

CONCEPT LEARNING OF YOUNG CHILDREN AS A  
FUNCTION OF SIBLING RELATIONSHIP TO  
CHILD - TEACHERS

Thesis for the Degree of Ph. D.  
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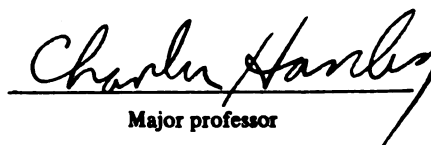
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presented by

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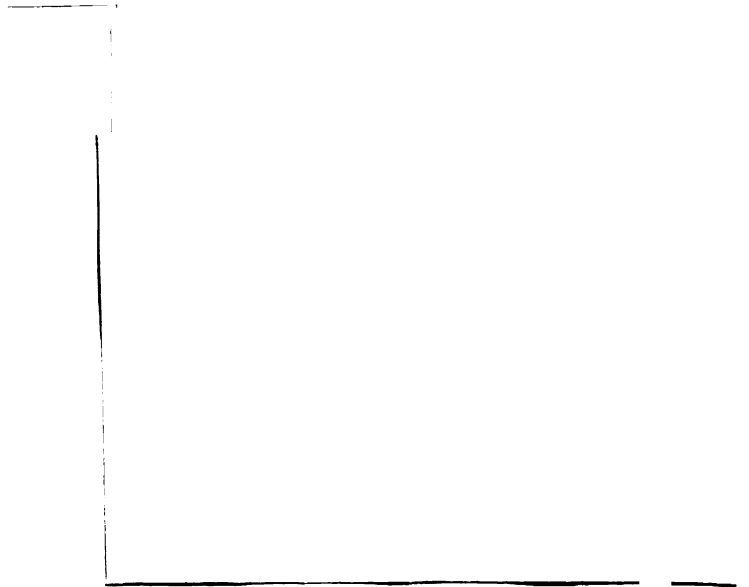
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## ABSTRACT

### CONCEPT LEARNING OF YOUNG CHILDREN AS A FUNCTION OF SIBLING RELATIONSHIP TO CHILD-TEACHERS

By

Victor G. Cicirelli

This study asked the question: Is concept learning of a younger child taught by an older child affected by sibling relationship? Each of the 120 first-grade children had an older sibling in third-grade; equal samples of 30 sibling pairs were drawn from the population of boys with older sisters, boys with older brothers, girls with older sisters, and girls with older brothers. For half of these children, the older sib served as teacher of the younger sib; the remainder were re-paired so that the older child taught an unrelated first-grade child. Once taught the concept, the older child taught it to the younger child in a 10-minute session.

The children scored higher on the concept attainment test when taught by a female sib than when they were taught by a male sib or by a female nonsib--boys scoring higher than girls. Girls teaching their sibs used a

deductive teaching method more than did other teachers. Children with higher concept attainment scores also showed greater awareness of the relevant attributes of the concept. Results can be interpreted in terms of role theory and sibling rivalry and have implications for the selection of older children for use in school tutoring programs.

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TO CHILD-TEACHERS

By

Victor G. Cicirelli

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# I

## INTRODUCTION

The academic achievement of children varies from child to child within the same family as well as from one family to another. Many investigators explain this phenomenon, at least partially, in terms of different parent-child interactions. Presumably, parents treat their children differently depending on the child's position in the family, and this in turn leads to differences in achievement. However, other investigators, while recognizing the influence of the parent, hold that the achievement of each child in the family may be related to the direct influence of sibling-sibling interactions on the child. Presumably, siblings also treat each other differently depending on their positions in the family, and this contributes to differences in achievement.

The achievement of each child in the family might be understood better if more attention were given to sibling structure and interaction as variables influencing the child directly or in conjunction with parent-child interactions. (Two children have a sibling relationship

when they share the same parents. The sibling structure of a family is the network of positions for children in the family defined by the number of children, birth order, sex of the children, their ages, plus the age spacing between the children. The sibling status of two or more children is their position within the network, defined by the age, sex, and birth order of each, plus the age spacing between them. "Sibling interaction" means the reciprocal interchange of nonverbal, emotional, and intellectual communication between siblings.) Intellectual communication (for example, the instruction of a younger child by an older) as one aspect of sibling interaction is of particular interest in relation to children's achievement, as also is the way such interaction may be patterned depending on the sibling status of the children. This study investigates the effect of the sibling relationship (for children with different sibling statuses) on the learning of a concept by a young child taught by an older child, and demonstrates the importance of sibling interaction as an educative process influencing the child's achievement.

