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SOCIAL INTERACTION, VERBAL COMMUNICATION, AND COGNITIVE DEVELOPMENT

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SOCIAL INTERACTION, VERBAL COMMUNICATION,

AND COGNITIVE DEVELOPMENT

by

BARRY D. WEINSTEIN

A dissertation submitted to the Graduate Faculty in Educational Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

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INTRODUCTION

In recent years there has been growing criticism of Piagetian theory and research that has been concerned primarily with the nonsocial world, that is, the concepts of time, space, number, and conservation, to name a few. The dialectical viewpoint, most notably espoused by Riegel (1975), has argued that the Piagetian emphasis on the child's interactions with objects fails to "consider that the most important objects are other subjects who, like the child, operate actively ... upon other subjects" (Riegel, 1976, p. 691).

Social cognitive research utilizing experimental paradigms adapted from studies of the nonsocial world has been subject to similar criticism. Early social cognitive research was aimed at developing formal stage models describing qualitative changes of how children organize their knowledge about the social world. Such experimental paradigms have been criticized not only because they artificially strip cognition of its usual social character by examining the accommodatory and assimilatory processes but also because they have failed to recognize the dialectical nature of children's construction of knowledge through their interaction with others (Damon, 1979; Riegel, 1979).

However, the recognition that social processes are central to the child's construction of knowledge, whether physical or social, has long been recognized by Piaget (1932, 1972). "Human intelligence develops in the individual in terms of social interactions--too often disregarded" (1971, pp. 224-225).

It is perhaps both the depth and breadth of Piaget's work on the more impersonal categories of experience as well as his later writings on the equilibration model (1977a, 1977b) that led researchers to direct their interests towards the more impersonal areas of cognition. The familiar and often cited example of the child's discovery of the conservation of number through his active manipulation of pebbles (Piaget, 1970) appears to ignore the social context in which knowledge is truly communicated, shared, and where exchanges of differing viewpoints occur. Chandler (1977), on the other hand, has argued that Piaget's theory does not distinguish between nonsocial and social cognition, for all cognitions are social in origin. Knowledge does not develop in a vacuum but instead is co-constructed by children as they interact with others and exchange viewpoints that differ from their own. "It is precisely by a constant interchange of thought with others that we are able to decentralize ourselves in this way, to coordinate internally relations from different veiwpoints" (Piaget, 1950, p. 164).

The view that knowledge of the physical and social world may in fact be better understood within the social context in which it is constructed has led Bearison (1983) to conclude that "social cognition not only reflects the development of social knowledge but also the social development of knowledge. All knowledge is inherently social in that the ontogenesis of mental development is motivated and maintained by social discourse" (p. 202).

Piaget's theory of cognitive development clearly reflects this perspective. According to Piaget (1971) "the most remarkable aspect in which human knowledge is built up ... is that it has a collective as well as individual nature" (p. 359). In his analysis of moral judgment, Piaget (1932) attributes the child's movement from a "morality of constraint" to a "morality of cooperation" to his or her interactions with peers. It is through children's cooperation with their peers and their exposure to contrasting and conflicting viewpoints that they are liberated from their moral realism. The social context in which knowledge is constructed is also reflected in Piaget's model regarding the isomorphism between the reciprocity of the logical grouping and social cooperation. "In the realm of knowledge, it seems obvious that individual operations of the intelligence and operations making for exchanges in cognitive cooperation are one and the same thing, 'the general coordation of actions' to which we have continually referred being an interindividual as well as an intraindividual coordination because such actions can be collective as well as executed by individuals" (Piaget, 1971, p. 360).

A constructivist-developmental perspective underscores children's interactions with the world about them, a world comprised of other social beings. It is this social world which presents children with viewpoints differing from their own and which obliges them to coordinate their actions with those around them. It is through this *general coordination of actions* that knowledge is constructed. This dialectical relationship between children and others forms the basis for the development of knowledge. While Piaget (1965) has presented a model which details the existing isomorphism between the operational structures and the structures which underlie children's social exchanges (e.g., cooperation) little light has been shed on the relationship between social interaction and cognitive development. Piaget thought it was impossible to develop a causal link between the development of "social logic" and the development of "individual logic" since they are said to "constitute two inseparable aspects of a single reality, at once social and individual" (Piaget, 1964, p. 158).

The examination of the role of social interaction in the development of cognition has evolved from two different theoretical models: social learning theory and the developmental psychology of Piaget. Social learning theory as formulated by Bandura (1971, 1977) depicts rule learning through modeling as the specified form of social interaction in which cognitive concepts are attained. Piaget's equilibration model (Piaget, 1971) describes the process of cognitive restructuring whereby children move from one level of cognitive development of the next higher stage. Disequilibrium created by the discrepant feedback from children's actions on the environment and their existing cognitive structure results in a new and more equilibrated cognitive structure. More recent research conducted in Geneva has stressed a "socio-cognitive conflict model" (Doise & Mackie, 1981) which emphasizes both the social and cognitive aspects of conflicts generated within the context of children's interactions with others.

Social Learning Model

Social learning theory views the child's behavioral and conceptual acquisitions as the result of imitation or modeling. Social learning theorists, however, stress that the vicarious learning of such concepts as conservation is a socially mediated form of rule learning. Such factors as the model's ability to present the rules in a clear and consistent manner are emphasized (Zimmerman, 1977).

A study by Rosenthal and Zimmerman (1972) was one of the first to examine the influence of modeling on children's conservation performances. First-grade children were pretested on the Goldschmid and Bentler Concept Assessment Kit (1968) in order to determine their level of conservation. Nonconserving children were either assigned to an experimental modeling condition or to a control condition. In the modeling condition children observed an adult female who gave conservation responses to six different tasks. Following this session all of the children were posttested using the same pretest items. In order to study the transfer of conservation to new tasks, a parallel test form was administered. The control group did not observe the model but were given the same tests as the modeling group. The results indicated that nonconserving children who witnessed a conserving model made significant gains on conservation tasks compared to children in the control group. As a further indication of the efficacy of modeling, Rosenthal and Zimmerman found that conservers who viewed a nonconserving model significantly reduced their conservation judgments on the immediate posttest.

Other studies (Zimmerman & Lanaro, 1974; Zimmerman & Rosenthal, 1974) have also provided empirical support for the positive effects of observing an adult model on children's conservation performances. Murray's (1974) research provided further clarification of the magnitude of modeling effects by examining both children's initial level of development and the types of models that were observed. Initial pretesting of childred ages 5 to 10 years on the conservation of substance-clay and substance-liquid identified three levels of concept attainment. Conservers were defined as children who achieved a perfect score on both conservation tasks, nonconservers by their failure on both tasks, while partial conservers only correctly answered one of the tasks. The results of this study indicated that positive modeling effects were dependent upon the child's initial level of cognitive development. Partial conserving children benefited from observing a conserving peer model. However, nonconserving children who had observed the same conserving model made no progress. In contrast to the findings of Rosenthal and Zimmerman (1972), where regression in performance was observed in conserving children who had viewed a conconserving model, children who had witnessed a nonconserving model did not regress. Conserving as well as partially conserving children were more likely to remain at their initial pretest level than either regress or advance.

Cognitive Conflict Model

Piaget's model of equilibration provides the framework in which cognitive conflict is viewed as the central process by which structural changes in children's thinking occur. Research based upon Piaget's equilibration model (1971) has involved methods whereby disequilibration is experimentally induced by introducing external perturbations (Langer, 1969).

Training studies which have utilized the concept of cognitive conflict as a means of empirically demonstrating Piaget's equilibration model have offered differing definitions of conflict. The learning studies of Inhelder, Sinclair, and Bovet (1974) have identified two different types of conflict that underlie the transition from one mode of thought to another. The first type of conflict is that which emerges between two different and conflicting "subsystems" or schemata which are brought into play with one another. The second type of conflict is between the child's existing hypotheses or inferences which are not in accord with his observations gained from the experimental manipulation of physical reality. The disequilibrium which results from these conflicts necessitates an attempt to coordinate and reconcile differences on a more structurally elaborate level.

Kuhn's (1972) study sought to explicate the mechanisms related to structural change by contrasting Piaget's equilibration model with an imitation model. Children aged 4, 6, and 8 years were pretested to determine their initial classification stage level. Each child was then exposed to an adult model who performed either (a) at the same stage as the child but in a manner different in content from theirs, (b) at a stage one below the child's, (c) at one stage above the child's, or (d) at two stages above the child's. Following the modeling phase each child was then immediately posttested on the classification tasks and a week later administered a second posttest. The results indicated that the greatest change occurred in the condition where children viewed an adult model perform one stage above their own. In comparison, less change occurred where children observed a model perform two stages above theirs, while the least amount of change occurred in the conditions where classification behavior of the same stage or one stage below was observed.

Kuhn's (1972) results suggested that there was an optimal distance or mismatch between the child's developmental level and the developmental level demonstrated by the model whereby cognitive conflict can occur and lead to structural advancement. Thus, models who were one stage above the child's were found to be effective in bringing about cognitive reorganization and structural change. Their efficacy, however, was not in determining the form of cognitive change, but rather acting as a source of stimulation of cognitive growth in the direction of more advanced levels of development. Kuhn's (1972) theoretical explanation of the structural changes in children's classification behavior was based upon an equilibration model. Her experimental procedures, however, made use of models in producing conflicts between both the child's and model's developmental levels.

