CONSERVATION THROUGH CONFLICT:
DO CONFLICTING WRONG SOLUTIONS HELP CHILDREN
INVENT THE RIGHT ONES?

by

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A total of 136 children from 5 to 8 years of age were presented with standard conservation of length and liquid tasks as well as story versions of those tasks. Half of the children were read stories in which the views of two non-conservers came into conflict, and the other half were read "conflict free" stories. Although the length conflict story was found to be significantly easier than the length task, the nonconflict story was not. In addition, the length conflict story was significantly easier than the length nonconflict story for the younger children (5-6 year-olds). However no significant differences were found among the liquid conditions. The results suggest that, for length, children's conservation performance was benefitted by cognitive conflict rather than merely the narrative format of the story problem and that children's reasoning can be affected by mere exposure to "socio-cognitive conflict". These results lend support to the controversial claim that symmetrical incorrect conflict is sufficient for stimulating cognitive development.
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Conservation Through Conflict:
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Invent the Right Ones?

CHAPTER 1: INTRODUCTION

Statement of the problem

This thesis is intended to address the contentious question of whether exposure to conflicting incorrect viewpoints is sufficient for fostering intellectual development. According to socio-cognitive conflict theory (Doise & Mugny, 1984; Perret-Clermont, 1980), a discrepancy among children's points of view serves to perturb the children both cognitively and socially, causing them to reflect on their own beliefs more critically and to consider alternative perspectives on the problem at hand. In turn, this may motivate them to work together in co-constructing an understanding of the problem that may be superior to one they could construct for themselves. Following this reasoning, one might expect that socio-cognitive conflict could be effective in inducing cognitive change in any situation in which a child is exposed to views different from their own, even if those views are equally as partial and limited as their own (i.e. a conflict between two incorrect solutions). In such a case, the strongest evidence for the efficacy of socio-cognitive conflict as a stimulus to development seems to arise when nonexpert partnerships produce progress without the benefit of modeling. Research to be discussed in the literature review has indicated: (a) that children have sometimes been shown to benefit
from a conflict between symmetrically incorrect views and sometimes not, and (b) that children must actually be a party to such interactions, simply being exposed to contrary viewpoints is not efficacious. In order to shed more light on such findings, conditions are employed and compared in this study in which children are (a) exposed to conflicting incorrect viewpoints on two problem tasks through the use of a story format, (b) exposed to nonconflicting incorrect viewpoints on the same two problem tasks through the use of a story format, and (c) assessed individually on these tasks.

Precursors to the Study of Socio-cognitive Conflict

Although conflict has a negative connotation in the popular culture, it is viewed as having a formative influence on development by many theorists. In the cognitive-developmental theory of Piaget, a mismatch between the child's conception or expectations of the environment and the child's experience creates a conflict for the child that is seen to be an important process in the acquisition and facilitation of knowledge and understanding. Recent research has provided evidence that social interaction can be an origin of such beneficial conflict. In this account, a conflict between children's perspectives induces children to work together in co-constructing a solution to the problem, a solution that accounts for all the discrepant evidence and that is agreeable to all participants. In this way, children may come collectively to negotiate a solution superior to that initially advocated by some or all of the participants. Such
interaction has sometimes been labeled socio-cognitive conflict (Doise & Mugny, 1984).

Historically, conflict has been accorded a central role in many theories of human development. In Klaus Riegel's dialectical theory of development, for example, the individual is viewed as embedded within several systems: inner-psychological, interbiological, cultural and external-physical. Conflict among these systems is said to be a stimulus to development (Riegel, 1976). In psychoanalytic theory, conflict between the child's anti-social impulses and the pressures of social reality is seen as shaping the child's personality and ability to adapt to the environment. Cognitive dissonance theory emphasizes the role that conflict plays in stimulating attitudinal change. According to Festinger (1957), the mind resists incongruity and the individual is motivated to reduce dissonance by altering attitudes so as to make them more congruent with behavior. This theory has been supported by a research study in which university students were asked to write counter-attitudinal essays (Linder, Cooper, & Jones, 1967). The findings indicated that after writing such essays the students tended to show a favorable post-essay attitudinal shift in the direction of the argument they were asked to falsely espouse. The authors credit this change of attitude to an effort to decrease the cognitive dissonance experienced by the students who championed a view contrary to their own.
In terms of cognitive development specifically, Piaget's (1928, 1977) theory accords conflict the important role of a primary catalyst of intellectual growth. In this view, conflict is crucial in creating disequilibrium or nonbalance, which may be characterized by a discrepancy among an individual's internal structures or between such structures and the environment. According to Piaget (1977), conflicts or disturbances fall into two categories. The first includes errors or failures on the part of the child. The second type of conflict may result from gaps in the child's knowledge. However, gaps will only result in a contradiction when they are relevant to the child's interests or when they stand in the way of accomplishing an act or solving a problem. Disequilibrium, or nonbalance, is seen to be a catalyst to the process of equilibration wherein the organism compensates for disturbances, both by construing what is perceived in terms of what is already known (assimilation) and by changing the internal structures in accordance with the novel features that have given rise to the conflict (accommodation). In this way, the process of equilibration results in the development of increasingly complex, integrated and more adequate structures (Mishel, 1971). This process is considered by Piaget to account for the development of knowledge and transition from one stage of reasoning to another: It is seen to be motivated by conflict or the nonbalance in which conflict can result.

It is worthwhile to note that however the nonbalance arises, it produces the driving force of development. Without this, knowledge remains static. But nonbalance also plays a release role, since its
fecundity is measured by the possibility of surmounting it, in other words, of reaching a higher equilibrium. It is therefore evident that the real source of progress is to be sought in both the insufficiency responsible for the conflict and the improvement expressed in the equilibration. Without the nonbalance there would not be 'increasing reequilibration.' (Reequilibration expresses the obtained improvement). (Piaget, 1977, p. 13).

The hypothesis that conflict can lead to cognitive growth has been supported empirically by a number of studies in which cognitive conflict has been induced experimentally (Inhelder, Sinclair, & Bovet, 1974). Those studies were designed so that a conflict between two strategies or between children's reasoning and experience was made apparent to them. For example, in a conservation of number study, children were initially pretested in order to determine their baserate level of performance. In this task, the children were presented with two equally numerous sets of objects. Once they agreed that each set contained the same amount, the experimenter spread one set out so that it covered more area the other. The children were then asked whether one set was of the same or of a greater number than the other. Nonconservers tended to assert that the transformed set was now bigger. They seemed to be using a strategy or applying a rule of "whichever one goes farther is the most numerous." These nonconserving children were then trained in one-to-one correspondence or "numerical equivalence", employing a number of different materials. In this procedure, they were asked to place a number of items in two equal piles. No attempt was made,
however, to lead the children progressively towards a correct solution on the conservation task. Finally, the children were given a conservation posttest. When children provided an incorrect judgment, the true state of affairs was demonstrated to them. In this way, the one-to-one correspondence strategy was at odds with the strategy commonly employed by younger children, in which they simply look at the configuration of an array and apply the rule "whichever one goes farther is the most numerous."

Generally, children who had undergone this training procedure were shown to advance considerably from the pre- to posttests, but the amount of advancement attained was dependent on their initial level. In this respect, children who, upon being pretested, evidenced some understanding of conservation (intermediate conservers) benefitted to a greater extent than those who were complete nonconservers. Inhelder et al. (1974) noted that the latter seemed to be unaware of any conflict, and when their predictions were disconfirmed they simply invented "ad hoc" corrections without any reference to judgments made before. Their failure to advance was seen as resulting from a lack of any initial understanding, into which the new material could be integrated. These methods were also shown to benefit children in the acquisition of the class inclusion concept and conservation of length. Inhelder et al. interpreted these data as evidence that "experience of discrepancies between one's predictions and ideas and the actual outcome of their
realization, is therefore an important factor in the acquisition of knowledge" (1974, p. 267).

A number of theorists have criticized Piaget for failing to adequately consider social influences on development (Smith, 1982; also see Chapman, 1986, 1988, 1990). However, although Piaget did write primarily about conflict as it arose from within the individual or between the individual and his or her environment, he speculated that it may come about through social interaction as well (Piaget, 1928, 1929, 1955). For example, he suggested that children may experience conflict when their views are contradicted or questioned in the course of peer interaction. In fact, he attributed the development of cognitive abilities such as logical verification as well as the decline of the egocentric thought which characterizes younger children to social conflict of this nature (Piaget, 1955).