There is evidence in the literature for the different treatment of children in different positions in the family by the parent. For example, Bossard and Boll (1960) describe the distinct role expectations for children depending on their position in the sibling structure.

In an interview study, Dean (1947) reported that mothers perceived their older child differently from their younger child of the same sex, and, in an observational study, Lasko (1954) noted that mothers were less warm emotionally and more restrictive and coercive toward their first child than toward their second. Similarly, Hilton (1967), in a laboratory study, found that mothers of first-born children were more likely to interfere with and direct the behavior of their first-born than their second-born child.

There is, however, little evidence relating interaction with siblings to the child's characteristics, behavior, and development. Irish (1964) has stated that in general the interactions between and among children in the home have been given relatively little heed, and, according to Bossard and Boll,

The role of siblings has been considered chiefly in the light of 'displacement' and 'rivalry.' It is rarely that one finds any but the negative aspects of sibling relationships, and warnings how to deal with them (1954, p. 532).

Yet Irish has surveyed the sociological literature to point out the strength and positive values of the sibling bonds throughout life, rating them second only to mother-child ties. He states,

Sibling relationship can perform a number of functions. Brothers and/or sisters spend many hours together and share a wide range of activities. . . . Interactions with siblings function as one avenue for the socialization of children . . . on occasion, siblings may act as substitutes for parents. They turn

to each other when sufficient attention is not shown by an indifferent, harried, or uncomprehending parent. Sometimes siblings are more effective teachers than adults, particularly if youthful skills are involved. Siblings may often understand childhood problems and new situations better, in some ways, than do the parents they share. . . . Siblings may serve as role models for one another; particularly may the younger observe the older siblings of the same sex. They can serve as challengers and stimulators (1964, p. 282).

From interview-questionnaires administered to kindergarten children from two-child families, Koch (1960) found that 70% of the children would rather play with their sibs than play alone (even though, paradoxically, second-born children said that they would be happier if they had no sib).

Adams (1963) found that siblings maintain fairly frequent contact throughout life, and that sibling rivalry or comparison between brothers remains important in adulthood.

From a comparative viewpoint, Harlow's (1969) studies with monkeys demonstrate the importance of peer interaction for adequate socialization (where peers are age-mates reared with the infant monkey). Cooperative behavior, control of aggression, and appropriate sex behavior develop optimally when both maternal care and peer play are available in contrast to maternal care alone. In fact, peer interactions under optimum conditions may fully compensate for lack of mothering.



Sutton-Smith and Rosenberg state,

Until now most of the work on siblings has attempted to show how parents make siblings different. The major point to be made in this book, however, is that siblings also make each other different (1970, p. 2).

Although the foregoing studies and comments make the reader appreciate the importance of a child's siblings for his development, they do little to clarify the nature of the sibling interaction.

In this regard, one study by Sutton-Smith (1966) asked fifth-grade children what games they played with their sibs and with their nonsib playmates, and who was usually "boss" in the play. He found that first-born children took high power roles with their younger siblings, and equal or lower power roles with their friends, while later-born children took low power roles with their older siblings but high power roles with their friends.

Sutton-Smith and Rosenberg (1970) reported the results of an interview questionnaire administered to upper-grade elementary school children in regard to tactics to get their sibling to do what they wanted him to do. Boys used attack and offense more often, while girls used reasoning, defense, and making the sibling feel obligated; certain tactics were more typical of first-born than of later-born children. Also same-sex siblings used more powerful tactics than did opposite-sex siblings.

Unfortunately, not much is known about the effect of sibling interaction on the child's achievement. There are no studies demonstrating that different sibling interactions are related to differences in achievement; studies relating sibling structure to achievement have not dealt with intervening sibling interactions. There are many studies relating birth order to children's achievement, but the literature is relatively small when one considers other sibling variables (age, sex, age spacing between siblings) and families with more than two children. Nevertheless, it seems important to summarize the results of certain studies in this area, as they demonstrate that a child's achievement is rather strongly influenced by his position in the sibling structure.

#### Sibling Structure, Intelligence, and Achievement

In the investigation of the relationship of sibling structure to intelligence and achievement, the earliest research efforts centered around family size and IQ. In general, a negative correlation has been found, which may diminish or disappear with increased socioeconomic status (Anastasi, 1956). Apparently family size as such need not limit the intellectual functioning of family members, provided the socioeconomic level of the family is high enough to provide adequate care for each child.