Murray (1972), in comparison, used an experimental methodology in which groups consisting of two conservers and one nonconserver were formed. To assess conservation, children 6 years of age were individually pretested on the Concept Assessment Kit (Goldschmid & Bentler, 1968). In another session each group was again given the identical conservation tasks and were instructed that they were to agree on one answer to each of the problems. When there was disagreement they were asked to discuss the problem and provide explanations for their judgments. A week after the social interaction phase all children were individually posttested on a parallel form of the pretest, followed by a test of two new concepts (conservation of length and area). Posttest scores were compared with the normative data provided by Goldschmid and Bentler. It was found that nonconservers made significant progress on the conservation posttests. There was also evidence of generalization to the new concepts of conservation. Social interaction, which entailed being subjected to contrasting perspectives, not only promoted nonconservers' cognitive development, but also conserving children benefited as well.

While Murray (1972) initially based his study on a cognitive conflict hypothesis, his discussion of the results appeared equivocal as to whether social interaction and conflict were important mediators of cognitive growth: "It is not clear what the nonconservers learned in the social situations that sustained them in the individual situation" (p. 5). Murray considered that the observed advances may have been due to modeling rather than the communication or peer interactions. In later research, Murray, Ames, and Botvin (1977) suggested that cognitive dissonance could facilitate cognitive growth.

Murray's (1972) research has been subject to several criticisms. Kuhn (1972) criticized the study for failing to provide a description of the communication conflicts which took place during the interaction phase. An analysis of the discussions would provide much needed information regarding the types of communications that were effective in advancing cognitive development. Perret-Clermont (1980) indicated that while the "experiment shows that interaction between peers can change operational behaviors, the significance of these changes at the level of cognitive structures still needs to be evaluated" (p. 40). Murray's data did not permit such a distinction because the posttest mean scores of nonconservers who made progress did not clearly indicate whether they were the result of operational explanations or simply correct judgments.

In a study reported by Silverman and Stone (1972) there was further evidence that conservation can be acquired by nonconservers who interacted with conserving children. Third-grade children were pretested on conservation-of-area tasks. Dyads were formed each consisting of a nonconserver and conserver. During the social interaction phase, dyads were informed of the differences on their pretest responses and were requested that they now reach an agreement. A control group had no opportunity for peer interaction. One month later all of the children were individually posttested. In the experimental group, nonconservers who adopted conservation responses during the interaction phase continued to give conserving responses on the posttests. In comparison, control children did not evidence any shift in conservation. While there were indications of a transfer of conservation to two new tasks, in only one instance was there an argument which was not previously provided during the dyad's interactions.

In a later study, Silverman and Geiringer (1973) provided additional support for Piaget's equilibration model and for the hypothesis that social interaction facilitates cognitive development. Using a similar experimental methodology as Silverman and Stone (1972) but including four conservation tasks (length, number, substance, and weight), first-grade conservers and nonconservers were paired together. It was found that nonconservers who had agreed upon a conserving answer during the social interaction phase made significant gains on all the tasks. Conserving children who had yielded to nonconservers later gave conserving responses on the posttests. These findings paralleled those found by Silverman and Stone (1972) where nonconservers made progress when they faced another's viewpoint which conflicted with their own, and conservers who interacted with nonconservers did not regress.

The failure to find reversals in conservation, as found by Rosenthal and Zimmerman (1972), led Silverman and Geiringer to consider whether subjects in that study may have interpreted the experimenter's instructions as a request to copy the model's nonconserving behaviors. Robert and Charbonneau (1978) found that reversals in conservation occurred only in the presence of an adult experimenter. Robert and Charbonneau argued that conservation reversals brought about by modeling procedures may be a function of subject's submissiveness to social influence features in the experimental procedures. The findings of the Rosenthal and Zimmerman study also raise questions as to whether or not modeling procedures can effect structural changes in conservation reasoning. Rosenthal and Zimmerman (1972) found that the effectiveness of models in reducing conservation responses were present only in the imitation phase, during which the pretest tasks were given, but not in the generalization phase.

In contrast to the conflict-equilibration model, proponents of the social learning approach have sought to explain concept attainment following interaction as a case of rule learning involving imitation of the modeled correct conserving response. Botvin and Murray (1975) sought to compare the efficacy of peer modeling with that of social conflict. Nonconserving first-grade children and conserving second-grade children were assigned to one of three treatment conditions: (a) a social interaction group, (b) a modeling group, and (c) a control group which consisted of only nonconservers. While finding significant differences on the posttest scores between the control group and both experimental groups, there was no significant difference between the gains made by children in the social interaction group and those who observed a model. Thus, social interaction and modeling were found to be equally effective in promoting conservation. Botvin and Muray, therefore, concluded that the "social conflict training effect itself may be attributed more parsimoniously to the nonconserver's modeling of the conservers than to the effects of his repeated communication conflicts with them" (p. 799).

Sociocognitive Conflict Model

The sociocognitive conflict model proposes that neither a social learning model nor a strict cognitive conflict model is sufficient to explain the role of social interaction in cognitive development. Both approaches, according to Doise and Mackie (1981), "have tended to reduce interaction members to mere producers of cognitive conflict in one case, or to correct response models in the others" (p. 59). The sociocognitive conflict model, in contrast, emphasizes both the social and cognitive aspects of conflicts experienced during social interaction.

In recent years, there have been a number of studies conducted at the University of Geneva by Willem Doise and his colleagues which have demonstrated that "in certain conditions, a situation of social interaction which requires subjects to coordinate either their actions or their points of view can bring about a modification in their individual cognitive structure" (Perret-Clermont, 1980, p. 169).

Several experimental paradigms have been employed in order to examine the influence of social interaction on cognitive development. The hypothesis underlying these studies has been that "conflicts of cognitive centrations embedded in a social situation are a more powerful factor in cognitive development than a conflict of individual centrations alone" (Doise & Mugny, 1979, p. 105).

A number of studies (Doise & Mugny, 1979; Doise, Mugny, & Perret-Clermont, 1975; Mugny & Doise, 1978) have used a spatial transformation task based upon Piaget and Inhelder's (1956) three mountains experiment. The task, as constructed by Doise and his colleagues, presented children with a model village consisting of three or four houses position on a cardboard base. Each base had a "mark" which served as a reference point for the orientation to the base. The children were then given the task of constructing the same village on another base positioned to the left of the model at a 90° angle.

In these studies it has been found that pairs of children who worked together successfully performed a task of spatial coordinations which children of the same age, working individually, were not capable of performing (Doise et al., 1975). The findings indicated that the success of any one individual was not sufficient to account for the more successful collective performances.

In another experiment Mugny and Doise (1978) further explored the role of sociocognitive conflict in the development of operational structures. First, children ages 5 to 7 years were individually pretested on the spatial transformation task. They were classified according to three levels: total compensation (advanced), partial compensation (intermediate), and no compensation (inferior). In the experimental situations inferior level children worked either with other children at the same inferior level or with children at the intermediate level, or with advanced level children. In another condition two children at the same intermediate level were paired together. During the collective interaction phase dyads worked together until they reached an agreement based upon their reconstruction of the model village. One week later all of the children were individually posttested. The results indicated that collective performances were better if one of the children were at a higher level. Dyads of inferior and intermediate level children were able to solve tasks collectively which neither one was able to do on the pretest. No progress occurred when inferior level children worked together, since utilizing the same noncompensating strategies did not produce conflict. In contrast, the greatest progress was found where children at different levels worked together. When inferior and intermediate level children interacted with one another, the former as well as the latter child made progress. Mugny and Doise interpreted this as demonstrating that even where correct solutions are not advanced, cognitive progress can occur when cognitive conflict is socially created and resolved. However, when an inferior level child interacted with an advanced level child, the former did not make any progress. Thus, while conflict may be a necessary condition for change it is in itself not sufficient to guarantee progress.

An analysis of the interactions which took place revealed that the advanced level child tended to carry out and solve the task on his own, ignoring the inferior child's remarks. This created a situation in which the latter child had no opportunity to actively participate and coordinate his point of view with that of his partner's. This finding suggests that when conflict is not socially expressed or communicated, progress is less likely to occur.

These findings differ from those of Murray (1974) and Silverman and Geiringer (1973) in that progress did take place in conditions where children, neither of whom were operating on an advanced level, had an opportunity to exchange conflicting perspectives. The findings that both inferior and intermediate level children demonstrated cognitive growth also stands in contrast to Kuhn's (1972) conclusion that models whose reasoning levels are one stage directly above that of the child's are the most effective in bringing about structural change. Further evidence that children need not interact with an advanced partner in order to demonstrate cognitive growth was provided by Bearison (1983). In his study, the most progress was made by dyads whose initial pretest scores were zero on a spatial perspective task.

