and that

of subject's partner on the other hand, and subject's individual post-test structural index score, amounts to the clearest possible indication of the preeminent role of justified frms of disagreement in the inter-individual conflict process. It is thus a reaffirmation of the Bearison et al. (1986) selection of this interaction strategy for study.

The finding of a negative linear relationship between the subject's partner's reaffirmations interaction strategy use and the subject's own individual post-test structural index score supports the contention of Damon and Killen (1982), that a negative, conflicting style of interaction such as is represented in this interaction strategy is counter-productive to cognitive advance. Indirectly, this finding also lends further support to the beneficial effects of justified disagreement, since the distinguishing characteristic of the reaffirmations interaction strategy is one of obstinate, repetitious disagreement or assertion without offering any justification for one's position. Since such a strategy provides no basis for inviting cognitive restructuring, the finding of a negative relationship is not at all surprising.

One of the most important accomplishments of the present study was the success of experimental female subjects on the Individual Post-test. The mean structural index score for females was nonsignificantly higher than the

mean for experimental males, and significantly higher than the mean for control males and control females, which was true also for experimental males. One of the major aims of the present study was to overcome differences in male-female performance found in Bearison et al. (1986) by instructing females in the use of an effective transactive strategy. No such differences were found on the pre-test in the present study, and this relationship was sustained with respect to experimental males, and superiority achieved over both male and female control group subjects. Moreover, by its finding of a positive linear relationship between a justification strategy and cognitive performance, the present study has increased understanding of the transactive character of specific interaction strategies.

Some observations in the present study deserve explanation. Some interactions were marked by extensive interaction between the dyadic partners, while others were characterized by very little or, in a few cases, virtually none at all. The instructions to the dyadic partners emphasized that the subjects should jointly arrive at a decision for each placement. In some cases this is what actually took place; but those cases were in the minority. In many cases the subjects each went about making an independent placement, and then afterward assessed the accuracy of their own placement(s) and those of their

partner. Such a result can be explained. In those cases where subjects came to the task with a measure of confidence in their ability to perform it, the perceived need for confirmation of their judgments by their peers was apparently minimal (Bearison, 1982). Accordingly, it is possible to find high levels of success on the cognitive measure accompanied by paradoxically low frequencies of occurrence of transactive behaviors that, under most circumstances, would tend to account for those cognitive successes.

Comparison of Individual and Dyadic Pre-test to Post-test Changes on the Structural Index Score

On the Individual Post-test both experimental and control group subjects showed a significant increase from the Individual Pre-test Structural Index Score. However, no significant difference was found between the Dyadic Post-test Structual Index Score and the Dyadic Pre-test Structural Index Score, either for experimental dyads or control dyads. The average post-test score for the individual subjects was in excess of 2-1/2 times the pre-test score; the average post-test score for dyads was twice that of the pre-test score for control group dyads, and from as low as 7% to as high as 80% of the pre-test structural index score for experimental group dyads. The question as to why a doubling of the structural index score pre-test to post-test did not constitute a significant increase requires explanation.

There were 120 subjects taking part in the present study. Analyses of the structural index scores on the individual pre-test and individual post-test used the individual score as the unit of analysis. Under these conditions the likelihood of finding a significant effect is increased, even if the effect size is relatively small, because the number of degrees of freedom by which the within-subjects sum of squares will be divided will result in a smaller within-subjects mean square by which the mean square for effect will be divided, therefore producing a larger *F* value and a lower *p* value. With 120 individual subjects, within-subjects degrees of freedom amounts to 115. The greater the number of cases, the lower the effect size required for minimal significance.

In the analyses of the dyadic structural index scores, however, it is the dyad that is the unit of analysis; consequently, there are only 60 cases instead of 120, and the number of degrees of freedom is 53 instead of 111. Thus, with fewer degrees of freedom to divide into the within-subjects sum of squares, the within-subjects mean square is larger, so that when divided into the mean square for effect, the resulting *F* value is lower and the *p* value higher. It is worth noting that control group dyads showed a significant increase in the dyadic structural index score pre-test to post-test, whereas experimental group

dyads did not show a significant increase in the stuctural index score pre-test to post-test. The object of these observations is to illustrate how the design of the research may act to mask results which, achieved under a different design, would reach statistical significance. In the present study, the primary focus is upon the individual post-test, since it is the structural index score of the *individual* subject after training that provides a measure of the cognitive restructuring achieved through dyadic interaction that has been modified as a result of training. The ultimate value of the training, after all, is that it lead to enhanced performance in the individual; enhanced performance in a dyad that is not carried over to its individual members has very limited theoretical and practical implications. From a theoretical viewpoint it would reduce the effect of interaction to one of additive abilities; the two members of the dyad working together would be able to perform the task, but the contribution of each member would remain with himself alone. As on an assembly-line in an automobile factory, each would contribute to the end-product; but the work of neither would be influenced by the other, and no shared understanding of the process would emerge. In the process of dyadic interaction, however, as occurred both in the present study and in Bearison et al. (1986), the end-product resulted from collaboration.