According to Piaget (1929, 1955), young children remain unaware of the subjective nature of their thoughts and perceptions and resist recognizing that their view is subjective simply because it fails to occur to them that it might be anything but objective or correct. Around the age of 7-8 years, however, they develop a desire to work with others and a desire to understand and be understood by other children which, in part, helps motivate them to begin to give serious consideration to suggestions contrary to their own. Two results are said to come of this development. For the first time, children become aware of the subjectivity of their views, and with this realization they also come to understand that others think and
perceive things differently from themselves. Until such a realization occurs, the egocentric nature of children's reasoning restricts their understanding in that they tend to believe that they know and understand everything. Thus, they do not trouble themselves with looking further or thinking harder on a problem. Consequently, egocentric children judge everything from an immediate, intuitive, and narrow point of view. Moreover, because the viewpoints of egocentric children tend to be centered on one aspect of a problem and because they are unable to think of two things simultaneously, they are unable to conceive of contradiction. Peer interaction aids children in taking the first step away from egocentrism by making them aware of the subjective nature of thought and thus allowing them to "decenter" their focus and take a broader range of perspectives into account.

Secondly, as children come to desire the understanding of others they develop the need and ability to verify logically their accounts to others and themselves. This development is not unrelated to the collapse of egocentrism. For example, "So long as the child supposes that every one necessarily thinks like himself, he will not spontaneously seek to convince others, nor to accept common truths, nor, above all, to prove or test his opinions" (Piaget, 1929, p. 33). However, as children come to understand that others have views discrepant from their own, they develop the need to support their judgments with explanations. In other words, they learn to justify their opinions logically. Piaget (1955) found that
children are not able to enter into a "genuine argument" and the reasoning it entails until the ages of 7-8. According to Piaget, this is an especially important development because arguments among peers "will cause the need for inner unity and for the systemization of opinions to make itself felt . . . all reflection is the outcome of an internal debate in which a conclusion is reached, just as though the individual reproduced towards himself an attitude which he had previously adopted towards others" (Piaget, 1955, pp. 91-92). In this way, peer argument can be seen as an origin of reflective and logical thought. Overall, discussion involving conflicting viewpoints among peers was considered by Piaget to be the primary cause for the gradual decline and collapse of egocentric thought, that characterizes younger children and for the consequential beginnings of logical verification around the ages of 7-8 years.

Piaget (1965) took pains in emphasizing that generally only peer relationships, as opposed to those between adult and child, may serve as a vehicle for cognitive progress. According to Piaget, the adult-child relationship is a unilateral one characterized by constraint, which contributes to the maintenance of egocentrism. That is, children are not on equal footing with adults and must submit to adult authority; they agree with or accept the commands of the adult, but any resulting change in attitude or behavior, if it occurs, is only superficial because children are limited in their ability to understand a point of view other than their own. The nature of this unilateral relationship exacerbates egocentrism in
that children are unable to put themselves in the superior position of the adult, and being unable to take the point of view of the other they are left secured within their own viewpoint (Chapman, 1988, Chapter 2).

The peer-peer relationship, on the other hand, is characterized by bi-directional or mutual respect and cooperation. Accordingly, children interact with same-aged peers on an equal basis and, as such, are given a chance to disagree and express contrary opinions. By doing this, children may discover the uniqueness of their own thought and develop an increasing understanding of their peers as different from themselves. The ability to differentiate one's position or thought from that of others contributes to the ability to cooperate, which in turn has its own developmental consequences:

The norms of reason, and in particular the important norm of reciprocity, the source of the logic of relations, can only develop in and through cooperation . . . reason requires cooperation in so far as being rational consists in 'situating oneself' so as to submit the individual to the universal. Mutual respect therefore appears to us as the necessary condition of autonomy under it's double aspect, intellectual and moral. From the intellectual point of view, it frees the child from the opinions that have been imposed upon him while it favors inner consistency and reciprocal control. (Piaget, 1965, p. 107)

Aside from contributing to the development of logical verification, to reflective thought and to the decline of egocentric thought, peer interaction may be said to be cognitively beneficial for any problem solving in general. For example, conflicts arising
between a child's perspective or comprehension of a problem and that of her peers could serve to perplex the child and motivate her to justify and defend her position. If agreement is to be reached, the children must consider alternative points of view and work together in co-constructing an understanding of the problem such that all the discrepant evidence is accounted for. Thus, peer interaction could be said to be more fruitful than individual problem solving for the following reasons: (a) Interaction with peers provides an arena for illustrating different viewpoints that the child has not yet recognized; (b) the nature of the social situation encourages children to justify and communicate their perspective to others and in doing so they may benefit from elaborating on their own ideas; and (c) in this situation children are motivated to arrive at the best solution, not only cognitively, but socially as well, because they have an investment in understanding and being understood by their peers.

Research on Socio-cognitive Conflict

In the spirit of such reasoning, Doise and his colleagues in Geneva (Doise, Mugny, & Perret-Clermont, 1975; Doise & Mugny, 1979; Doise & Mugny, 1984; Mugny & Doise, 1978) instigated a research program designed to assess empirically the influence of peer interaction on cognitive development. This program was successful enough to lead them to infer that "conflicts of cognitive centraions embedded in a social situation are a more powerful factor in cognitive development than a conflict of individual centraions alone" (Doise & Mugny, 1979, p. 105). Prior to a
discussion of the particulars, it would be useful to outline the experimental paradigm employed by Doise and other researchers in this field, in which socio-cognitive conflict is induced and progress is measured. Typically, participants are pretested so that their initial level of ability may be assessed. For example, in an experiment using conservation of length as the independent variable, children are assessed as either partial, total, or nonconservers. Next, often some time later, the children participate in an interaction session in which, the subjects may be paired with one or two other children whose operatory level may be the same or different from their own. The experimenter presents the conservation of length problem to the children and asks them to come to a collective agreement on the solution. Finally, again, after some time has passed the children are tested individually (as in the pretest) and their posttest performance is assessed. The posttest performance of children who participated in the social interaction condition is compared with that of a control group who worked on the task individually.

In some cases the conflict may be resolved prematurely by subjects who simply accept the view of the other without having understood the task. Children in this case are not found to demonstrate any cognitive progress (Mugny & Doise, 1978; Russell, 1981). Some theorists (Zimmerman & Blom, 1983; Russell, 1981, 1990) have suggested that children may be progressing due to exposure to a correct answer as opposed to socio-cognitive conflict.
This modeling interpretation was addressed by Mugny and Doise (1978) who demonstrated that many children who provided a correct justification on the posttest also employed novel explanations to which they had not been exposed during the interaction: Modelling could not account for this finding. Consequently, in the posttest the children were asked to justify their conclusions to control for the possibility that they may be merely imitating a correct response that they heard during the interaction session.

In fact, studies have shown that collective conflict can be more effective in inducing cognitive change than individual conflict in tasks such as spatial perspective taking (Doise & Mugny, 1977, Doise et al., 1975; Girotto, 1987; Peterson & Peterson, 1990), conservation (Doise et al., 1977; Murray & Ames, 1977, 1982; Perret-Clermont, 1980; Silverman & Stone, 1972; Russell, 1982; Russell, 1990; Weinstein & Bearison, 1985), and the tower of Hanoi (Vincenzo & Kelly, 1987; Glachan & Light, 1982). Moreover, these benefits have sometimes been shown to generalize to other tasks (Ames & Murray, 1982; Russell, 1982). Socio-cognitive problem solving has been shown to be superior to individual problem solving both in dyads, as in the studies cited above, and in triads (Vincenzo & Kelley, 1987).

Accordingly, this conceptualization of intellectual growth has received substantial experimental confirmation. Even so, socio-cognitive conflict has not been shown to be superior to individual problem solving in all cases. There are several variables that
mediate its effects. The following is a report of some intraindividual and interindividual characteristics that may hinder or further the probability of benefitting from socio-cognitive conflict.