In a later study, Doise and Mugny (1979) provided evidence to suggest that children who were involved in interindividual conflicts of centrations demonstrated relatively superior performances on a spatial coordination task compared to children who were confronted with their own contradictory responses. After being pretested on a task of spatial transformation, children identified as inferior or intermediate level on their pretest were retained for the experimental phase. Pairs of children at the same cognitive level worked together at opposite sides of the table where the experimental material was arranged. In the control condition, individual children were allowed to move from one viewing point to the other at the opposite side in order to determine whether children who worked from successive opposed viewpoints also experienced conflict. The results of the study indicated that children in the interindividual conditions showed more progress than children in the intraindividual conditions. Thus it seems that children who were confronted with a contrasting point of view in a dyadic exchange and were led to coordinate their perspectives and resolve their differences outper-performed peers who did not partake in a social exchange. Social communication of conflict, or what has been termed "sociocognitive conflict," appears to be an important factor in the determination of cognitive development.

Doise et al. (1975), employing a task of liquid conservation from Piaget and Szeminska (1952), sought to demonstrate that cognitive growth takes place through social interaction not simply by modeling others' behaviors.

Initially, children aged 6 and 7 years were pretested to determine their operational level of development: nonconserver, intermediate, and conserver. Groups were formed consisting of two conservers paired with either a nonconserver or an intermediate conserver. Nonconserving and intermediate level children were instructed to pour juice into their partner's different shaped glasses so that there was agreement that each partner had an equal amount to drink. One week following the interaction phase, nonconserving and intermediate level children were posttested, and after a 1-month interval a second posttest was administered. In a control condition, children were only pretested and posttested. The results indicated that a significant number of nonconserving and intermediate level children progressed on the first posttest when compared to children in the control group. Further analysis of the delayed posttest indicated that progress was stable over time attesting to a process of a continuing structural development. Even more important was the qualitative analysis of the explanations given at the posttest. Former nonconserving children provided novel arguments which were not evident either during their pretest or in their interaction session.

Perret-Clermont's (1980) replication of a study conducted by Doise et al. (1975) also found that children who attained conservation of liquid generalized their attainment to the conservation of matter and length.

Studies reviewed so far have provided empirical support for the sociocognitive conflict hypothesis. Cognitive growth takes place when, during the course of social interaction, children experience conflicts of cognitive centrations in a social interchange. "The interaction obliges the subject to coordinate their actions with those of others, and this brings about a decentration in the encounter with other points of view which can only be assimilated if cognitive re-structuring takes place" (Perret-Clermont, 1980, p. 148).

Doise, Mugny, and Perret-Clermont (1976) studied whether children would exhibit cognitive advancement after interacting with an adult who also was operating at the same cognitive level as the children but whose solutions were opposed to theirs. Only children who were nonconservers were used in the study. In one experimental condition the children, after having acknowledged the equal lengths of two parallel rulers, subsequently claimed that one ruler was longer after it had been displaced. In response to this, the adult pointed to the other end of the other ruler and claimed it to be longer. This judgment, like that of the children's, was also incorrect, but it was based on a symmetrically opposed centration. In another condition the adult provided a correct judgment and explanation of conservation. In the control condition, children were presented with two rulers of equal length and, after watching four displacements, were asked if they were of equal length. It was found that in comparison to the control condition only children in the two experimental groups made progress in the conservation of equality on both the immediate and delayed posttests. An examination of the arguments provided by the children indicated that the vast majority of explanations were novel and could not be accounted for by the process of simply imitating the adult model.

In two other studies, Mugny, Giroud, and Doise (1978, 1979) used the conservation of length paradigm to evaluate the effects of sociocognitive conflict on children's cognitive development. In the first experiment children who systematically complied with the experimenter's contradictory responses made no progress. In comparison, children who consistently opposed the experimenter's responses attained conservation. In the second experiment, two nonconserving children were seated at opposite sides of a table in which one or two rulers was displaced. On posttests of equality, children whose interactions were conflictual made significantly more progress than children who did not experience conflict. Children in a control group who attempted to solve the conservation problem individually made no progress.

Summary

The role of social interaction in children's cognitive development can be traced to Piaget's (1932) seminal work, The Moral Judgment of the Child. However, cognitive developmental research based upon Piaget's writings focused primarily upon the ontogenesis of the child's cognitive structures as he or she interacted with the nonsocial world.

Nearly two decades ago, Smedslund (1966) argued that the focus of cognitive developmental research should move away from emphasizing children's interactions with the nonsocial world and concentrate upon social interactions between children.

Studies which have investigated the role of social interaction in children's acquisitions of cognitive concepts generally fall into three cateogires. Social learning studies involve a subject observing the performance of a peer or adult who provides a correct solution to a cognitive task (e.g., conservation). Studies based upon Piaget's (1977) equilibration model involve a subject interacting with a peer who provides a correct solution, as may be the case when a nonconserver is paired together with a conserver. More recently, research studies conducted by Doise and his colleagues have investigated how subjects who offer different, and not simply correct, solutions both profit from their social interactions.

Social interaction studies compared to modeling studies hypothesize that conflict through social interaction is a sufficient condition to promote cognitive growth. The cognitive gains evidenced by children in social interaction studies reflect a reorganization of the individual's cognitive structures and not simply the transmission of information generated by the interaction. Doise et al. (1978) and Ames (1980), for example, found that children made cognitive gains after being presented with solutions which were incorrect but contradictory to their own.

The mechanisms which have been used to explain the effects of social interaction on cognitive development reflect essential differences between the social learning model and the cognitive conflict model of development.

Social learning theory has attempted to explain the cognitive gains made by children who have observed peer or adult models as the result of modeling rule-consistent behaviors. In comparison, cognitive developmental theory has attempted to explain cognitive gains made by children in social interaction as the result of cognitive conflicts which oblige them to coordinate and reconcile contrasting viewpoints.

Chapter II

STATEMENT OF THE PROBLEM AND HYPOTHESES

Statement of the Problem

Genevan research has provided a much needed clarification of the role played by social interaction in the development of cognition. Social interaction research has specified the conditions which appear sufficient to facilitate cognitive development. These experimental conditions involve collective situations during which children are confronted with viewpoints which differ from their own.

Although research conducted within the sociocognitive conflict model has systematically varied the abilities of the partners in social interaction according to their pretest scores, little is known about what particular aspects of the interaction experience contributes to cognitive development. Piaget (1926) has indicated that repeated conflicts of communication are necessary for the children to advance from one stage to another. However, few studies have examined the social communications which reliably account for development. Bearison (1983) has stated that while "there is little doubt that peer conflict generated in the course of social interaction promotes cognitive development ... it is necessary to determine what particular aspects of the interactive experience ... facilitate cognitive growth" (p. 209). Doise and Mugny (1975) have shown that preventing verbal communication between children impedes progress. However, Doise and his colleagues have not analyzed children's social communications while participating in collective problem-solving tasks.

Miller and Brownell (1975) and Cooper (1980) appear to be some of the few that have included verbal measures that describe the interactions that take place between children as they work on cognitive tasks.

In the study conducted by Miller and Brownell (1975), pairs of nonconserver and conserver children worked together on conservation of length and weight tasks. An analysis of the interaction revealed several measures on which conservers differed from nonconservers: "explains answer," "counters other," and "moves or suggests moving stimuli." Cooper's (1980) research, which examined specific communication behaviors that facilitated young children's collaborative problem-solving efforts, found that "questions" and "directives" were associated with task success. In addition, children's use of "attention focusing" statements, "accurate attributes," "evaluative feedback," and "relevant comments" were also related to successful performance. On the other hand, the use of "inaccurate attributes" and "irrelevant comments" were associated with lack of success.

The purpose of the present study was to investigate the role played by social interaction in the development of conservation in young children. Consistent with a sociocognitive conflict model of cognitive development, it was hypothesized that the efficacy of social interaction on development was due to the reciprocal coordination of mutual points of view between particular subejcts. One way to test this hypothesis was to compare subjects in the social interaction condition to subjects who were exposed to the same task-relevant verbal statements and behavior as the interacting subjects but for whom these statements and behaviors were passively perceived instead of interactively generated in the process of social discourse.

In order to gain a better understanding of congitive conflict and its role in children's cognitive development, an analysis was made of children's social interactive exchanges during a series of conservation problems. Sociocognitive conflict, as defined by Perret-Clermont (1980), involved a social situation "in which an individual's strategy is explicitly contradicted by another person's strategy" (p. 31). In keeping with this definition, one aspect of this conflict was where one child's conserving/nonconserving judgment was rebutted by another child. This type of conflict--disagreement of respective centrations--was examined in order to differentiate what types of nonconforming statements were associated with cognitive gains achieved on conservation tasks.

Hypotheses

1. It was hypothesized that nonconservers who had an opportunity to engage in social interaction with intermediate level conservers and thus participate in an exchange of viewpoints would make significantly greater cognitive progress than nonconservers who only observed the social interaction.

2. It was hypothesized that nonconservers who engaged in social interaction would make significantly greater cognitive progress than nonconservers who worked alone.

3. It was hypothesized that intermediate level conservers who had an opportunity to engage in social interaction with nonconservers and thus participate in an exchange of viewpoints would make significantly greater cognitive progress than intermediate level conservers who only observed the interaction.

4. It was hypothesized that intermediate level conservers who engaged in social interaction would make significantly greater cognitive progress than intermediate conservers who worked alone.

5. It was hypothesized that the frequency of task-relevant disagreements during social interaction would be positively correlated with cognitive gains among experimental subjects.

Chapter III

METHOD

Subjects

The sample consisted of 80 first-grade children, 40 boys and 40 girls. They were from three schools located in a predominantly lower-middle-class area of New York City. The average age of the children was 6 year 6 months. The age range was from 6 year 4 months to 6 years 8 months.