A second major question has been the effect of birth order on ability and achievement, spurred both by the psychoanalytic conception of the unusual role of the first-born and by observation of the over-representation of the first-born among the eminent (Altus, 1966; Schachter, 1963). Studies of birth order among older children and college students have generally demonstrated the superiority of the first-born over the later-born child on measures of IQ and school achievement (Altus, 1966; Lees & Stewart, 1957; Maxwell & Pilliner, 1960; Rosenberg & Sutton-Smith, 1964; Schachter, 1963; Walker & Tahmisian, 1967), although the situation appears to be reversed with preschool and kindergarten children (Abe, Tsuji, & Suzuki, 1964; Koch, 1954). It might be noted parenthetically that Bayley (1965) found no relation between birth order and sex of the child and mental and motor test scores from 1-15 months of age. Harris (1964), in a detailed analysis of the work of eminent and highly creative men, concluded that those among them who were first-born children tended to produce work of an abstract verbal nature, while the work of those who were later-born children was characterized by practical inventiveness and precise, discriminating attention to detail. The superiority of the first-born child, particularly in verbal skills, is usually accounted for by his unique relationship with his mother.

Studies of more complex family patterns engendered when the child's birth order, sex, sex of sibling(s), and sibling spacing are taken into consideration have found their effect on the child's intelligence and achievement to be less simple than that claimed for birth order alone. Such findings are characterized by a great deal of interaction between variables, most frequently involving the sex of the child in relation to the sex of the sibling. Both Koch (1954) and Schoonover (1959) reported that, in the two-child family, boys and girls with a male sibling were superior in IQ and achievement to children with a female sibling. They concluded that, perhaps because of his greater freedom, the male is somehow more stimulating to his sib. Rosenberg and Sutton-Smith (1964), in a study of college students, confirmed this finding for quantitative scores on the ACE, but found that language scores were enhanced by the presence of a female sibling. When the three-child family was considered (Rosenberg & Sutton-Smith, 1966), the quantitative ACE scores were enhanced for girls who had two brothers, and for boys who had heterogeneous siblings (rather than two brothers or two sisters). In a third study (Rosenberg & Sutton-Smith, 1969), college males from two-child families scored higher on the ACE when there was a large (4-6 year) age spacing between them and their sibs, while females scored higher when they had a female sib with a close age spacing

(1-3 years). Cicirelli (1967), in a study of sixth-grade school children, found that in the two-child family first-born girls and second-born boys scored higher on IQ than second-born girls or first-born boys, while reading and arithmetic achievement was enhanced for children with a sibling of like sex close in age. In a portion of the study concerned with larger families, birth order was not significantly related to abilities or achievement in three- or four-child families; however, in the three-child family, IQ and reading achievement were significantly depressed for children who had two brothers (compared to children who had two sisters, or a sister and a brother).

Only a small amount of evidence is available regarding other kinds of cognitive abilities and traits. Stewart (1967) discovered the first-born male to be more field-dependent than the last-born male, while Eisenman (1967) found that first-born males and later-born females prefer greater stimulus complexity than do later-born males or first-born females. Cicirelli (1967) reported that, in the two-child family, verbal creative abilities were enhanced for children who had a sibling of like sex close in age.

Even though any attempt at summarizing the complex interactions between sibling structure variables found in the Koch, Rosenberg and Sutton-Smith, and Cicirelli

studies will surely result in over-simplification, certain general trends exist in their results:

1. Ordinal position in the family bears less relation to intellectual ability and achievement in the three- and four-child family than in the two-child family.
2. There is some evidence (Cicirelli, 1967) for a developmental trend in the effects of birth order and sibling sex; that is, a sibling status associated with enhanced development of a child's abilities at a certain age may be less facilitating at a later stage in the child's development.
3. Sibling spacing may affect intellectual ability in interaction with sex and position variables, but the effect is not clear or consistent. Effects of sex and position variables seem most pronounced for spacings of 2-4 years.
4. Intellectual ability seems to be affected by the sex of siblings (female sibs associated with verbal ability, male sibs with quantitative).