Limitations Affecting Internal and External Validity of the Findings

Some caution is in order, both in the conclusions to be drawn as a result of observed differences between groups on the one hand, and in the generalization of the findings in the present study to a larger universe on the other hand.

The first concern is whether or not the observed differences between subjects in experimental and control dyads were the result of the treatment alone. The treatment in the present study consisted of training of subjects in experimental dyads to give reasons for disagreements, with subjects in control dyads not receiving such training. This was the only *intended* difference in the respective treatments, and for the purposes of this argument it is assumed that this was the only actual difference as well. It would thus seem to follow that any observed differences on the post-test measure would be due to the effects of the experimental treatment.

The problem with this conclusion is that the training was *not* the only treatment given to subjects. In addition to the training given to subjects in experimental dyads, *all* subjects—those in experimental dyads and those in control dyads—were videotaped during the entire dyadic interaction process. All subjects were aware of this; they saw the videocamera, they saw the experimenter operate it, and they

knew that they were being videotaped. That this knowledge of being videotaped influenced subjects in their behavior is immediately evident to anyone who views the videotapes. A very large percentage of subjects clearly "performed" for the camera; and it would be not at all unreasonable to assume that knowledge of being videotaped caused subjects to behave differently than they might have had there been no camera. From an experimental standpoint, then, whatever effects are found must be seen as the result of an interaction of the training (T_1) with the videotaping (T_2) for subjects in experimental dyads, and as a main effect for the videotaping (T_2) for subjects in control dyads. To say that since both experimental and control dyad subjects were videotaped that there is a "wash" as to the effect of the videotaping on subjects in the respective dyadic conditions is to ignore the role of the videotaping as a variable in its own right. Thus where differences favoring the experimental dyad subjects over control dyad subjects were found, it cannot be confidently claimed that the treatment alone, as opposed to the treatment interacting with the videotaping, accounted for such differences. Such a claim would have required that parallel experimental and control groups without videotaping be included in the experimental design (Campbell & Stanley, 1963), and this was not done.

The same concerns arise when efforts are made to generalize such findings to a larger universe. The purpose of the present research was to further the work of identifying transactive behaviors begun in Bearison et al. (1986), and to demonstrate that children could be trained to include trained transactive behaviors in their general interaction style, with a resulting advance in cognitive performance. The use of the videocamera was simply for the purpose of facilitating recording of the interaction process for the purpose of more accurate coding of the individual behavior strategies and was not intended to be an "active" part of the investigation. But where, as here, there is clear basis for a belief that the existence of the videocamera may have stimulated behavior on the part of the subjects that, in the absence of the videocamera, might very well have been different or even nonexistent, the effort to generalize these results to other children, however otherwise similar, who will not have their interactions videotaped, poses many problems.

Many of the potential problems discussed by Campbell and Stanley (1963) probably played only a very minor role in the present study. Taking history as an example, because the Individual Pre-test was in all cases followed by dyadic assignment, dyadic treatment/non-treatment, and the Dyadic and Individual Post-tests over the next day or two, the

probability of the occurrence of significantly different experiences for treatment as opposed to control subjects is likely to be very small. Moreover, the process of random assignment to control and experimental groups reduces even further the likelihood of any systematic differences along group lines.

The possibility of statistical regression, however, cannot be easily dismissed. This refers to the tendency for group means to shift toward the universal mean in a population where selection is based upon some extreme performance score (Campbell & Stanley, 1963, p. 10). In the present study, subjects were selected on the basis of scoring less than two on each of two Individual Pre-test trials (p. 40). Accordingly, all "average" or "above-average" performing children in the available population were eliminated from the sample, leaving only "below-average" or certainly "least able" children in the sample.

> Regression effects are thus inevitable accompaniments of imperfect test-retest correlation for groups *selected for their extremity* (Campbell & Stanley, 1963, p. 11).