Test Instrument

Forms A and B of the Concept Assessment Kit--Conservation (Goldschmid & Bentler, 1968) were used to assess conservation abilities. Forms A and B consist of six conservation problems: two-dimensional space, substance, continuous quantity, weight, and discontinuous quantity.

Psychometric and statistical properties of the conservation kit are provided by Goldschmid and Bentler. Kuder-Richardson-20 internal consistency reliability coefficients of .96 for judgments and .95 for explanations were obtained, indicating a high level of internal consistency for the items. Intercorrelation of the test scores on Forms A and B resulted in a correlation of .90

indicating that both judgments and explanations were measuring the same construct across the tasks. Multidimensional homogeneity scaling yielded a coefficient of .98 in which one dimension was interpreted as "conservation."

Scoring

One point was given for each problem which included both a correct conservation judgment and explanation that noted either reversibility (e.g., "if you roll the hot dog back it is the same as the ball"), compensation (e.g., "the hot dog and the ball are the same because the hot dog is longer but it is also skinner"), or invariant quantity (e.g., "the ball and hot dog are the same 'cause you did not add or take any clay away"). Scores ranged from 0 to 6.

Procedure

Subjects were individually pretested on Form A. Subjects who attained scores of 0 or 1 were classified as nonconservers; subjects who attained scores of either 2 or 3 were classified as intermediate conservers. Subjects who attained scores of 4, 5, or 6 were classified as conservers and were dropped from the study. There was a total of five subjects who attained one of these scores.

Nonconserver and intermediate conservers were randomly assigned to one of three conditions: (a) social interaction, (b) observer control, and (c) standard control. The social interaction condition consisted of 20 nonconservers paired with 20 intermediate conservers, 10 male dyads and 10 female dyads.

Four control groups were formed. There were two observation control groups. One group consisted of 10 individual intermediate conservers, 5 males and 5 females. The other observation control group consisted of 10 individual nonconservers, 5 males and 5 females. Two traditional control groups were also formed. One control group consisted of 10 individual intermediate conservers, 5 males and 5 females. The other traditional control group consisted of 10 individual nonconservers, 5 males and 5 females.

Approximately 1 week after the pretest (Form A), dyads from the social interaction group were given the same conservation problems used in the pretest. For 10 of the dyads in the social interaction group an intermediate conserver from the observation control group was present to observe each dyad work together on the pretest conservation problems. For the other 10 dyads in the social interaction group a nonconserver from the observation control group was present to observe each dyad work together. Subjects from the observation control group were always of the same sex as the dyads they were observing. During the same time period, both intermediate conservers and nonconservers from the traditional control group were individually given the pretest conservation problems.

The experimenter escorted each dyad from the social interaction group along with the respective observer to a room where the conservation tasks were presented. After seating each dyad at the table, the observer was given a seat at a vantage point where the dyad and the conservation materials were easily seen.

The experimenter turned to the observer and said, "Please just watch these two children play these games. You will play these games at another time." The experimenter then turned to the dyad and said "[name of the observer] is here in the room just to watch you play these games. Please do not talk to him/her while you play."

After the experimenter presented these preliminary directions, each dyad was given the following instructions: "Remember these games? We are going to play with them again. This time I would like you both to play together. I want you to talk to each other about what you think. If you don't agree with each other, I want you to talk and explain to each other why you think the way you do. I want you to agree on one answer. Now watch what I do."

The experimenter then proceeded to present each of the tasks, beginning with the conservation of two-dimensional space. In each of the six conservation tasks the experimenter arranged the conservation materials so as to establish the equality of the objects (e.g., two squares composed of small wood blocks, two balls of play doh). After the subjects agreed to the equality of the two objects the experimenter than transformed one of the objects (e.g., the blocks from one of the squares were rearranged to make a pyramid, one of the two clay balls was rolled into a hot dog). Following the transformation, each subject in the dyad was asked to tell the other his or her judgment as to whether the stimulus materials were still equal or whether one had more (or less) and to discuss their reasons why they thought so.

Subjects in the dyads were permitted to manipulate the conservation materials, but the experimenter gave no information or reinforcement for the positions or reasoning that they advanced. In order to maintain a flow of discussion, if either subject in the dyad did not respond to the other's statement after a period of 10 seconds the experimenter interved by asking, "What do you think?" The discussion was completed when, after a 10-second interval, there was no further response by the subjects to the experimenter's question.

The subjects' verbal interactions were tape-recorded and classified according to four categories of disagreement. A "disagreement" was operationally defined as statements made between two subjects such that one subject's assertion (judgment/explanation) was different than the immediately prior assertion (judgment/explanation) made by the other subject. The four categories of disagreement were as follows.

1. Disagreements with correct justification were defined as follows. One subject's assertion that following the transformation there was no longer equivalence between the stimulus materials was countered by the other subject's assertion that in spite of the changes there was still equivalence. The latter subject also supported his or her position by providing an argument based upon either compensation, invariant quantity, or reversibility. For example, in the conservation of substance task when the play doh was rolled into a hog dog, one subject stated, "There is more here in the hot dog; it goes out to here; it's longer." The other subject countered, "No, you're wrong. They're still both the same. The hot dog is longer but you see it's also thinner" (compensation); or "No, they are still both the same; you didn't add or take anything away, so they're still both the same" (invariant quantity; or "No, they're still the same 'cause if you take this hot dog and roll it back it would be the same as the ball" (reversibility).

Situations where both subjects provided conserving judgments and offered differing but equally correct arguments were not considered to be disagreements with correct justification. For example, one subject provided a conserving judgment on the conservation of substance task with an explanation based upon a compensation argument. The other subject disagreed with the explanation and in turn offered an explanation based upon reversibility.

2. Diagreements with incorrect justification were defined as follows. (a) One subject's assertion of the continuing equivalence of the stimulus materials was countered by the other subject's assertion that they were no longer the same. The latter subject supported his or her position by an argument based upon a perceptual theme. For example, in the conservation of number task one subject stated, "There is still the same number of red chips as white chips 'cause you didn't add or take any away." The other subject responded, "I think you're wrong. The chips are spread out to here; that's why there are more here." (b) One subject's assertion that there was no longer equivalence between the materials after the transformation was countered by the other subject's assertion that the physical property was conserved. The latter subject, however, supported his or her position with an incorrect explanation. For example, one subject stated, "There are more chips here 'cause they go all the way out to here." The other subject responded, "No, there is still the same number of white chips and red chips 'cause they look the same." (c) Both subjects denied conservation but both disagreed as to which of the stimulus materials had more.

Each of the subjects provided their own incorrect explanation. For example, in the conservation of discontinuous quantity task, one subject stated, "The large cup has more corn; you see, the corn goes up higher." The other subject responded, "No, there is more corn in these cups here. You see, there are five of them. That's more than this one cup."

3. Disagreements with irrelevant justification were defined as follows. (a) One subject's assertion of the continuing equivalence of the stimulus materials was countered by the other subject's assertion that they were no longer the same. The latter subject, however, supported his or her position by an argument which was unrelated to the task. For example, in the conservation of substance task one subject stated, "They are the same. The hot dog is longer, but it's also skinnier than the ball." The other subject responded, "No, the ball has more play doh 'cause I like the ball better." (b) One subject's assertion that there was no longer equivalence between the materials was countered by the other subject's assertion that the physical property was conserved. The latter subject, however, provided an explanation unrelated to the task. For example, in the conservation of two-dimensional space task one subject stated, "The tower has more wood than the square 'cause it goes higher up." The other subject responded, "They're both the same 'cause

my teacher said so." In this example the latter position was supported by a "magical" justification which was irrelevant to the task. (c) Both subjects denied conservation of the stimulus property but disagreed as to which of the stimulus materials had more. Each of the subjects provided their own irrelevant explanation. For example, in the conservation of number task one subject stated, "There are more white chips 'cause the white ones are nicer." The other subject responded, "No, there are more reds. You see, the reds are the best."

4. Disagreements with no justification were defined as follows. (a) One subject's assertion of the continuing equivalence of the stimulus materials was countered by the other subject's assertion that they were no longer the same. The latter subject, however, failed to provide an explanation to support his or her position. For example, in the conservation of weight task one subject stated, "They weigh the same; you didn't add or take away anything." The other subject responded, "No, the ball weighs more." (b) One subject's assertion that there was no longer equivalence between the stimulus material was countered by the other subject's assertion that the physical property was conserved. The latter subject, however, failed to provide any explanation for his or her position. For example, in the conservation of discontinuous quantity task one subject stated, "The big glass has more corn

'cause it goes up higher." The other subject responded, "No, it doesn't. They both have the same amount of corn," with no further explanation offered. (c) Both subjects denied conservation of the stimulus properly but disagreed as to which of the stimulus materials had more. Each of the subjects, however, failed to provide any explanation for their respective position. For example, in the conservation of two-dimensional space task one subject stated, "The square one has more wood." The other subject responded, "No, you're wrong. The tower has more."

Approximately 2 weeks after the social interaction phase and after the subjects in the traditional control group had been presented the pretest conservation tasks, all of the subjects were individually posttested on Form B of the concept assessment kit.