The previous research has made it evident that a child's learning and achievement are rather strongly influenced by the siblings who surround him during his early years. Some writers (Bossard & Boll, 1960; Harris,

1964) attribute these effects largely to the different parental treatment accorded a child by virtue of his age, sex, and position in the family, and to the resulting role specializations within the family. Others (Irish, 1964; Koch, 1960; Sutton-Smith & Rosenberg, 1970) recognize the influence of the parent, but hold that the quality of the interaction between siblings is an important factor; sibling interactions, like parent-child interactions, vary according to the participants' positions in the sibling structure. A child's achievement has been related to his sibling status, and his sibling status has been related to the nature of his sibling interactions; there is as yet no evidence demonstrating sibling interaction to be an intervening mechanism between sibling status and sibling achievement.

#### Problem

Inasmuch as the sibling relationship is one of extensive intimate daily contact, it seems reasonable to assume that a sibling pair has established customary patterns of communication and responsiveness to each other, i.e., an enduring, characteristic manner of interacting. One aspect of this characteristic interaction pattern might be an educative function where information is transmitted from one sibling to another and styles of learning and abilities are gradually shaped and resulting levels of achievement modified.

If a sibling relationship leads to characteristic and enduring ways of interacting, and one aspect of this interaction is educative, then a young child might learn more when taught by an older sibling (with whom he has well established communication patterns) than when taught by a similar child who is not his sibling. In other words, children who have a sibling relationship may learn more in a teaching-learning interaction situation than children who do not have a sibling relationship. Of course, the sexes of the children (and other sibling status characteristics) may influence both the interaction and the learning achievement.

On the other hand, the effects of sibling rivalry and competition are not clear, although Rosenberg and Sutton-Smith (1969) suggest that sibling competition may have a negative effect on males when their sib is close in age.

Studies of social reinforcement (Stevenson, 1965) while not involving a teaching-learning situation have shown that social reinforcement by peers was effective in increasing task performance. However, effects were greater when reinforcement was delivered by a disliked rather than by a liked peer. Also social reinforcement was more effective when delivered by strangers than by parents. If one considers the older child in the teaching-learning situation as having some of the properties of



the social reinforcer, then one might predict that the more familiar sibling would be less effective than the nonsibling.

In the present experiment, the older child of a pair of children (both sibling and nonsibling pairs) was given a set period of time to teach a concept to the younger child. Although the primary focus was on the outcome of the teaching session (as reflected in the learner's concept attainment relative to the sexes of learner and teacher and their sibling relationship), certain behaviors in the teaching session were also measured. The study asked the following questions:

1. Is the concept learning of a young child when taught by an older child affected by the fact of their being or not being siblings?
2. Is there a difference in the concept attainment of children when taught by older children who are male or female?
3. Is there a difference in the concept attainment of young boys and girls when they are taught by older children?
4. Does the effect of the sib or nonsib as teacher depend on his sex and also on the sex of the younger child?

### Significance of the Study

The study should contribute to a greater understanding of the family, and, more specifically, to the understanding of the relation of sibling status to sibling interaction and concept attainment. If young children do learn more (or less) from their older siblings than from nonsiblings this would suggest the important effects of sibling interaction.

From a practical viewpoint, the study may also extend understanding of an area in which there is as yet little knowledge: the effectiveness of older children as teachers of younger children. Bronfenbrenner (1970) has described the wide use of older children as teachers of younger children in the Soviet Union, and feels the United States has failed to exploit this potential source of teaching talent. The findings may have application to the more effective use of older primary grade children as tutors of younger children in the primary grades in this country. Since approximately 60% of elementary school children have sibs in the same school, it would be important to know whether sibs or nonsibs function more effectively as teachers.

## II

### DESIGN AND METHOD

A 2-x-2-x-2 factorial study was designed. The three factors in the design were sex of the learner, sex of the teacher, and whether the teacher was a sibling. Below is a diagram of the experimental groups indicating the number of subjects in each.

	Male teacher		Female teacher	
	Sib	Nonsib	Sib	Nonsib
Male learner	n = 15	n = 15	n = 15	n = 15
Female learner	n = 15	n = 15	n = 15	n = 15

Subjects could not be assigned at random to the factors sex of learner and sex of teacher, since they are properties of the subjects themselves. Consequently, other factors associated with sex may not be balanced out, and may cause differences in concept attainment. However, such a design does allow one to determine if any relationship exists between sex of the learner and concept attainment.