**Mediating Variables**

Foremost among the intraindividual variables that mediate the effects of socio-cognitive conflict is the age of the child, or more specifically, cognitive and social capabilities which are highly associated with age. There is a consensus in the research literature that children below a certain age are often unable to benefit intellectually from social discussion. As previously mentioned, Piaget (1955) found children below the ages of 7-8 to be "insensible to contradiction" due to their egocentric nature (p. 91). It is clear that in order to gain as a result of socio-cognitive conflict, children must first notice that there is a conflict in order for it to be experienced (Mugny, 1984; Murray, 1983). For example, children may be contradicted by experience, but will fail to notice that fact because they forget their original stand on the issue. Even if a conflict in views is perceived, cognitive growth does not necessarily follow; younger children may view their differences as stemming from mystery or magic ("when you are looking it is bigger, when I am it is not") (Mugny, 1984, p. 135), or they may not be concerned that their views are different.
A second point is that naturally-occurring interaction patterns between children do not tend to involve discussion in terms of duly justified reasonable arguments. The types of conflicts in which young children do get involved are of a different nature. For example, Shantz (1987) notes that most conflicts between preschool children are generally disputes over possession and use of valued items. Typically, one child responds to a verbal act, signifying the beginning of a conflict, by refusing to satisfy the other child's request or denying the other's assertion. Piaget found that "children between the ages of four and five are extremely quarrelsome [but] generally conduct their disputes without talking" (1955, p. 84). In fact, before the age of 7 children generally have not been found to produce genuine arguments that engender spontaneous logical justification.

Overall, in order for children to benefit from situations in which a solution to a problem may be co-constructed, they should have certain cognitive and social capabilities in their repertoires. Often these abilities are related to age. Such abilities may include the ability to recognize contradiction, to take more than one view into account at the same time, to logically justify a position. Previous experience in this type of interaction is also a mediating factor related to age. Moreover, children should be of an age at which they are socially motivated to justify their own and others accounts of a problem. Accordingly, the literature shows that older children tend to benefit more from socio-cognitive conflict than
younger children especially within the age groups of 6-8 years (Russell, 1982; Ames & Murray, 1982).

A similar but more specific example of an intraindividual mediating variable concerns the initial cognitive level of the child. Research studies have often established that those children who benefit the most from social conflict are those who are already close to grasping the solution to the problem at hand (Bell et al., 1985). In other words, the performance of children who evidence some cognitive competency in the pretest (e.g., a partial conserver) tends to increase more than that of children who displayed no pretest competency (e.g. nonconserver). Although a number of studies have indicated that children who perform very poorly on the pretest can profit significantly from socio-cognitive conflict (Doise, Mugny, & Perret-Clermont, 1976; Doise & Mugny, 1984; Peterson & Peterson, 1990), there are other findings such that subjects who exhibit the poorest performance on the pretest seem to benefit least or not at all from this collective approach to problem solving (Perret-Clermont, 1980).

For example, Perret-Clermont found that only the subjects who had performed at one of the higher levels of nonconservation (i.e., partial conservation) were seen to make substantial posttest gains (Perret-Clermont, 1980). Doise and Mugny (1978) proposed that children who are less advanced require stronger and more constraining conflict situations in order to benefit than do those who are at an intermediate level in the acquisition of a concept (e.g.,
conservation). An example of a highly constraining situation is a condition in which an experimenter repeatedly points out the fact that the child's initial judgment is at odds with that of his peer. Similarly, Murray's (1974) results revealed that, whereas partial conservers were able to benefit from observing a conserving model, nonconservers assessed at pretest were not. He concluded that the positive effects of exposure to a contradictory model are predictable according to initial cognitive level. Finally, Taal (1981) noted that only the subjects who evidenced an early form of understanding of her hierarchical construction task were able to benefit from the collective problem-solving situation. Thus, in order to benefit from social interaction a child should have reached a level of task mastery sufficient for comprehending the problem and for participating in a discussion of its solution. This point will be taken up again later in the paper.

Among other individual characteristics that may bear on a child's performance are those which are brought about socially, such as socioeconomic background, degree of social isolation, and upbringing variables. According to Bell et al (1985), children from disadvantaged backgrounds (low SES) often manifest poor pretest performance as compared to their peers from more advantaged backgrounds. However, these differences are found to diminish on posttest performance: "It is as if the social interaction gave disadvantaged subjects the opportunity to 'catch up' . . . with their peers" (1985, p. 47). Those authors suggest that initial differences
may be a function of how children perceive the task: Advantaged subjects are seen as having more experience and social competencies relevant to the testing situation, and their performance is aided by knowing what the tester wants and what to expect; once disadvantaged children are exposed to the same experience, their performance is likewise benefitted.

The amount of peer interaction in the past may also affect the probability of advancing cognitively from social problem solving tasks. LeMare and Rubin (1987) found that peer interaction in grade 3 is correlated positively with success on perspective-taking tasks. If the ability to coordinate one's perspective with that of others is helpful in achieving maximum progress in socio-cognitive conflict tasks, group problem solving may not be as facilitory for socially isolated children.

Along a similar line of reasoning, Peterson and Skevington (1988) found that children whose parents used induction of cognitive conflict as a child-rearing strategy were advanced in their role-taking skills. Here, the parents used a strategy known as distancing, which involves questions that challenge the child's existing view. (e.g., "How does your friend without the doll feel?"). Parents' use of this strategy was found to be significantly and positively correlated with their children's perspective-taking ability. Again, if greater benefits from socio-cognitive conflict would come to those with superior perspective-taking abilities, children whose parents use distancing strategies and who have had a sufficient amount of peer
interaction would likely be predisposed to benefit from collective conflict.

In sum, age, initial cognitive level, experience with testing situations, perspective-taking abilities facilitated by peer interaction, and child-rearing strategies are intraindividual variables that have been found to mediate the effects of socio-cognitive conflict. The principle mediating interindividual variable is the relative cognitive level of the two participants in a dyad. Many studies have shown that there may be an optimal cognitive gap between participants which most beneficially influence outcomes. In the case of conservation, for example, matches involving a partial conserver with either a nonconserver or a total conserver were found to be the best for stimulating cognitive development in both partners (Mugny & Doise, 1978). Mugny (1978) noted that when a low-level subject is paired with an intermediate subject the intermediate subject, "whose system is less stable, is perturbed by the unacceptable solution proposed by the nonconserver, although he does not yet possess the cognitive instruments necessary to solve the problem. While looking for a satisfactory solution, the partial conservers explicate their strategy and the problems they face. As a result, they progress, but so do the nonconservers who are able to take part in the search for a correct solution" (p.190). Other studies have shown that a nonconserver paired with another nonconserver tend to show little progress on the posttest. Often this is because they both use the same inadequate problem-solving strategies or
because one simply agrees with the other, and as a result usually not much conflict is generated (Mugny & Doise, 1978; Russell, 1981, 1982).

**Alternative Explanations**

The finding that socio-cognitive conflict is most efficacious for a nonconserver when paired with a more advanced partner and the finding mentioned before that the children who benefit the most from conflict are those who already display some competence have caused some concern among theorists. For example, Russell (1981, 1990) questioned (a) whether socio-cognitive conflict is sufficient for intellectual development (can give rise to new competence), (b) whether it merely has the role of a facilitator only useful after an initial grasp of a concept is achieved, or (c) whether it has a role at all. As previously mentioned, he argued that children may simply be modeling a correct answer provided by a more advanced peer. However, this could not account for the finding that children are able to provide correct explanation to which they had not been exposed previously (Mugny & Doise, 1978) or for the gains of children who were paired with someone espousing explanations less advanced than their own (Doise & Mugny, 1976). Finally, if this modeling or social learning interpretation was true then nonconserving children would be just as likely to adopt an alternate nonconserving as a conserving response, a supposition that has not been supported by the literature (Russell, 1990).
Apart from specific experimental concerns, Russell (1990) suggested that an ineffectiveness of socio-cognitive conflict, in the case of conservation, is consistent with Piaget's theory and further, that such conflict cannot be sufficient for giving rise to development. For example, a nonconserver is egocentric in lacking the ability to consider alternate perspectives, and a child that is unable to do so would not be expected to experience or benefit from other conflicting views. Yet, exposure to conflicting viewpoints is implicated in the acquisition of the conservation concept. How can children develop an ability from the very ability that they need to develop? Chapman and McBride (in press) referred to this argument as an epistemological paradox. They tried to resolve this issue by explaining that: (a) Piaget described a transitional stage in development when children are able to recognize a contradiction but still not have the capacity to resolve it; (b) children may acquire the competence to recognize conflict through other means than simply equilibration itself. In other words, Piaget suggested that maturation and the social and material environment were also important factors in development. An interaction between these catalysts and equilibration may be necessary for giving children the initial intellectual equipment necessary for apprehending conflict.