Chapter IV

RESULTS

There were three principal analyses of the data. The first analysis was to determine whether or not there were significant differences in mean gain scores between subjects in the social interaction, observer, and control conditions. The second analysis was to determine whether or not there were significant differences between the number of subjects in the social interaction and observer conditions who provided novel explanations for conservation on the posttest. The third analysis was to determine the relationship between disagreement categories and pretest-to-posttest gain scores among the experimental subjects.

Results of the Pretest

Table 1 presents the distribution of pretest scores on the Goldschmid and Bentler conservation test. A total of 110 subjects were pretested, of which 80 participated in the study.

Social Interaction and Cognitive Development

The subjects in the social interaction condition were compared to subjects who were in observation and

Table 1

Distribution of Pretest Scores[a]

Pretest scores	Total number of subjects pretested	Number of subjects in study
0	51	32
1	8	8
2	33	28
3	13	12
4	1	0
5	1	0
6	3	0

[a]Subjects with pretest scores of 4, 5, or 6 were not included in the study.

traditional control conditions with respect to their pretest-to-posttest cognitive gain scores. The mean conservation scores and standard deviations for the social interaction, observer, and control conditions are presented in Table 2. Figures 1 and 2 present the mean pretest and posttest conservation scores for both pretest nonconservers and pretest intermediate conservers.

Two 3 x 2 (condition [social interaction, observer, and control] by sex [male and female]) analyses of covariance of posttest minus pretest conservation scores were conducted, one for pretest nonconserving subjects and one for pretest intermediate conserving subjects. The pretest conservation scores were used as the covariate.

The analysis of covariance for pretest nonconservers (presented in Table 3) revealed a significant main effect for condition ($\underline{F}[2,33] = 19.90$, $\underline{p} < .0001$). A Scheffé post-hoc analysis indicated that pretest nonconservers in the social interaction condition had significantly greater mean gain scores ($\overline{X} = 3.5$ vs. .29, $\underline{p} < .01$) than pretest nonconservers in the observer condition and in the control group ($\overline{X} = 3.5$ vs. 0.0, $\underline{p} < .01$). There were no significant differences in the mean gain scores between pretest nonconservers in the observer condition and pretest nonconservers in the control condition. There was no significant sex main effect or condition by sex interaction.

Table 2

Mean Conservation Scores and Standard Deviations for Experimental and Control Groups

	Conditions					
	Social interaction		Observer		Control	
Trial	NC[a]	IC	NC	IC	NC	IC
Pretest						
$\bar{X}$	0.15	2.45	0.30	2.10	0.20	2.20
SD	0.37	0.51	0.48	0.32	0.42	0.42
n	20	20	10	10	10	10
Posttest						
$\bar{X}$	3.65	4.85	0.60	1.70	0.20	2.40
SD	2.21	1.63	1.07	1.77	0.42	1.58
n	20	20	10	10	10	10

[a]Pretest conservation levels: NC = nonconserver, IC = intermediate conserver.

Table 3

Analysis of Covariance of Nonconservers' Gain Scores

Source of variation	SS	df	MS	F	p
Condition	110.67	2	55.33	19.90	.0001
Sex	3.02	1	3.02	1.09	n.s.
Condition x sex	4.26	2	2.13	0.77	n.s.
Error	91.78	33	2.78		

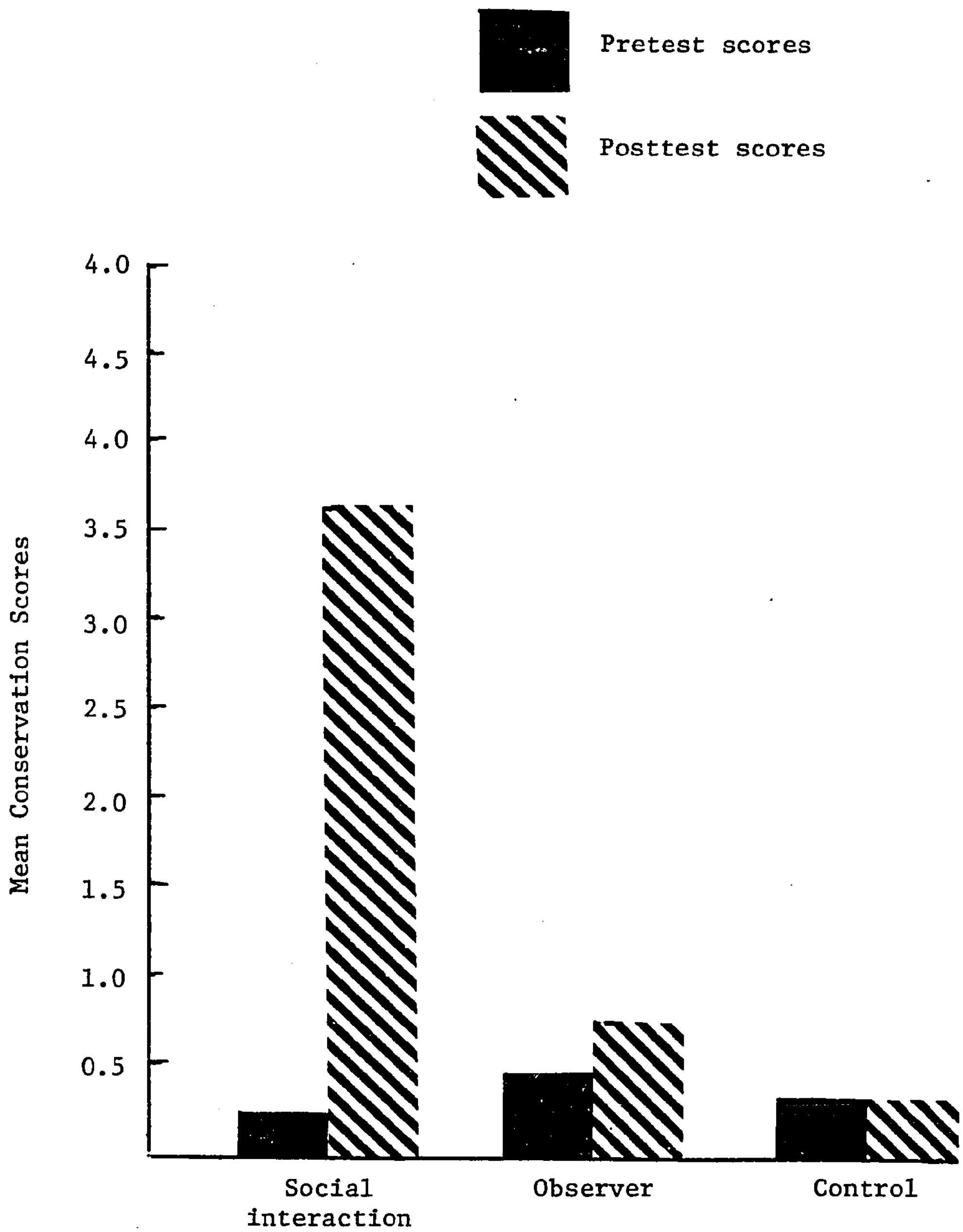

Figure 1. Mean pre- and posttest conservation scores of pretest conservers.