Age of teacher and learner and the spacing between them were held approximately constant by using only first-grade learners with an older sib in the third grade, so that on the average the learner was six years old with a sib two years older. Because of the small population of sibling pairs available for the study, it was not possible to control for the number of children in the family or for the ordinal positions of learner and teacher therein. However, within the basic four groups of the sample (boys with older brothers, boys with older sisters, girls with older brothers, and girls with older sisters), there was no reason to believe that size of family and ordinal position would vary systematically.<sup>1</sup> Assignment to the sib and nonsib teaching conditions was random, so that uncontrolled sib structure variables and other individual differences would not be expected to vary systematically between these two groups.

Analysis of covariance was originally proposed to control for the effect of individual differences in the learning abilities of teacher and learner. Both the number of trials needed for the older child to attain

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<sup>1</sup>Of the 120 sibling pairs in the study, 107 pairs were found to come from families where the older and younger child were "next" to each other in ordinal position; 12 pairs came from families where there was one other sib between the first and third grades, and the remaining pair had twins between them in the family. The average family size in the study was 4.

criterion on the trapezoid concept and the younger child's score on the Metropolitan Readiness Test were considered as possible covariates, but since correlations with the dependent variable were extremely low (see page 30), the analysis of covariance was not used.

In carrying out the study, the experimenter first taught the trapezoid concept to the third-grade child who in turn taught the first-grade child the same material. The same experimenter was used throughout the study, thereby minimizing any personality differences that might have influenced the study. A standardized procedure (developed in a pilot study) was used in teaching the trapezoid concept to the third-grade child; the sequence of events in this teaching session was always the same. After the 10-minute session in which the older child attempted to teach the younger child the trapezoid concept, a standardized concept attainment test was administered to the younger child.

A list of subjects to be tested at each school was prepared by an associate and placed in a sealed envelope to be given to the school secretary who summoned the children from their classrooms for the experimental session. Thus, when the older child came for the teaching session, the experimenter did not know whether the child with whom he was paired was a younger boy or a younger girl, or whether the younger child was a sibling or a

nonsibling. Since the list of subjects was randomly ordered within each school, no attempt was made to control time of testing.

### Population and Sample

The population of the study consisted of all the sibling pairs in 10 of 14 elementary schools in Beloit, Wisconsin, such that the younger sib was in the first grade and the older sib was in the third grade. There were 134 such sibling pairs. The subjects were primarily lower middle class. Beloit is a small city of 35,000 people on the Illinois border, about 85 miles northwest of Chicago. It is the site of a small liberal arts college. Industries in the city include woodworking, and the manufacture of papermaking and grinding machines, diesel engines, power pumps, machine tools, shoes, hosiery, and building and carton paper. Even though the city is surrounded by farmland, it reflects an industrial-urban rather than a rural culture.

Of the 120 families actually represented in the study, 6 fathers held executive or higher professional positions, 10 fathers were business managers, proprietors of medium size businesses, or lesser professionals, 11 fathers were administrative personnel or owners of small independent businesses, 9 fathers were clerical or sales workers or technicians, 35 were skilled manual workers,

33 fathers were machine operators or semiskilled workers, and 16 were unskilled workers.

The population was divided into the following four groups: first-grade boys with third-grade sisters (34 pairs), first-grade boys with third-grade brothers (31 pairs), first-grade girls with third-grade sisters (31 pairs), and first-grade girls with third-grade brothers (38 pairs). A sample of 30 sib pairs was randomly drawn from each of these four subgroups of the population; 15 pairs were assigned to the sib teaching condition and 15 pairs were assigned to the nonsib teaching condition. (This random sampling and assignment was accomplished by assigning each sib pair in a given category of the population a number from a table of random numbers; these numbers were then arranged in ordinal sequence and the first 15 pairs assigned to the sib condition and the next 15 pairs assigned to the nonsib condition.)

The 15 pairs in a given nonsib group were then re-paired so that a first-grade learner would be taught by someone other than his sib. However, since children could not be transported between schools for the experiment, the re-pairing had to be done within those sib pairs in the sample from each school. If there were only two sib pairs at a particular school, these were simply re-paired; if there were three or more pairs at a particular school, each pair was assigned a number from a table

of random numbers, then the numbers were arranged in order and the older sib of the lowest number pair in the series was assigned to the younger sib of the next highest pair, and so on.