In terms of research, another challenge to socio-cognitive conflict theory concerns the relatively smaller gains obtained by children who display a lack of competency on the posttest. According to this theory, a discrepancy among children's points of
view serves to perturb children causing them to reflect on their own contentions more critically and to consider alternative perspectives on the problem at hand. In turn, this may motivate them to work together in co-ordinating an understanding of the problem that may be superior to one they could construct for themselves. Following this reasoning, one might expect that socio-cognitive conflict could be effective in inducing cognitive change in any situation in which children are exposed to views different from their own and regardless of whether those views are equally as partial and limited as their own. An example might be a conflict between two incorrect solutions. In this case, it seems that the strongest evidence for the efficacy of socio-cognitive conflict as a stimulus to development arises when nonexpert partnerships produce progress without the benefit of modeling.

In an effort to provide evidence for this position, Mugny, Doise and Perret-Clermont (1975, 1976) conducted a conservation experiment in which children who had provided incorrect responses on the posttest were paired with an adult confederate who espoused a conflicting viewpoint that was equally as incorrect as the child's. In that study, children were initially shown two sticks of equal length. After the child agreed that the sticks were equal, the tester moved one over so that the ends of the sticks were no longer aligned, then asked the child if they were still the same length. Here, the nonconserving child would typically reply that one stick was longer because its end protruded past the other. The tester would then
assert that in fact the other stick was longer because its end protruded. If the child changed positions and agreed with the tester, the tester would then suggest the other stick was longer. The findings indicated that nonconservers did advance in this condition, thus supporting the argument that it is conflict itself, not exposure to superior reasoning, that is responsible for measured gains. Moreover, nonconservers have been shown to progress when an opposing incorrect view is postulated by a child as well (Ames & Murray, 1982). Finally, Vincenzo and Kelley (1987) found that children who worked in homogeneous triads of less advanced subjects, as well as those of heterogeneous triads, appeared to experience cognitive growth.

However, research has not entirely supported these findings: The majority of studies in which such a condition was employed report a lack of effectiveness of symmetrical social conflict, wherein each child suggests an equally incorrect answer, in a variety of tasks (Mugny & Doise, 1978; Russell, 1981a, 1981b, 1982; Russell & Haworth, 1988; Russell, Mills, & Reiff-Musgrove, 1990). Although many of these studies found that children's performance was, indeed, facilitated somewhat by symmetrical incorrect conflict, improvement was not found to be significantly greater than that found in the individual condition.

There have been a number of attempts to account for the efficacy of symmetrical incorrect conflict reported by others (Ames & Murray, 1982; Doise, Mugny et al., 1975, 1976). For example,
Russell et al. (1990) reasoned as follows: Possibly, success in such conditions is not brought about by the "collective situation", but simply by spontaneous improvement in one member of the dyad and the adoption of the higher level response by the other member. Such a sequence of events is consistent with the fact that spontaneous improvement is generally seen to occur in individual control conditions, but not to the extent that progress is seen in dyadic conditions. This line of reasoning seems plausible, given that the children who are most likely to benefit from collective problem-solving are those who already have a minimum of task mastery. Thus, if one child in a dyad improved spontaneously the other might be swayed by the certainty of their conservation response and blindly adopt or model the correct answer. Russell's (1990) research has indicated that nonconservers tend to adopt conservation responses more readily than alternative nonconservation responses. Therefore, the chances of being exposed to a conservation response is doubled in the dyadic condition.

Accordingly, Russell (1990) argued that children who have been assessed as nonconservers on a pretest show a 20% spontaneous improvement rate at retest. If one child in the dyad improved spontaneously and convinced the other to adopt a conservation response, the increase in performance of the dyad might be mistakenly attributed to socio-cognitive conflict. However, such an alternate hypothesis can not account for Mugny et al.'s (1975, 1976) findings that performance in the symmetrical
incorrect conflict condition was superior to that in the individual control condition, because the children participating in the former condition were exposed only to an alternate incorrect judgment provided by an adult confederate (Chapman & McBride, in press). Moreover, Chapman and McBride (in press) suggested that discrepancies between studies employing an incorrect symmetrical conflict condition may be accounted for by differences in the amount of conflict employed in the individual control conditions. They suggested that evidence for this possibility may be found in the fact that while Russell observed improvement in his individual control group Mugny et al. (1975, 1976) did not. Possibly, Russell's individual control conditions have included manipulations so effective in inducing intrapsychic conflict that the dyadic manipulation, although fruitful, was not significantly more so. Finally, on a cautionary note with regard to such studies, Bijistra (1989) warned that perhaps experimenters have not been careful enough in separating the higher (intermediate) from the lower level "nonconservers" with the result that these dyads are not purely symmetrical.

Another similar issue is the question of whether simple exposure to a contrary view is beneficial. If socio-cognitive conflict should be effective in inducing cognitive change in any situation in which a child is exposed to views different from their own, then any kind of exposure to such views should be sufficient. However, the limited evidence in regard to this hypothesis is again
mixed. For example, Murray (1974) found that partial conservers evidenced significant posttest gains as a result of exposure to a videotape portraying a conserving model, whereas nonconservers did not. On the other hand, Weinstein and Bearison (1985) compared performance in three conditions, in which (a) partial conservers and nonconservers worked collaboratively, (b) children individually observed pairs of subjects working together, and (c) children worked alone. They found that children in the social interaction condition progressed significantly more than those in the observation and control conditions. There were no significant differences between the latter conditions. Further, children in the social interaction condition provided significantly more novel conservation explanations than those in the observation condition. Weinstein and Bearison interpreted those results as indicating that an active involvement in socio-cognitive conflict is necessary for improvement to occur.

One possible explanation for the discrepant findings between these studies may lay in differences of how much children in each study were induced to focus specifically on the task at hand. The videotape condition employed in Murray's study may have been especially effective in ensuring that children apprehended and paid attention to relevant information. In that condition, the children were first asked to remember the previous conservation "games that they had played" in the pretest and told that they were going to watch a boy on television playing the same game. The children were
specifically instructed to watch "real hard" because the next day they would be playing again. Experimenters took pains to make sure that the children paid close attention to the ensuing six minute video. In Weinstein and Bearison's (1985) social observation condition the children were told to "just watch and see how these other two children play these games". They were then exposed to an entire interaction between two children, presumably only a portion of which contained the relevant conflict and information. The average duration of that interaction was not reported. It is possible that the observers in the Weinstein and Bearison study would have had superior posttest performance if they had been aware of the relevant dimensions of the game or had been instructed to try and think of how they would participate themselves if they were part of the interaction. Such a procedure would be one way of assuring that children apprehended and followed the relevant aspects of the interaction. Overall, the question of whether children may benefit from mere exposure to socio-cognitive conflict remains unsolved.

In sum, two controversial issues found in the socio-cognitive conflict literature center around whether incorrect symmetrical conflict and simple exposure to conflicting viewpoints are sufficient stimuli for cognitive development. Part of the difficulty in answering these questions lies in the lack of control inherent in the social interaction paradigm. Such methods fail to allow control over the types of reasoning to which children are exposed and further fail to insure that children both notice and direct their
attention to the relevant dimensions of the social conflict. If these
difficulties could be overcome, future research could provide the
means for a better understanding of the processes underlying
cognitive development.

Hypotheses

This study was proposed in order to investigate the following
questions: (a) Is social interaction as such necessary for a child to
benefit from a conflict of views? and (b) Can a symmetrical conflict
stimulate cognitive growth, even if the two solutions are incorrect?

The two hypotheses that guided the present study are as
follows:

1. Children will perform better on stories concerning a conflict
of nonconservation arguments between protagonists in which each
argument is incorrect (conflict stories) than they will on
corresponding tasks.

2. Performance will be better on stories containing a conflict
over solutions (conflict stories) than on corresponding stories in
which the protagonists do not argue (nonconflict stories). Similarly,
performance on the nonconflict stories is not expected to be
significantly better than task performance.