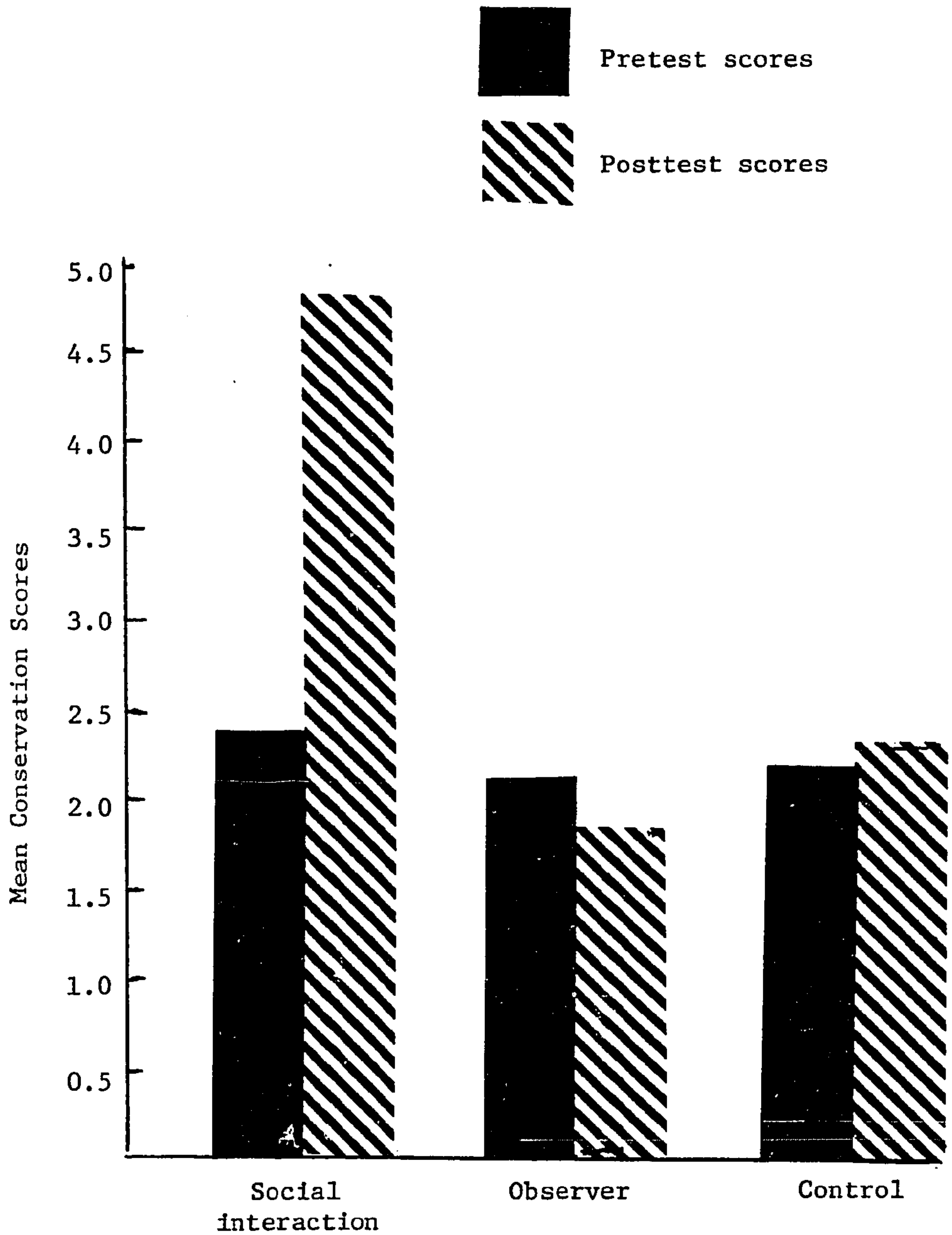

Figure 2. Mean pre- and posttest conservation scores of pretest intermediate conservers.

The analysis of covariance for pretest intermediate conservers (presented in Table 4) revealed a significant main effect for condition ($F[2,33] = 10.03$, $p < .0004$). A Scheffé post-hoc analysis indicated that pretest intermediate conservers in the social interaction condition had significantly greater mean gain scores ($\overline{X} = 2.35$ vs. -0.33, $p < .01$) than pretest intermediate conservers in the observer condition; and in the control condition ($\overline{X} = 2.35$ vs. 0.23, $p < .01$). There were no significant differences in the mean gain scores between pretest intermediate conservers in the observer condition and pretest intermediate conservers in the control condition. There was no significant sex main effect or condition by sex interaction.

Analysis of Posttest Conservation Explanations

The purpose of this analysis was to determine whether subjects' posttest explanations for conservation were novel or whether they repeated explanations previously offered on the pretest or presented during social interaction. An analysis of novel posttest conservation explanations presented by subjects in the social interaction and observation conditions was done. Novel explanations were operationally defined as explanations of conservation for a given subject which he or she had not presented on the pretest or offered or heard during the interaction. Since subjects in the

Table 4

Analysis of Covariance of Intermediate Conservers' Gain Scores

Source of variation	SS	df	MS	F	p
Condition	50.91	2	25.45	10.03	.0004
Sex	0.78	1	0.78	0.31	n.s.
Condition x sex	0.67	2	0.33	0.13	n.s.
Error	83.78	33	2.53		

control condition did not participate or observe the interaction, they were not included in the present analysis.

The posttest conservation explanations were independently scored by the experimenter and another trained assistant. A random sample consisting of 30 posttest protocols (social interaction--10 pretest nonconservers, 10 pretest intermediate conservers; observer--5 pretest nonconservers, 5 pretest intermediate conservers) were judged according to type of novel explanation provided by the subjects. Interrater agreements of 97% and 99% were obtained for novel explanations based upon reversibility and invariant quantity, respectively.

Table 5 presents the number and percent of novel reversibility and invariant quantity explanations offered by subjects in the social interaction and observer conditions. For subjects in the social interaction condition, 31% of the total number of posttest explanations were novel explanations as compared to subjects in the observer condition whose novel posttest explanations were 4% of their total number of explanations.

Table 6 presents the number and percent of pretest nonconserver and pretest intermediate conservers who provided novel conservation explanations. Novel exaplanations were given by 72.5% of the subjects in the social interaction condition. In comparison, 25% of the subjects in the observer condition gave novel explanations on the posttest.

Table 5

Number and Percent of Novel Reversibility and Invariant Quantity Explanations Presented by Subjects in the Social Interaction and Observer Conditions

Condition	Reversibility No.	Reversibility %	Invariant quantity No.	Invariant quantity %
	Novel conservation explanation category			
Social interaction				
Nonconserver ($\underline{n} = 120$)[a]	24	20	13	11
Intermediate conserver ($\underline{n} = 120$)	25	21	12	10
Observer				
Nonconserver ($\underline{n} = 60$)	0	0	2	3
Intermediate conserver ($\underline{n} = 60$)	0	0	3	5

[a]$\underline{n}$ = total no. of posttest explanations (6 tasks x no. of subjects).

Table 6

Number and Percent of Subjects Providing Novel Explanations on the Posttest

Condition	Nonconserver No.	Nonconserver %	Intermediate conserver No.	Intermediate conserver %
	Pretest conservation level			
Social interaction ($\underline{n} = 40$)[a]				
Novel explanations	15	75	14	70
Observer ($\underline{n} = 20$)				
Novel explanations	2	20	3	30

[a]$\underline{n}$ = number of subjects in each pretest conservation level.

A log-linear analysis (Knoke & Burke, 1980) was performed on the number of children in the social interaction and observer conditions who provided novel conservation explanations. The results of this analysis are summarized in Table 7. These frequencies can be recovered from the percentages presented in Table 6. The presence of novel explanations, the dependent variable, was analyzed by condition (social interaction, observer) and pretest conservation level (nonconserver, intermediate conserver), the independent variables. The equiprobability model is the null hypothesis that there are no actual differences between the number of novel explanations given by the nonconservers and intermediate conservers in the social interaction and observer conditions. The analysis of the data provided two hierarchical logit models. The first model, Hierarchy 1, indicated that the condition variable accounted for the variation in the number of novel explanations provided by the children in the social interaction and observer conditions. Hierarchy 2 indicated that pretest conservation level did not contribute to the variation in the number of novel explanations given by children. Thus, a model with conditions (social interaction, observer) was sufficient to explain the variation in the dependent variable, with pretest conservation level making no significant contribution to the observed differences in the number of novel

Table 7

Logit Models of Rate of Novel Explanations

Model	Likelihood ratio statistic (L^2)	df	p
Hierarchy 1			
Equiprobability	12.954	3	.0047
Condition	.3935	2	.8213
Conservation level	.3935	1	.5304
Hierarchy 2			
Equiprobability	12.954	3	.0047
Condition	12.954	2	.0015
Conservation level	.3935	1	.5304

explanations between the social interaction and observer conditions.

Disagreement Categories and Cognitive Development

Intercoder Reliability

All of the tape-recorded verbal statements made by each of the 20 dyads during the social interaction phase were transcribed. The verbatim transcripts were independently scored by the present experimenter and another trained assistant according to the frequency of the type of disagreement between nonconserver and intermediate conserver. Frequency scores were summed for each of the dyads (see Appendix). The intercoder correlations for the frequency of the type of disagreement category were: disagreement with correct justification, r = .97; disagreement with incorrect justification, r = .98; disagreement with irrelevant justification, r = .93; and disagreement with no justification, r = .99.

The Relationship between Disagreement Categories and Gain Scores

The relationship between the frequencies of disagreements made by dyads in the social interaction condition and their pretest-to-posttest gain scores was investigated by both a correlational analysis and an analysis of variance.

Because the number of disagreements were determined jointly between pairs of subjects who worked collectively, each member of a dyad was assigned the disagreement score that was generated between them during the social interaction.

A nonsignificant Pearson correlation, $r = -.15$, was found between the number of disagreements made by subjects in the social interaction condition and their pretest-to-posttest gain scores.

Table 8 presents the mean pretest-to-posttest gain scores analyzed by the frequency of disagreement and pretest conservation level. The three frequencies of disagreement were operationally defined in the following way: low (0 disagreements), medium (1-10 disagreements), and high (11-30 disagreements). A 3 x 2 (frequencies of disagreements by pretest conservation level) analysis of variance of the pretest-to-posttest gain scores revealed no significant main effects or interaction.

An investigation was made to determine whether there was a nonlinear relationship between the frequencies of disagreement and cognitive gain scores for subjects in the social interaction condition. A scatter plot analysis failed to find a nonlinear relationship.

Two 3 x 2 (frequencies of disagreement [high, medium, and low] by pretest conservation level [nonconserver and

Table 8

Mean Pretest-to-Posttest Gain Scores as a Function of Frequencies of Disagreement and Pretest Conservation Level

	Pretest conservation level	
	Nonconserver	Intermediate conserver
Frequency of disagreement		
Low ($n = 12$)	3.83	2.66
Medium ($n = 16$)	4.12	2.25
High ($n = 12$)	2.33	2.66

intermediate conserver]) analyses of variance were done on the cognitive gain scores of subjects in the social interaction condition. In one analysis, the frequencies of disagreement equalled the number of times a subject heard a disagreement with a correct conservation explanation from his or her partner. In the other analysis, the frequencies of disagreement equalled the number of times a subject heard a disagreement with an incorrect conservation explanation from his or her partner. There were no significant main effects or interaction found in either analysis.