In two cases, there was only one pair out of the subgroup of 15 that was to be re-paired at a particular school; hence there was no other pair available at that school for re-pairing. This was handled in the following manner. Assume that four schools were represented in the sample of boys with older brothers, and that after random assignment to sib and nonsib conditions the distribution of the pairs was:

	Sib	Nonsib
School A	4	5
School B	4	4
School C	4	5
School D	3	1

One of the sib pairs from school D was randomly selected and transferred to the nonsib group; then one of the nonsib pairs from schools A, B, and C was randomly selected and transferred to the sib group. Once this was done, the re-pairing was done as before. Such a procedure disrupts the original random assignment of pairs to sib and nonsib categories; however, since this happened only twice it was felt that the results would not be distorted to any great degree.



Once the re-pairing of the nonsib groups was done, an associate prepared lists for each of the ten schools containing all of the sib and nonsib pairs selected from that school arranged in random order. This list was then given to the school secretary who summoned children for testing; the experimenter did not know the subgroup identification of the children he was working with prior to the teaching session.

#### Dependent Variable

The dependent variable was the learner's score on a concept attainment test involving the trapezoid concept. (A trapezoid is a four-sided figure with two parallel sides.) The trapezoid concept was selected as being of sufficient difficulty and unfamiliarity so that first-grade learners would not be able to identify it immediately. In other words, the trapezoid concept was not only a concept to be learned, but one of such difficulty that it would allow the third-grade teacher to interact with the first-grade learner over a considerable period of time. (This would allow one to gather data on the teaching-learning process.)

Various types of discriminably different trapezoids were constructed, varying in the length of the sides, size of the angles, and orientation of the figure. Of these, 15 different examples were drawn on cards. Fifteen other geometric figures (circle, rectangle, square, hexagon,

etc.) to be used as negative examples were also drawn on cards. The positive and negative examples were placed in a random sequence for presentation to the learner. (Appendix A is a copy of the test.)

Instructions for administering the test were as follows:

Look at each figure. If it is a trapezoid, say "yes."

If it is not a trapezoid, say "no."

In administering the test, each card was shown in sequence. The experimenter asked for each card, "Is this a trapezoid?" The experimenter also asked each subject why he answered the way he did and recorded his reasons.

The learner's score was the number of positive and negative examples correctly identified. Content validity was assumed; the internal consistency reliability (Kuder-Richardson formula 20) was computed to be 0.63 for the sample of the study.

#### Procedure

The third-grade child was brought to the experimental room by the school secretary or her assistant, and introduced to the experimenter. During the first part of the session, the third-grade child was taught to master the

trapezoid concept. While a standardized teaching procedure was used, it included a variety of teaching techniques.<sup>2</sup>

The instructional materials were 40 geometric figures on cards: 30 were trapezoids (constructed as previously described) and 10 were other geometric figures. A set of 12 thin black sticks about 6 inches in length was available for extending the lines of the figures.

The subjects were first shown three examples of trapezoids and three negative examples (circle, triangle, hexagon) to establish a contrast. They were asked if they noticed anything similar about the three trapezoids. Some subjects immediately noticed the four sides (or four lines). Others did not, and attempted to find some similarity on the basis of size or shape. Finally the experimenter asked them to count the number of sides. After they did so, the experimenter asked them again what was common to the trapezoids, to which most would then say that they have four sides. Another three examples of trapezoids were then shown, along with three more negative

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<sup>2</sup>In a pilot study, third-grade pupils tended to imitate the way they were taught when teaching the younger learner. A variety of teaching techniques was then used by the experimenter so that the third-grade pupil would not have time to imitate all of these in the short session in which he taught the younger child. In other words, since there was not sufficient time for him to duplicate all of his own experience, he was forced to select certain of the experimenter's teaching methods. This selective imitation revealed his preferences and allowed for individuality and variability in teaching behavior.

examples. This time they were shown other geometric figures which had four sides: a rectangle, a square, and a parallelogram. The sticks were then used to extend the lines of the figures to demonstrate that when it was a trapezoid one pair of sides was parallel (maintained the same distance between them and did not meet when extended). It was pointed out that these negative examples (rectangle, etc.) had two pairs of lines in which this occurred. Subjects were asked to judge the distance between pairs of sides of the figures.

The children were then asked to define a trapezoid (assuming that they were, by this time, familiar with the attributes). If the child could not give a definition he was given hints about the relevant attributes. Finally, if necessary, he was told the attributes and then asked to tell what a trapezoid was in his own words. Coaching was continued until he was able to give a definition.

Then the deck of cards containing the 40 examples was placed on the table, and the subject was asked to sort them into two piles: trapezoids and nontrapezoids. After the subject finished, the experimenter told him which of his sorts had been correct, which wrong.