An additional source of concern arises from the possibility of effects traceable to the very fact of testing, without any reference to the treatment. Under such a condition, the very act of being tested on an artificial task

is considered to exercise some influence. If one allows that "test anxiety" may act to depress performance, one must allow the equal possibility that testing effects may act to enhance performance. While this enhancement would presumably be approximately equal in both experimental and control dyad subjects and thus play no role in producing any differences between them found on either the Dyadic or Individual Post-test, testing effects could contribute to the pre-test to post-test gain. In such a case it could hardly be said that the treatment alone accounted for the pre-test to post-test gain, and failure to consider the effects of testing, either as an independent variable or as an independent variable interacting with the treatment, videotaping, or both, will result in overestimation of the effects of the treatment. Unfortunately, while design changes would make it possible to overcome the effects of videotaping, no such simple solution is available with respect to possible testing effects in the present study. The customary method of overcoming possible testing effects is to employ a measure normal to the activity of the subjects and to administer it under conditions indistinguishable from those under which it is normally taken. This was not possible in the present study, since the choice of task was determined by that used in earlier studies, and use of any other task would have made it

impossible to compare the findings in the present study with those of previous studies upon which the present study was based.

These questions are raised here as meriting consideration when evaluating the results of the present study. Further examination may lead to the conclusion that their effects are likely to have been minimal and that they may therefore be disregarded. On the other hand--and this seems the more likely--they may require further investigation before any satisfactory conclusions may be drawn as to the importance of the role they may have played in bringing about the results in the present study.

Educational Implications of the Findings

What significance ought to be read into the findings in the present study with respect to important educational concerns? Recent research into small-group learning in schools modeled on the sociolinguistic paradigm suggests that educators are coming to realize that the process of successful interaction is by no means easy to predict. It had long been thought that gender, more than anything else, tended to shape the character of interaction (Wilkinson, 1982). The results of the present study, however, do not support such a conclusion. There were no main effects for gender on any of the cognitive measures or interaction

strategies. Condition of the subject determined performance on the cognitive measure, and also determined use of the trained strategy. Such a finding holds out considerable promise that the success of intervention, at least as it applies to the narrow purpose of the present study, need not be gender-influenced, and that interventions targeted to address the needs of members of a specific gender can be successful.

School learning tasks typically fall into one of two classes. The first of these depends heavily upon rote memorization, the second upon the development of heuristics, in many cases to aid in determination as to the algorithm to be applied in the solution of the problem. In the latter class of learning task the dynamics of the interaction play a critical role in determining whether or not the group will arrive at the correct judgment, especially in cases where, as in the present study, neither of the parties to the interaction possesses a knowledge as to the end-state sought to be achieved. (It is to be remembered that in the present study, all of the participants had demonstrated inability to correctly work out the solution.) By identifying interaction strategies most conducive to successful cooperative performance, and in so doing reaffirming the earlier finding in Bearison et al. (1986), the results of the present study clearly indicate that the key to successful small-group

learning in the school lies in the development by the teacher of efficacious interaction strategies as part of the general interaction style of the students *in advance of* an effort to promote small group learning of the subject material. It now appears certain that the most efficacious interaction strategy consists of giving explanations for disagreements, whether verbal or demonstration with verbalization (verbal-enactive disagreement with explanation).

The present study has demonstrated that it is possible to teach primary-grade students to modify their interaction style, *provided that the students are made to understand the benefits of the interaction strategy they are instructed to use.* While the present study, by providing instruction as to the benefits of use of the strategy to *all* experimental group subjects trained in the use of the strategy, did not provide for an uninstructed experimental group as a control against the instructed groups(s), the influence of the instruction in assuring increased use can be reasonably inferred from the very substantial increase in the utilization of the strategy in the course of dyadic interaction following training.

It has thus been demonstrated by the present study that targeted interaction strategies can be introduced and/or increased by training. The targeted interaction strategies can act to improve cognitive performance, by promoting

a style of interaction that is optimal for increasing the potential for successful performance. Classroom teachers may prepare their students for small-group learning activity by first training them in the use of identified transactive interaction strategies, and then instructing them in the benefits of use of the trained interaction strategies. On the basis of the results achieved in the present study, an improved cognitive performance can be expected to result.

Suggested Future Research

Bearison et al. (1986) succeeded in identifying a major transactive behavior. The present study has demonstrated that subjects can be trained to use specific transactive behaviors and that the use of the trained behaviors will produce an enhanced cognitive performance. It has added to knowledge of transactive behaviors, but much remains to be discovered. There is a need for further study of the dynamics of the interaction process. Webb (1982-a, -b) studied interaction in groups that were composed of larger numbers of participants at an older age, but the focus of investigation in both studies was upon a single behavior, of receiving replies to questions. What is needed is a study of broader scope, capable of capturing a more complete picture of transactive behavior.

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