If both hypotheses are supported, the results would indicate
that exposure to a conflict of viewpoints can stimulate reasoning
more effectively than consideration of only one viewpoint, even if
the conflicting perspectives are incorrect. The conflict story
paradigm should be especially effective for illustrating the gains from symmetrical incorrect conflict, because such a method controls for the competing hypothesis suggested by Russell that spontaneous improvement plus modeling may be causing improvement in nonconserver-nonconserver dyads. Accordingly, any effect of the conflict stories relative to the effects of tasks and nonconflict stories cannot be attributed to modeling a correct view, because the children will neither be exposed to any correct solutions in the story, nor working with any other children. Therefore, they could not benefit from modeling another child's correct solution. Moreover, the nonconflict story control condition ensures that any effect of the conflict stories can be attributed to the conflict within the story and not to the fictive nature of the task.

Secondly, support for the two hypotheses will provide evidence that social interaction in itself is not necessary for a child to benefit from a conflict of views. The story paradigm should be effective in illustrating that fact because the format of a story helps to ensure that children's interest is maintained and that they pay attention to the relevant information. Weinstein and Bearison's (1985) social observation condition might not have yielded any benefits to children merely observing a conflict of perspectives, because children's attention may not have been directed to the relevant dimensions of the interaction.
CHAPTER 2: METHOD

Procedural Summary

Subjects

A total of 136 children between the ages of 5 and 8 years old were recruited from after-school daycare centers in the Vancouver area. Only children whose parents provided the necessary permission, who were willing to participate themselves, and who spoke and understood the English language adequately were interviewed for this study. An equal number of boys and girls were drawn from one of two age groups comprised of 5-6 and 7-8 years old. There were 72 children in the 5-6 year-old age group ($M = 6$ years, 4 months) and 64 children in the 7-8 year-old age group ($M = 8$ years, 2 months).

Each child was presented with the two conservation tasks as well as the two story versions of these tasks. Half of the children received the conflict versions of the stories and the other half received the nonconflict stories. A digit span task was also administered to all of the participants between the two sets of tasks in order to give the children a rest from the similar sets of questions posed in each task and to minimize the types of carry-over effects that may occur in a repeated-measures design.
The presentation order of the liquid and length tasks in both formats (story format and task format) was counterbalanced, as was the presentation order of format to control for order effects resulting in eight different orders, 16 children were randomly assigned to each order group. The time of testing took approximately 20 minutes for each child.

**Materials**

**Tasks**

Two solid coloured pencils were used as materials in the conservation of length task, these were 180 mm in length. One tall, thin and two identical short, wide glasses and some water were used for the conservation of liquid task, the tall glass was 65 mm in diameter and 135 mm in height, the short glasses were 80 mm in diameter and 95 mm in height. The story format of the length task concerned two farmhands in search of a long and short log. Having discovered two logs of equal length, one of the farmhands kicks one log so that its end sticks out past the end of the other log. He asserts that the log which ends closest to him is now longer than the other, "because its end sticks out". In the conflict condition, the other farmhand, standing at the opposite ends of the logs insists that the other log is longer for the same reason. They argue back and forth in this manner, and the children were asked to resolve the conflict by indicating which log they thought was the longest. In the nonconflict condition, the story is identical, except that when the
one protagonist insists that one log is longer the other simply expresses some doubt. The conservation of liquid story concerns two girls who have ordered two milkshakes of the same size. One shows her friend how to "make the milkshake bigger" by pouring it from the short fat glass to the tall thin one. In the conflict condition, they then argue over whether there is more milkshake in a tall thin glass or in the fat squat glass. In the nonconflict condition, one of the girls simply asks, "Do you really think you have more milkshake than before?" A set of three pictures accompanied each of the stories showing the story objects before, during, and after the transformations of shape.

Procedure

Upon meeting the children the tester would introduce herself and ask the children what their birthdate was and how to spell their names in order to assure that she had the correct information on the consent form and to "warm up" the children so that they felt comfortable. Prior to any testing, the children were consulted as to whether they would like to participate in "playing some games that would help us in our project" and they were assured that they could chose not to participate if they did not want to. Further, they were told that they could stop at any time. At the commencement of all the tasks and stories, children were told, "Now we are going to play a game with sticks (glasses of water)," or, "Now we are going to
read a story about two farmhands (two girls who went to get a milkshake).

Conservation of Length Task

In the conservation of length task, children were shown two pencils with their ends even and asked if they were the same or different lengths. Once the children said that they were the same length, one of the sticks was displaced so that the ends were no longer even. The initial question was then repeated and the children were asked to justify their answers. The protocol for this task may be seen in Appendix A.

Conservation of Liquid Task

Two identical glasses containing the same amount of water were presented to each child for the liquid task. When the children agreed that there was the same amount of water in each glass, the water from one of the glasses was poured into a taller, thinner glass. The tall glass and short glass were then placed side by side, and they were asked again whether the amount of water in the two glasses was the same or different. The children were then asked to justify their answers. The protocol for this task may be seen in Appendix B.

Conservation Conflict and Non-Conflict Stories
Children were read the stories and shown the corresponding pictures (see Appendices C, D, E and F). At the end of each story, they were asked to indicate which of the two logs they thought was the longest or which glass they thought contained more milkshake. At the end of the session, the children were thanked and told that they had been a great help. They were also given some stickers.

Coding

The conservation tasks in both formats were all coded using the same system. Judgments as to whether the materials were the same or different after their configuration was transformed were coded as pass and fail. Children were scored as providing a correct judgment if they stated that the amounts of liquid or the lengths of the logs (or pencils) were the same.

The four answer categories employed for the justifications were as follows:

1. **No Explanation**: This category included all answers that failed to explicitly justify the reasoning the children used to arrive at their justification such as, "I don't know", "I forgot", "I remembered". This category also included all examples of circular reasoning, such as, "Its longer because it's longer".

2. **Nonconservation**: This category included all answers indicating that the children had focused on only one dimension of the array and/or thought that the amount of the task material had changed when its configuration was altered. For example, "This stick is longer because it sticks out", "There is more water in this
glass because it goes higher up than the other one," or, "There's more because you moved it".

3. **Identity**: This category included answers in which the children mentioned that the amounts could not have changed simply as a result of altering their position. For example, "They are the same because they were the same when they started," or "You can't change it by moving it".

4. **Compensation**: These answers reflected children's understanding that a change in one dimension was accompanied by a change in another. For example, "The water is higher in that glass but its wider in the other glass," or "Both the sticks are sticking out at both ends".

Justifications falling in categories 1 and 2 were coded as incorrect, and those in 3 and 4 were coded as correct. For all analyses, children were scored as passing a task only if they provided a correct judgment and a correct justification. Such a judgments-plus-justifications criterion was employed in order to ensure that children credited with passing a task had used conservation logic in order to arrive at their judgments as opposed to a nonlogical strategy such as guessing. If a judgment-only criterion were used, children could answer 50% of the judgment questions correctly on the basis of chance alone. The inter-rater reliability for the justification codes was 87%. Whenever there was a disagreement between raters, it occurred between justification categories 1 and 2 or 3 and 4, never between "correct"
and "incorrect" categories. Thus, 100% agreement was obtained for the judgments-plus-justifications score.
CHAPTER 3: RESULTS

Children's performance (percent correct), scored according to the judgment-plus-justification criterion, is given in Table 1 by content, format, age group, and conflict condition. **Conflict condition** (conflict vs. nonconflict stories) and **age group** (5-6 vs. 7-8 years) are between-subjects factors, and **content** (liquid vs. length) and **format** (task vs. story) are both within-subject factors.

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**Age and Conflict Condition**

The effects of the between-subjects factors of age group and conflict condition were analyzed in a three-way performance (pass-fail) x age group x conflict condition hierarchical loglinear analysis for each content x format within-subjects condition. The best-fitting model was determined through backward elimination: Beginning with the saturated model, each possible main effect and interaction was assessed and dropped from the model if found to be nonsignificant, until only the effects that best described the data remained. For each analysis, the best-fitting model is given in Table 2, along with the $L^2$-fit value for each model and the $L^2$-change values for each effect within each model. The $L^2$-fit values indicate
the goodness-of-fit of the best-fitting models to the data, and the $L^2$-change values represent the amount by which $L^2$-fit would increase if the effect in question were dropped from the model. Accordingly, the $L^2$-change value acts as a test of significance for the effect in question.