The child then was asked to draw a trapezoid and a figure that was not a trapezoid. If the drawings were

not acceptable (four sides and one pair of parallel lines), the experimenter identified his errors and asked him to try again.

Finally, the child took the concept attainment test. After each trial the experimenter informed the child of his errors, and the test was repeated until he made no more than two errors.

This teaching session with the older child lasted from 30 to 45 minutes, depending on his speed of learning.<sup>3</sup>

When the older child had reached the learning criterion, he was asked to be the teacher of the younger child, and was given the following instructions:

Now you know how to tell a trapezoid when you see one. We have someone from first grade coming in, and I would like you to teach him (or her) what a trapezoid is. I want you to be the teacher now. You can teach any way you like. You do not have to teach in the same way that you were taught. Feel free to try new ways of teaching. It may be that the first grader will be your brother or sister. If so, teach him like you would teach anyone else. You may use my cards, sticks, pencil, paper, or anything else you

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<sup>3</sup>The experimenter recorded on his data form (Appendix C) the older child's performance at various stages in the teaching session: whether or not he had difficulty in grasping the attribute of four sidedness, and the attribute of parallel lines, whether he could verbalize the attributes in giving a definition, time needed to sort the deck of example cards into trapezoids and nontrapezoids, number of negative examples falsely identified as trapezoids, number of positive examples falsely identified as nontrapezoids, number of trials needed to make an adequate drawing, as well as item scores for each of the presentations of the concept attainment test.

would like. Now you take my chair and think for a minute on how you want to teach while I get the first-grade student.

Then the younger child was brought into the room and introduced to the older child as follows:

I want you to meet \_\_\_\_\_. He (or she) is going to be your teacher. He has been working very hard and he has learned what a trapezoid is. Now he would like to teach you the meaning of a trapezoid. Okay, \_\_\_\_\_, now you are the teacher.

The teaching session between the older and the younger child then took place; it was timed to last 10 minutes. The experimenter sat in a chair off to the side and manually recorded the ongoing session. The session was also tape recorded, but the experimenter's recording sheet was used as the primary source of data. This was found to be more fruitful, since the experimenter could record both verbal and nonverbal behavior (pointing, sorting, etc.) of the children. The tape alone could not reveal nonverbal behavior, and many children relied heavily on it. The tapes were used to cross-check the verbal responses recorded manually. (A copy of the experimenter's recording sheet is in Appendix C).

After ten minutes, the experimenter interrupted the teaching session, thanked the older child for his help, and dismissed him to return to his classroom. Then the experimenter administered the concept attainment test to the younger child. The younger child then was thanked and dismissed to return to his classroom.

Pilot Study

Before the study was undertaken, a small pilot study with 20 sibling pairs was carried out in an elementary school in Mount Horeb, Wisconsin. The pilot study provided a basis for selecting one of two tasks proposed for the study; for determining the level of difficulty of the task, and also whether the subjects responded appropriately to the instructional materials; and for estimating the grade level of children suited to the task. Neither kindergarten children nor first-grade learners identified by the principal as "disadvantaged" (children from extremely poor large families, many from broken homes) were able to learn the trapezoid concept with the short teaching session. Teaching procedure, recording procedure, materials, and instructions were modified and then standardized. The suitability of the concept attainment test was determined (range and variability of scores).

### III

#### RESULTS

The learner's scores on the trapezoid concept attainment test were tabulated. Frequency distributions of scores for the total group and four main subgroups are presented in Appendix B. Scores ranged from 11 to 30, the latter being the highest possible score. (The probability of an individual score of 20 or greater on the basis of chance is less than .05. Over half of the children achieved scores of 20 or above, indicating that some learning of the trapezoid concept had taken place.)

A fixed-effects analysis of variance in the factorial design was used to analyze the learners' concept attainment scores, and provide answers to the above questions.<sup>4,5</sup> Table 1 is a summary of the analysis of

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<sup>4</sup>Cochran's C statistic was calculated to test for homogeneity of variance. It was .206 for 8 groups and 14 degrees of freedom for each cell. This failed to reach the .05 level of significance. Since the individuals in the study were randomly selected from a defined population, the assumptions concerning random samples from populations and the independence of numerator and denominator of the F ratio should be met. Distributions for the group as a whole and the four main subgroups are given in Appendix B. Visual inspection of these distributions does not reveal