Chapter V

DISCUSSION

The purpose of the present study was to investigate the role played by sociocognitive conflict in the development of conservation in young children. This study also sought to determine if there was a relationship between the expression of sociocognitive conflict, defined as task-relevant verbal disagreements between children who worked collective on conservation tasks, and individual cognitive gains. Consistent with a sociocognitive conflict model of development, it was hypothesized that the facilitating effect of social interaction on children's acquisition of conservation was a function of the reciprocal coordinations of contrasting points of view between children who worked together on a series of conservation tasks.

In order to more clearly define the social context in which conservation development occurs, children who pretested as nonconservers and intermediate conservers were randomly assigned to one of three conditions: (a) dyadic social interaction, (b) observer control, and (c) traditional control. The observer control condition provided a control for the amount of task-relevant information produced by the social interaction. This experimental design made it possible to test the efficacy of social interaction on cognitive development by comparing children who expressed conflicting views while working collectively on conservation tasks with children who either passively observed dyads working together or worked on the problem individually.

Children who worked collectively on conservation tasks had the opportunity to view their perspectives relative to others. In such social interactive exchanges there was the potential that children would be confronted with views different from their own and thus would be obliged to coordinate and reconcile these differences. The opportunity for children to actively coordinate contrasting viewpoints was relatively absent in situations where children were passive observers or worked alone. Therefore, it was expected that children who engaged in social interactive exchanges would make greater cognitive gains on posttest conservation tasks than children who either observed the social interaction or who worked alone. The theoretical importance attributed to the social expression of contrasting viewpoints suggested that cognitive growth would also be associated with the frequency of task-relevant disagreements expressed between children working collectively.

It was hypothesized that pretest nonconserver and intermediate conserver children who worked together in pairs would make significantly greater pre-to-posttest gains on conservation tasks than children who observed pairs of children working together. It was also hypothesized that pretest nonconservers and intermediate conservers who worked together would make significantly greater pre-to-posttest gains than children who worked alone on the conservation tasks. It was also predicted that the frequency of particular kinds of disagreements among children working collectively and the pre-to-posttest gains would be positively correlated.

Sociocognitive Conflict and Conservation Development

It was found that children in the social interaction condition made significantly greater pre-to-posttest gains on the conservation tasks than children in either the observer or the individual condition. There was no observed differences in cognitive gain scores between children in the observer and individual conditions.

The posttest conservation performances of the nonconservers who worked collectively with the intermediate conservers were superior to nonconservers who only had the opportunity to observe the dyadic exchanges and to nonconservers who worked alone on the conservation tasks. Similarly, the posttest conservation performances of the intermediate conservers who worked collectively with nonconservers were superior to those intermediate conservers who observed the dyadic exchanges and to intermediate conservers who worked alone.

The positive effects of the social interaction on children's cognitive development was demonstrated by comparing children's conservation levels on the pretest with their posttest levels. Of 20 pretest nonconservers, 30% advanced to the level of intermediate conserver and 45% advanced to the level of conserver. In comparison, only 20% of the 10 pretest nonconservers in the observer condition advanced to the level of intermediate conserver and none advanced to the level of conserver on the posttest. None of the pretest nonconservers who worked alone showed any progress from pre- to posttests.

Pretest intermediate conservers also made substantial progress as the result of having worked with cognitively less advanced partners in the social interaction condition. Eighty-five percent of the intermediate conservers ($\underline{n} = 20$) advanced to the level of conserver. In comparison, only one intermediate conserver in both the observer and individual conditions advanced to the conserver level.

These findings suggest that social interactions allow for the expression of conflicting centrations that oblige participants to coordinate their actions with one another and that this promotes their cognitive development. These findings support the findings of previous studies of children's social interaction and cognitive development reported by Botvin and Murray (1975), Miller and Brownell (1975), Murray (1972), Silverman and Geiringer (1973), and Silverman and Stone (1972). These studies provided support for Piaget's (1977) equilibration model and demonstrated that peer interactions are an effective means of promoting cognitive growth. In all of these social interaction studies, nonconservers made significant progress on conservation tasks after having interacted with conservers. However, the present investigation differed from previous studies in that nonconservers were confronted by other children who themselves had not yet achieved conservation. The pairing together of nonconservers and intermediate conservers reduced the likelihood of nonconservers acquiring conservation through the social transmission of correct conservation responses (i.e., modeling), as may be the case when nonconservers interact with conservers. It was also possible to demonstrate the facilitating effects of social interaction on cognitive development by showing that it was not necessary for children to interact with more advanced partners in order to demonstrate significant cognitive gains.

The present findings suggest that it is not necessary to present children with a correct operational solution in order for them to attain conservation. Cognitive development is made possible when, in the course of social interaction, children are confronted with viewpoints differing from their own. Consistent with the findings of Doise, Mugny, and Perret-Clermont (1975) and Mugny and Doise (1978), collective performances were not only superior to individual performances but nonconserving and intermediate conserving children both profited from social interaction.

A number of researchers (Rosenthal & Zimmerman, 1972; Zimmerman & Lanaro, 1974; Zimmerman & Rosenthal, 1974) have demonstrated that cognitive gains in children's operational development were made by using observational learning and modeling procedures. Botvin and Murray (1975) directly compared a peer interaction procedure with a peer modeling procedure and found that both procedures were effective methods of facilitating conservation attainment. However, a direct comparison of social interaction and modeling procedures is subject to difficulties in interpretation given differences in experimental methodologies. In social interaction studies, children are generally requested to work on the task(s) until they have reached a consensus regarding the task solution. Their interactions and discussions are otherwise unrestricted, allowing for a wide range of task-relevant information to be generated. In modeling studies, however, training procedures are more structured in that the function of the model is to present clear, rule-consistent conservation judgments/explanations which are in response to the experimenter's transformation of the stimulus property (e.g., a clay ball).

Zimmerman and Blom (1983) used dyadic modeling conditions in order to determine the role played by conflict in children's cognitive development. Preoperational children who observed two adult models displaying rule-consistent behavior had significantly greater cognitive gains compared to children who observed two models, one playing the nonconserver the other playing the conserver. It should be noted, however, that Zimmerman and Blom's operational definition of conflict, having a nonconserver observe a debate between a nonconserver model and conserver model, is not consistent with Piaget's equilibration model. For Piaget, the concept of cognitive conflict entails an interactive dialectical process during which contradictions are resolved. The experimental conditions set by Zimmerman and Blom clearly failed to capture this interactive process.

Several social interaction studies (Ames & Murray, 1982; Doise, Mugny, & Perret-Clermont, 1976) have found that preoperational children need not be presented with correct conservation information in order to make cognitive gains. Nonconservers who worked together but who advanced equally incorrect but opposing centrations attained conservation. These findings suggest that sociocognitive conflict and not the informational content contained in the social interaction was responsible for the cognitive gains made by children.

The cognitive gains made by children in many social interaction studies pose some problems in interpretation. The social interaction procedures may be confounded by task-relevant information contained in them. The present study focused upon the social contextual origins of cognitive development while controlling for the informational content generated through social interaction. This was accomplished by including an observer control group in addition to the traditional control group. In the present study, individual nonconservers and intermediate conservers were "yoked" to social interaction dyads in order to control for the effects of task-relevant information. Any cognitive gains made by children who worked together, compared to children who only observed them, could thus be attributed to the dyad's dialectical confrontations and coordinations of reciprocal points of view and not simply to the exposure of task-relevant information.

During the time which children in the social interaction condition worked together on the conservation tasks, the observers followed the experimenter's directions and did not participate in the discussion. However, children who acted as observers demonstrated their interest by directing their attention toward the dyad's discussions. Many of the children, in spite of their role as silent observers, appeared involved in the discussions that were taking place before them. Children who were observers demonstrated their involvement by shaking or nodding their heads as each member of the dyad expressed his or her point of view regarding the conservation of the materials.

The findings that both nonconservers and intermediate conservers who were confronted with others' oppositing points of view made greater cognitive gains than children who observed them suggest that a social interactive dialogue is a sufficient condition for cognitive growth. The passive observation of children who express conflicting views is, in itself, an insufficient condition for facilitating operational development. These findings are in marked contrast to modeling studies (e.g., Rosenthal & Zimmerman, 1972; Zimmerman & Blom, 1983) which have shown that children need only to observe models provide rule-consistent conservation information in order to demonstrate conservation behaviors. In the present study, children who only had the opportunity to observe children's social interactions failed to make any cognitive gains.

Posttest Conservation Explanations

Further evidence of the efficacy of sociocognitive conflict in promoting cognitive growth in young children was provided by an analysis of the posttest conservation explanations offered by children in the social interaction and observer conditions.

A significantly greater number of children who worked collectively on the conservation tasks gave novel explanations for conservation on the posttest than children who observed the social interaction. A novel explanation was operationally defined as a conservation explanation provided by a given subject which he or she had not presented on the pretest nor offered nor heard during social interaction.

There have been a few social interaction studies that have reported novel posttest conservation explanations. Silverman and Stone (1972) found that in only one instance did a nonconserver who conserved on the posttest provide a conservation argument which had not been provided by their conserving partner during the interaction. Doise et al. (1975) found that more than half of the children who conserved on a conservation of liquids task used one or more arguments that had not been used during the social interaction.