As indicated in Table 2, age group x performance interactions were found for each content x format condition, but performance interacted with conflict condition only in the case of the length task. As shown in Table 1, the performance x age group interactions indicate that the performance of the older children (7-8 years of age) was superior to that of the younger children (5-6 years of age) in all content x format conditions. In the case of the three-way (performance x age group x conflict condition) interaction found for the length task, the 7-8 year-olds' performance in the nonconflict condition was superior to the 7-8 year-olds' performance in the conflict condition, and the performance of 7-8 year-olds was better that that of the 5-6 year-olds in both conditions.

Insert Table 2 about here

In order to test the hypothesis suggested in the literature that only intermediate level conservers are likely to be affected by cognitive conflict, the proportions of 5-6 year-olds passing the length and liquid story problems in the conflict condition were
compared to those in the no conflict condition by means of a \( z \)-test of proportions. For the purposes of this analysis, 5-6 year-olds were considered "intermediate" because their performance level was greater than 25% correct, indicating some understanding of conservation, and less than the 75% correct level that is traditionally considered a criterion for mastery in the Piagetian literature. The results indicated that 5-6 year-olds scored significantly higher in the conflict as compared to no conflict condition for the length story only, \( z = 1.97, p < .05 \).

**Content and Format**

In order to compare children's performance on the length and liquid tasks, children were categorized into three groups: (a) those who passed the liquid task and failed the length task, (b) those who performed equally on both tasks, and (c) those who passed the length task and failed the liquid task. This three-level content comparison variable was then cross classified with the between-subjects factors of age group and conflict condition, and the parameters representing simple contrasts between levels of each variable were estimated for the saturated loglinear model. The main effect of content was then tested according to the significance of the parameter representing the contrast between levels (a) and (c) of the three-level variable described above, and the interactions between content and age group and between content and conflict condition were tested by the significance of the corresponding
parameters. A similar procedure was followed in comparing length and liquid stories and for testing differences of format (task versus story) within each content (i.e., for length and liquid separately). (For a general description of the kind of nonstandard loglinear analysis used here and examples of developmental applications, see Rindskopf, 1990).

With respect to the comparison of length versus liquid tasks, the parameter representing the main effect of content was significant, $z = 2.17, p < .05$. As shown in Table 1, children performed better on the liquid task as compared to the length task. However, the parameters representing the interactions between content and age group and between content and conflict condition were not significant. In the case of the comparison of length versus liquid stories, neither the main effect of content nor the content x age group or content x conflict condition interactions were statistically significant.

With respect to the comparison of stories and tasks within length, the parameter representing the interaction between format and conflict condition was significant, $z = 2.06, p < .05$. As shown in Table 1, children in both age groups performed better on the length story as compared to the length task in the conflict condition, but not in the nonconflict condition. Neither the main effect of format within length nor the interaction of format and age group were statistically significant. With respect to the comparison between tasks and stories within liquid, neither the main effect of format
nor the format x age group or format x age group x conflict condition interactions were statistically significant.

**Justification Types**

The percentages of children providing each category of justification is given in Table 3. Four loglinear tests of independence between justification types and conflict condition, computed separately for each content within age group, yielded only one significant finding, for the liquid story among 7-8 year-olds, $\chi^2(3) = 11.87$, $p < .01$. In this case, the children's performance was superior in the nonconflict as compared to the conflict condition, although the pass rate in both conditions was above 80 percent. However, these analyses should be viewed with caution because of the low cell frequencies for some of the justification categories.

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Insert Table 3 about here

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Also observable in Table 3, is a general pattern among the 5-6 year-olds of more nonconserving justifications and fewer identity justifications in the nonconflict as compared to the conflict stories. In the case of *length*, the 5-6 year-olds provided, 22.2% versus 47.2% nonconserving and 50.0% versus 25.0% identity justifications for the conflict and nonconflict stories, respectively. For *liquid*, the
comparable figures were 36.1% versus 52.8% nonconserving and 33.3% versus 22.2% identity justifications. In order to explore this trend more closely, the association between these two types of justifications and conflict condition within age group was tested with a two-way loglinear analysis. The irrelevant and compensation justification categories were excluded from this analysis on the principle that conflict stories should be most beneficial for those at an intermediate level of understanding. Accordingly, children who offer irrelevant justifications (e.g. "I don't know") and those providing full compensatory justifications were judged to fall outside the range of intermediate conservation reasoning. The percentages of the 5-6 year-olds providing nonconservation and identity justifications to the stories in both conflict conditions is provided in Table 4. Of the two content groups, an interaction between explanations and conflict condition was found only for length, $L^2(1) = 6.37, p < .05$. Because the foregoing analyses were conducted after seeing the data in Table 3, they must be considered post-hoc only. The reliability of the effects of cognitive conflict on nonconserving and identity justifications needs to be verified in subsequent research.
Order

In order to determine whether the order in which the within-subjects problems affected performance, the frequency of children passing each problem was compared across order groups. Each analysis was conducted separately for each age group and conflict condition. Children's correct performance is shown in Table 5 by age and order groups.

For the length task, significant order effects were found for the 5-6 year-olds and the 7-8 year-olds in the conflict condition, $L^2(3) = 8.96$ and $L^2(3) = 9.54$, both $p's < .05$, and for the 5-6 year-olds in the conflict condition, $L^2(3) = 8.96$, $p < .05$. In all cases, the children tended to perform better when the task came later in the testing session. An order effect was also found for the length story among 5-6 year-olds in the conflict condition only, $L^2(3) = 10.84$, $p < .05$. Again, the children's story performance increased as it came
later in the testing session. For the **liquid task** no order effects were found, but for the **liquid story** there were order effects for the 5-6 year-olds in both the conflict and nonconflict conditions, $L^2(3) = 11.19$ and $L^2(3) = 12.83$, respectively (both $p$'s < .05). In those cases, however, the effects failed to follow the usual trend of better performance later in the session. In the conflict condition, the children performed best on the liquid story when it followed the liquid task, second best when the liquid conflict story came first or last in the testing session, and poorest when the length task and story preceded the liquid conflict story. In the nonconflict condition, 5-6 year-olds performed best when the task came first, second best when when the length task and story preceded it, third best when only the liquid task preceded it, and poorest when it came last in the testing series.
Chapter 4: Discussion

Two central questions concerning the relation between conflicting perspectives and problem solving in young children were addressed in the present study. First, can children benefit from observation of a conflict, even if both parties of the discussion argue incorrect views? Second, given that a conflict of perspectives within a social interaction can facilitate problem solving, do children need to be interacting with the proponents of these views to be benefitted? Or is simple exposure to a conflictual interchange sufficient?

The results of this study suggest that the performance of 5-6 year-old children on conservation of length problems was facilitated when such problems were presented in a conflict story format as compared to either a nonconflict story format or a traditional task format. However, performance on the nonconflict story format was not significantly different from that on the task format. Such findings provide some support for the hypotheses (a) that exposure to conflicting viewpoints can be cognitively beneficial, even if these viewpoints are incorrect, and (b) that children need not be active parties to an interaction in order to benefit from "socio-cognitive conflict".

With regard to the first hypothesis, the finding that the children in the younger age group performed better in the conservation of length conflict story condition as compared to a traditional task condition indicates that children can and do benefit
from symmetrical conflict, even when the conflicting information is incorrect. The finding that performance in the conflict story condition was also better than that in a corresponding nonconflict story condition, which did not significantly differ from that in the traditional task condition, suggests that the 5-6 year-olds in the length conflict condition benefitted from the conflict in the story, rather than simply from the narrative format of the task.

This evidence provides support for the efficacy of socio-cognitive conflict as a stimulus to development and is consistent with the results of other research in which symmetrical incorrect conflict produced superior reasoning (Ames & Murray, 1982; Doise, Mugny et al., 1975, 1976). However, the design employed for this research served to counter various methodological critiques to which earlier studies remained open. Most importantly, the present method controlled for the competing hypothesis suggested by Russell, Mills, and Reiff-Musgrove (1990) that spontaneous improvement plus modeling accounts for posttest improvement in nonconserver-nonconserver dyads. To recap briefly, those authors pointed out that children sometimes improve spontaneously in individual control conditions and that such spontaneous improvement can be expected to arise in nonconserver-nonconserver dyads, allowing the enlightened children to share their reasoning with their partners. The partners may then adopt or model conservation answers without appreciating the underlying reasoning, and thus falsely appear to have benefitted cognitively from the interactions.
In this way, increased performance in social interaction conditions may be attributable to a number of children merely imitating the answers provided by their partners rather than to genuine cognitive change. Moreover, Russell, Mills, and Reiff-Musgrove (1990) noted that in previous studies children seemed especially likely to adopt the conservation answer of their partners because such answers were typically delivered with confidence.

The results of the present study are not open to this alternative hypothesis, because children were not exposed to correct solutions in the story nor were they working with any other children who could provide them with conservation responses. The fact that the younger age group performed significantly better in the length conflict story condition as compared to the corresponding nonconflict story and task conditions is especially impressive, given the manner in which the conservation test questions were posed. Recall that in the length story conditions children were asked, "Do you know which log is longer?" In that case, providing a correct solution (i.e. that both logs are the same length) entailed giving an answer completely different from either of the misleading alternatives. The test question posed for the length task was much less misleading. Children were asked, "Is one of the sticks longer or are they both the same length?" Thus, despite the fact that they were not exposed to correct solutions and that questions were posed in a misleading manner, children's reasoning was facilitated by symmetrical incorrect conflict
The success of this research calls into question the suggestion made by Russell, Mills, and Reiff-Musgrove (1990) that nonconservers lack the logical insight to benefit from cognitive conflict because the inability to conserve is intertwined with the inability to comprehend conflict. The results of this study suggest instead that nonconservers as measured on the task both recognized and benefitted from the contradiction to which they were exposed in the conflict stories. However, I do not argue that conflict is a sufficient condition for conservation reasoning, only that it is a facilitative one. As mentioned in Chapter 1, children may be unaware that their solutions are contradictory (Murray, 1983), or they might notice a conflict of perspectives but view it as stemming from mysterious origins ("when you are looking it is bigger, when I am it is not") (Mugny, 1984, p. 135). In such cases exposure to conflict is not sufficient for conservation. Conflict can facilitate the reasoning of nonconservers, however, by directing attention to originally neglected aspects of the task which must be taken into account if the problem is to be fully understood (Chapman & McBride, in press).

In regard to the second implication of these results, the evidence that the 5-6 year-olds' performance was superior in the conflict as compared to the nonconflict story condition in the case of length provides some indication that children can benefit cognitively from merely being exposed to a conflict of perspectives without actually participating in the situation from which such
conflict arises. This result calls into question the findings of Weinstein and Bearison (1985) discussed in Chapter 1, which suggested that "social observation" of a conflict is no more beneficial than working alone. It may be the case that children in such social observation conditions, who only passively observe a conflictual discussion, fail to understand which aspects of the interaction they should attend to. As previously mentioned in Chapter 1, the children in that condition were simply asked to watch the another two children interacting, and their attention was not directed towards any particular aspect of the interaction. In this study, the conflict story format was useful for illustrating the potential benefits of social observation of a conflict, because the simple and interesting story format may have helped to ensure that children apprehended the relevant information. In this view, presenting children with a story, rather than a real interaction, helps to control the sheer degree of complexity, number of events, and extraneous information to which children are exposed and to ensure that the relevant aspects of the fictive interaction are apprehended. Clearly, a story depicting an interaction is not the same as a real interaction but it perhaps may be considered sufficiently similar to have the predicted effect.

Although the hypotheses were not supported by the findings yielded by the conservation of liquid problems, in which children's performance in the conflict story condition was not significantly better than the liquid task and nonconflict story conditions, the
trend was clearly in the predicted direction as shown in Table 1. This null result might be explained in part by the finding that performance was quite high on the liquid task, suggesting that a ceiling effect may be responsible for the lack of differences among the various liquid content conditions. In particular, the performance of the older age group was nearly at ceiling level for all tasks.

There are many reasons that could account for the superior performance on the liquid task compared to the length task, a finding that is consistent with those of other studies (Flavell, 1985). For example, children may well have more experience with the conservation of liquid as compared to length. The very form of the task, pouring water from one glass into another, is likely to be a more familiar experience for children than that of the conservation of length task. Secondly, the conservation of length task may be more difficult because children find the task to be more misleading. Children typically fail conservation problems because they focus their attention on one salient aspect of the array while neglecting other task-relevant features (Flavell, 1985). For example, when the tester moves one of the sticks so that the ends of the two sticks are no longer aligned, the younger children tend to focus on the protrusion of the stick that has been displaced beyond the other stick, neglecting the fact that the other stick protrudes at the opposite end of the array. Chapman and McBride (in press) suggest that the displacement of the stick serves as a "misleading cue"
causing the children to focus on one aspect of the display to the exclusion of other relevant aspects.

In contrast, it is conceivable that the displacement of liquid into a taller and thinner glass next to a short fat glass, as in the conservation of liquid problem, does not engender a cue as misleading as that in the length task because of the visual juxtaposition of the relevant features of the display (e.g., relative height and width). Children might be drawn to the greater height of the liquid in the tall thin glass, but perceive in the same glance the greater width of the liquid in the second short fat glass beside it. In this way, two contradictory facts may be noticed simultaneously, aided by their proximity to each other. Given the tendency for children to infer relative amounts as a function of single physical dimensions they might infer the contradictory conclusion that both glasses contain "more" liquid, one as a function of being higher and the other as a function of being wider. In short, the nature of the conservation of liquid task may be such that it facilitates simultaneous attention to the physical dimensions that must be considered in order for a valid inference to be made. In contrast, the length task may be more misleading, because the relevant aspects occur at opposite ends of the array and the act of displacing one of the sticks in a particular direction might draw children's attention toward one end and away from the other. This account of performance differences between the two tasks could be assessed
empirically by studying the effects of various distances between task-relevant cues on conservation performance.

For the most part, the discrepancy between the findings of the present study and those of others has been attributed to the use of the story paradigm. A story format allows for control over many important factors that are difficult to control in a social interaction format. As previously mentioned, the foremost of these factors concerns control over the type of reasoning espoused in the "interaction". As compared to a social interaction format, in which conflicts between perspectives often fail to arise and simple compliance is a concern, a simulated fictive condition does not necessitate the employment of groups or dyads of children working together, allowing the experimenter to determine the degree and types of conflict that occur. Although the use of confederates also allows for such control, this fictive method is more expedient and less expensive. Moreover, social factors such as anxiety and distractions, which can affect children's responses or inhibit the attention available to the task, are inherent to social interaction but less of a concern with the story method. Finally, the fictive conflict method may prove to be a useful tool in future studies for illustrating the effects of relative dominance of partners on reasoning in a conflictual interaction.

One limitation of the present study is that it cannot be determined whether children's reasoning was facilitated by conflict itself or by the information contained in the differing justifications
provided by the story characters. Accordingly, the findings of the present study suggest a further avenue of research aimed at delineating the particular aspects of social conflict that advance understanding. In order to investigate the relative effects of information and conflicting judgments, performance on the following types of story problems could be compared: (a) stories in which the two characters disagree about the solution of a problem without providing justifications for their reasoning, (b) stories in which the two characters who disagree produce justifications for their viewpoints, (c) stories in which characters provide justifications for different viewpoints without coming into conflict, and (d) stories that include neither conflict nor justifications. The exploratory analysis of the justification types in the present study suggests the following prediction: that children will produce more identity justifications and fewer nonconserving justifications in the conflict as compared to nonconflict conditions.