In the present study, 75% of the pretest nonconservers and 70% of the pretest intermediate conservers who worked together provided at least one conservation explanation on the posttest which differed from both their original pretest explanations and explanations that they presented or heard during the social interaction. In comparison, only 20% of the pretest nonconservers and 30% of the pretest intermediate conservers in the observer control condition offered novel explanations for their conservation judgments on the posttest.

In addition to the percentage of subjects who offered novel posttest explanations, the number of novel conservation explanations by all children who worked collectively was compared to children who acted as observers. Children who worked together in pairs gave significantly more novel conservation explanations on the posttest than children who only observed the interaction. Thirty-one percent of the total number of posttest explanations given by children in the social interaction condition were novel explanations. Twenty percent of the novel explanations were reversibility arguments, and 11% were invariant quantity arguments. For pretest intermediate conservers, 21% of the novel conservation explanations were reversibility arguments and 10% invarient quantity arguments. Very few of the children in the observer control condition gave novel conservation explanations. Only 4% of the total number of conservation explanations were novel explanations, all of which were invariant quantity arguments.

These findings suggest that cognitive gains realized by children in the social interaction cannot be explained as the learning of previously demonstrated conservation behaviors. Nonconservers did not simply repeat the arguments that they heard or offered during the social interaction but offered novel arguments that they had not been capable of providing in the pretest or during the social interaction. Similarly, it is not possible to explain, by reference to modeling processes, the presence of novel explanations provided by intermediate conservers who had interacted with their less advanced partners. The presence of novel explanations by children in the social interaction appear to involve an elaboration or cognitive restructuring.

Verbal Disagreements and Cognitive Development

The present study also tested the relationship between the expression of task-relevant disagreements among children in the social interaction condition and the extent of their cognitive gains. It was hypothesized that there would be a positive correlation between the number of disagreements made by children who worked collective to solve conservation tasks and their pre-to-posttest gain scores. However, correlations between the expression of various types of disagreements between partners in the social interaction condition and their cognitive gain scores were not significant.

An analysis of variance also failed to find any significant relationship between the frequency of disagreements (low, medium, and high) and children's cognitive gain scores. Further analysis failed to find a significant relationship between hearing a disagreement with either a correct or incorrect conservation explanation and cognitive gain.

Piaget (1926) and Smedslund (1966) have suggested that repeated conflicts in verbal communication play an important role in facilitating cognitive growth. Although there are a significant number of studies that have demonstrated the positive effects of peer interaction on children's cognitive development, few studies have analyzed the types of social interactive processes that are associated with developmental growth. Although Ames (1980) coded and analyzed children's social interactions during their work on conservation tasks, it was not possible to determine which behaviors were related to cognitive growth. Cooper (1980) found that verbal communications which facilitated preschoolers' collaborative problem-solving on a balance task included the use of attention-focusing statements, responsiveness to the partner, the expression of substantive hypotheses and the use of comparative labels in order to assess the consequences of their actions.

Several studies (Berkowitz, 1980; Berkowitz & Gibbs, 1983) have applied a structural process analysis to moral discussions in order to identify dialogical communications which were associated with developmental changes in moral reasoning. They found that transactive communications (from Dewey & Bentley, 1949), defined as "reasoning that operates on the reasoning of another," characterized moral discussions of the dyads that made the greatest pre-to-post-test changes in moral reasoning. Damon and Killen (1982) also studied peer interaction and development in children's moral reasoning and found no relationship between the amount of verbal exchange during peer debates and advancement to higher levels of moral reasoning. Contrary to a sociocognitive conflict explanation of developmental change, there was evidence to suggest that disagreements impeded rather than facilitated children's cognitive growth on moral reasoning tasks. Dyads who disagreed, contradicted, and gave contrary solutions were found to be more likely among those who failed to advance to a higher level of moral reasoning compared to dyads whose interactions were characterized by a "reciprocal quality of acceptance of transformation of one another's ideas" (p. 365).

In the present study, the question of what particular aspects of children's social interaction contributes to their cognitive gains remains unanswered. It appears, however, that more sensitive measures need to be employed in order to identify the dialectical exchanges and coordinations which are responsible for development. The failure to find a significant correlation between disagreements and cognitive gain may have been related to the limited amount of disagreements generated by the dyads. It is also possible that the expression of disagreement is related to the type of task used in the experimental procedures. It may be that the conservation tasks employed in this study did not provide the optimal conditions for an extensive discourse where disagreements could be expressed and conflict resolution achieved.

Conclusions

The results of the present study support a socio-cognitive conflict model of development. Cognitive development cannot be reduced to children's passive appropriation of task-relevant information and behaviors, but rather it is a constructive process.

The idea that social processes play a central role in the development of higher mental processes has long been acknowledged by Mead (1934), Vygotsky (1962), and Luria (1976). For Vygotsky, human interaction underlies the development of all higher psychological processes for "the true direction of the development of thinking is not from the individual to the socialized, but from the social to the individual" (1962, p. 20). Similarly, Perret-Clermont has concluded that "the coordination of actions between individuals precedes the individual cognitive coordination of certain actions" (1980, p. 24).

A psychosociological theory of knowledge, as presented by Perret-Clermont and her colleagues, appears to be an attempt to bring about a new synthesis or rapprochement between Piaget's cognitive-developmental theory and Vygotsky's social deterministic theory of the origins of thinking.

A comparison of Piaget's and Vygotsky's theories of development has often been described as representing a dichotomy between individual and social conceptions of knowledge. However, as Piaget has stated, "there are many unnecessary problems arising from the fact that some have committed themselves from the outset to a dichotomy 'individual or society' while forgetting that there is a relational perspective according to which there exist only interactions, which can be globally studied either sociologically or ontogenetically during the course of individual development" (1966, p. 249).

While Piaget's theory has recognized the role played by social interaction in the development of intelligence, his model of the structural isomorphism between social and individual logic precluded the possibility of establishing a casual relationship. The findings of the present study and those which have been conducted at the University of Geneva (Doise et al., 1976; Mugny & Doise, 1978; Perret-Clermont, 1980) suggest that social interactions which require interindividual coordinations of contrasting perspectives play a direct role in the reorganization of the individual's cognitive structures.

In the present study, the superior performances of children who worked together compared to children who passively observed them or those who worked alone on the conservation tasks suggest that cognitive development will be more likely to occur if the individual is involved in a social interactive process. Placing the child in the role of listener-observer is an insufficient condition for learning to take place.

The present investigation has provided evidence that the efficacy of social interaction on cognitive development rests with the opportunity for interindividual coordination of opposing perspectives. Traditional learning theories and instructional methods (e.g., Gagne, 1967; Skinner, 1968) have conceptualized learning as a matter of transmitting a body of knowledge which is prepared for the individual learner. The present findings suggest that learning or cognitive development cannot be attributed to a copying process but rather involves an interactive subject who, in the course of social interaction, coordinates perspectives which differ from his or her own.

Implications and Applications of Social Interaction Research

Research studies investigating the role of social interaction in the development of cognitive have been limited for the most part to the period of concrete operations. If social processes play an integral part in cognitive development one should be able to extend the parameters of social interaction to other stages of mental development. For example, social interaction paradigms could be applied to the development of combinatorial reasoning and problem-solving strategies during the formal operational period.

The findings of social interaction studies also are relevant to the field of teaching. Instructional methods utilizing peer debates and discussions during which students have the opportunity to discuss, defend, and exchange opposing views can be an effective means of promoting learning. Piaget (1973) appeared to be advocating such a position when he wrote, "No real intellectual activity could be carried on in the form of experimental actions and spontaneous investigations without free collaborations among individuals--that is to say, among the students themselves, and not only between the teacher and student" (pp. 107-108).

The use of peer tutors may also be a fruitful approach in developing the skills of both the tutor and tutee. In a critical review of the literature on peer tutoring, Sheehan, Feldman, and Allen (1976) cite a number of studies which demonstrate the effectiveness of peer tutoring in promoting academic gains for both the tutor and tutee. A tutoring program developed by Lippitt and

Lippitt (1968) found that both tutors (seventh- and eighth-grade students) and tutees (low-achieving fourth-, fifth-, and sixth-grade students) made academic gains in reading, arithmetic, and language arts. In another study, Robertson (1972) found that low-achieving fifth-grade tutors and their first-grade pupils both made progress in reading following a 2-month tutorial program.

Further extension of the peer tutor model to clinical interventions with emotionally disturbed children may also be a promising area of applied social interaction research.

Appendix

FREQUENCY OF TYPE OF DISAGREEMENT

Frequency of Type of Disagreement

Dyad	Correct justification	Incorrect justification	Irrelevant justification	No justification	Total
A	3	0	0	9	12
B	1	7	0	3	11
C	0	0	0	0	0
D	2	4	0	4	10
E	3	0	0	0	3
F	0	0	0	0	0
G	0	0	0	0	0
H	4	1	0	2	7
I	0	1	0	0	1
J	1	5	0	5	11
K	1	3	0	0	4
L	1	0	0	1	2
M	1	0	0	0	1
N	0	1	0	0	1
O	0	0	0	0	0
P	0	0	0	0	0
Q	1	11	0	0	12
R	1	1	3	11	16
S	6	14	8	2	30
T	0	0	0	0	0

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