Another question to be investigated in future research concerns the comparison of performance in conflict story conditions with that in social interaction dyad conditions. In order for such fictive conflict to be considered an analogue to real interaction, the differences and similarities between the two conditions should be elucidated. However, the use of a story paradigm as opposed to an interaction paradigm in this study in no way detracts from the results. The main question posed at the beginning of this study was whether exposure to a conflict of perspectives is sufficient for
facilitating reasoning. Investigating such a question did not necessitate the study of children actually working together. Even so, the story method employed helped to avoid a number of factors that complicate research on social interaction. Such a method may prove to be a useful tool in future studies for illustrating the role of socio-cognitive conflict in cognitive development.
References


Russell, J. (1981a). Why 'Socio-cognitive conflict' may be impossible: the status of egocentric errors in the dyadic


# Table 1

**Percent Correct by Task, Condition, and Age Group**

<table>
<thead>
<tr>
<th>Content/Format</th>
<th>Conflict Condition</th>
<th>Age Group (Years)</th>
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<tbody>
<tr>
<td><strong>Length Task</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conflict</td>
<td>31</td>
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<td>Nonconflict</td>
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<td>90</td>
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<tr>
<td><strong>Length Story</strong></td>
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<td>Conflict</td>
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<td>Nonconflict</td>
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<td>81</td>
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<td><strong>Liquid Task</strong></td>
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<td></td>
</tr>
<tr>
<td>Conflict</td>
<td>44</td>
<td>81</td>
</tr>
<tr>
<td>Nonconflict</td>
<td>30</td>
<td>90</td>
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<tr>
<td><strong>Liquid Story</strong></td>
<td></td>
<td></td>
</tr>
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<td>Conflict</td>
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<td>84</td>
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<tr>
<td>Nonconflict</td>
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<td>94</td>
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</table>

\[ a \ n=72 \]
\[ b \ n=64 \]
### Table 2

**Hierarchical Loglinear Analysis of Age Group and Conflict Condition for All Content x Format Conditions**

<table>
<thead>
<tr>
<th>Content x Format</th>
<th>Likelihood Ratio Tests</th>
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<tbody>
<tr>
<td>Length Story</td>
<td></td>
</tr>
<tr>
<td>Performance x Age Group</td>
<td>L²-fit (df), p &lt; .440</td>
</tr>
<tr>
<td>Length Task</td>
<td></td>
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<tr>
<td>Performance x Age Group</td>
<td>0.00 (0), =1.00</td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Performance x Age Group</td>
<td>3.74 (4), &lt; .480</td>
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<tr>
<td>Liquid Task</td>
<td></td>
</tr>
<tr>
<td>Performance x Age Group</td>
<td>2.67 (4), &lt; .615</td>
</tr>
</tbody>
</table>
Table 3

Percent of Justification Categories for the Conflict and Nonconflict Stories by Age Group

<table>
<thead>
<tr>
<th>Justification Category¹</th>
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<td>Condition</td>
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<tr>
<td>5-6 Year-olds (n=72)</td>
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<tr>
<td><strong>Length</strong></td>
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### 7-8 Year-olds \((n=64)\)

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1: No Explanation; 2: Nonconservation; 3: Identity; 4: Compensation
Table 4

Percent of Nonconserving and Identity Justification Categories for the 5-6 Year-Olds by Conflict Story Condition

<table>
<thead>
<tr>
<th>Task</th>
<th>Nonconserving</th>
<th>Identity</th>
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Table 5  
**Number of Children Passing Each Task By Order By Age Group**

<table>
<thead>
<tr>
<th>Conflict Condition</th>
<th>Order</th>
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5-6 Year Olds (n=72)
7-8 Year Olds ($n=64$)

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<td>4</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>8</td>
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</tbody>
</table>

1 Order 1: length task, length story, liquid task, liquid story  
Order 2: length story, length task, liquid story, liquid task  
Order 3: liquid task, liquid story, length task, length story  
Order 4: liquid story, liquid task, length story, length task
Appendix A

Conservation of Length Task

Tester lays out two sticks so that the ends are even.
1) "Here are two sticks. Is one longer or are they both the same?"
Tester moves one of the sticks so that the end sticks out.
2) "Now, is one longer or are they both the same?"
3) "How do you know?"
Appendix B

Conservation of Liquid Task

The tester shows the child two glasses of the same size each filled with an equal amount of water.

1) "Here are two glasses of water. Does one have more water in it than the other or are they both the same?"

The tester pours one of the glasses of water into a taller thinner glass.

2) "Now, does one have more water in it than the other or are they both the same?"

3) "How do you know?"
Appendix C  
The Length Conservation Conflict Story

Once there was a farmer who had two farmhands who helped him do all his farmwork, and their names were Burt and Kelley. One day the farmer called Burt and Kelley and told them "I need both of you to go and find two logs to fix the broken fences. One of the logs must be longer than the other one, because one of the fences is bigger than the other. Please go and get these two logs for me and don't forget that one must be longer than the other." So off Burt and Kelley went to try and find two logs. They decided that the best place to find them would be in a forest, so that is where they went. Right away Burt saw two logs that were lying on the ground side by side. "Look" he yelled "there are two logs right there, now we won't have to look any further." Both Burt and Kelley looked at the two fallen logs that were lying side by side on the ground and Kelley said "we were supposed to get one log that was longer than the other, but these two logs look like they are the same size." Then Kelley got an idea, he kicked one of the logs so that it's end stuck out past the end of the other log. "There" he said "now this log is longer than the other one. You can tell, because its end sticks out beyond the other one." Burt walked around to the other side of the logs. "I don't know" he said "I think the other log is longer because it sticks out farther on this end." "No you're wrong" Kelley said "the first log is longer because it sticks out farther at my end." Burt and Kelley argued
back and forth for a long time, each saying that the log sticking out closest to him was really longer.

1) What do you think? Can you help Burt and Kelley figure out which log is longer than the other?

2) How do you know?
Appendix D

The Liquid Conservation Conflict Story

One afternoon when school had finished for the day, Becky and her friend Debbie decided to go out for a milkshake. Both of their mothers gave them enough money to get a small milkshake each. They went to a nice restaurant down the block from where they lived that had the best milkshakes in town. Becky asked the waiter to bring her a small chocolate shake, and Debbie ordered a strawberry shake. When their milkshakes came they were both the same size and very small. "This is the smallest small milkshake I've ever seen in my whole life" Becky said. "I wish I could have a bigger one." Debbie looked at her friend with a smile and said "I know a way of making it bigger." She called the waiter and asked him to bring them a bigger glass. Soon the waiter returned with a tall thin glass and put it on the table in front of Debbie. Debbie poured the milkshake from her short fat glass into the tall thin glass and said, "Look, now I have more milkshake than you do because mine goes higher up in the glass." Becky stared at the glass. The drink was higher up. But then Becky said "No, you're wrong. I have more milkshake than you do because my glass is fatter than yours." Debbie said "No I have more because mine is taller." The two girls could not agree who had more milkshake.

1) What do you think? Can you help Debbie and Becky decide who has more milkshake?

2) How do you know?
Appendix E

The Length Conservation Nonconflict Story

Once there was a farmer who had two farmhands who helped him do all his farmwork, and their names were Burt and Kelley. One day the farmer called Burt and Kelley and told them "I need both of you to go and find two logs to fix the broken fences. One of the logs must be longer than the other one, because one of the fences is bigger than the other. Please go and get these two logs for me and don't forget that one must be longer than the other." So off Burt and Kelley went to try and find two logs. They decided that the best place to find them would be in a forest, so that is where they went. Right away Burt saw two logs that were lying on the ground side by side. "Look" he yelled "there are two logs right there, now we won't have to look any further." Both Burt and Kelley looked at the two fallen logs that were lying side by side on the ground and Kelley said "we were supposed to get one log that was longer than the other, but these two logs look like they are the same size." Then Kelley got an idea, he kicked one of the logs so that it's end stuck out past the end of the other log. "There" he said "now this log is longer than the other one." Burt walked around to the other side of the logs to see if this was indeed true. Now, Burt and Kelley were standing at opposite ends of the logs. "I don't know" Burt said "They both looked the same before." 1) What do you think? Can you help Burt and Kelley figure out which log is longer than the other?

2) How do you know?
Appendix F  

The Liquid Conservation Nonconflict Story

One afternoon when school had finished for the day, Becky and her friend Debbie decided to go out for a milkshake. Both of their mothers gave them enough money to get a small milkshake each. They went to a nice restaurant down the block from where they lived that had the best milkshakes in town. Becky asked the waiter to bring her a small chocolate shake, and Debbie ordered a strawberry shake. When their milkshakes came they were both the same size and very small. "This is the smallest small milkshake I've ever seen in my whole life" Becky said. "I wish I could have a bigger one." Debbie looked at her friend with a smile and said "I know a way of making it bigger." She called the waiter and asked him to bring them a bigger glass. Soon the waiter returned with a tall thin glass and put it on the table in front of Debbie. Debbie poured the milkshake from her short fat glass into the tall thin glass and said, "Look, now I have more milkshake than you do because mine goes higher up in the glass." Becky stared at the glass. The drink was higher up. "Wow" she said "that is a really great trick. Do you really think you have more milkshake than before?"

1) What do you think? Is Debbie right that she has more milkshake than before or does the other glass have more?

2) How do you know?