TABLE 1  
SUMMARY OF ANALYSIS OF VARIANCE FOR TRAPEZOID  
CONCEPT ATTAINMENT

Source	df	Mean Square	F	p
Sib-nonsib status of teacher (S-NS)	1	1.88	.13	.72
Sex of teacher (Sex T)	1	99.01	6.92	.01
Sex of learner (Sex L)	1	110.21	7.70	.006
S-NS x Sex T	1	126.08	8.81	.004
S-NS x Sex L	1	3.68	.26	.61
Sex T x Sex L	1	6.08	.42	.52
S-NS x Sex T x Sex L	1	20.01	1.40	.24
Within Cells	112	14.31	-	-

variance; the means and standard deviations of the groups involved in the analysis of variance are given in Table 2.

There was no significant difference between teachers who were siblings or nonsiblings but there was a significant main effect of the sex of the teacher. Both of these results must be qualified in the light of the

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a gross distortion; therefore the assumption of normal distribution appears to be satisfied. In any event, violations of these assumptions are not serious when the cell frequencies are equal as in the present study.

<sup>5</sup>The original plan of analysis was to use as covariates the learner's MRT scores and the number of trials needed for the teacher to reach a predetermined level of mastery of the trapezoid concept. (Teachers took from one to five trials to attain the learning criterion; the mean number of trials to criterion was 2.87.) However, when correlations of these variables with the concept attainment score of the learner were computed, the teacher's number of trials correlated  $-.122$  with the learner's concept attainment, and the learner's Metropolitan Readiness Test score correlated  $.021$  with his concept attainment score. Neither of these correlations was large enough to be statistically significant, and so the analysis of covariance was not used. (It might be added that the teacher's IQ correlated  $.05$  with the number of trials needed for him to attain the trapezoid concept, and  $.04$  with the learner's concept attainment score.) The experimenter recorded on his data form (Appendix C) the older child's performance at various stages in the teaching session: whether or not he had difficulty in grasping the attribute of four-sidedness and the attribute of parallel lines, whether he could verbalize the attributes in giving a definition, time needed to sort the deck of example cards into trapezoids and nontrapezoids, number of examples falsely identified as trapezoids, number of examples falsely identified as nontrapezoids, number of trials needed to present an adequate drawing, as well as item scores for each of the presentations of the concept attainment test. Since none of these measures was significantly associated with the learner's concept attainment, no further analysis of this material was made.

TABLE 2  
MEANS AND STANDARD DEVIATIONS OF TRAPEZOID  
CONCEPT ATTAINMENT FOR SUBGROUPS

Sex of Learner	Sex of Teacher	Sib or Nonsib	N	M	SD
1. -	-	Sib	60	19.50	4.19
2. -	-	Nonsib	60	19.25	3.66
3. -	Male	-	60	18.47	4.08
4. -	Female	-	60	20.28	3.54
5. Male	-	-	60	20.33	3.78
6. Female	-	-	60	18.42	3.88
7. -	Male	Sib	30	17.57	4.17
8. -	Female	Sib	30	21.43	3.26
9. -	Male	Nonsib	30	19.37	3.90
10. -	Female	Nonsib	30	19.13	3.48
11. Male	-	Sib	30	20.63	4.39
12. Female	-	Sib	30	18.37	3.71
13. Male	-	Nonsib	30	20.03	3.08
14. Female	-	Nonsib	30	18.47	4.11

15.	Male	Male	-	30	19.20	4.18
16.	Male	Female	-	30	21.47	3.45
17.	Female	Male	-	30	17.73	3.95
18.	Female	Female	-	30	19.10	3.75
19.	Male	Female	Sib	15	23.20	1.52
20.	Male	Male	Nonsib	15	20.33	4.48
21.	Male	Female	Nonsib	15	19.73	2.96
22.	Female	Female	Sib	15	19.67	3.60
23.	Female	Female	Nonsib	15	18.53	3.94
24.	Female	Male	Nonsib	15	18.40	4.40
25.	Male	Male	Sib	15	18.07	4.85
26.	Female	Male	Sib	15	17.07	3.45
27.	Total			120	19.38	4.07

significant interaction between the sex of the teacher and the teacher's sib status. In other words, the differences in effectiveness of sibs or nonsibs as teachers depends upon their sex, and the differences in effectiveness of male or female teachers depends upon their sibling relationship to the learner.

In order to interpret this interaction, tests of simple main effects in the analysis of variance were carried out to answer the question: Is there a difference in effectiveness of male and female teachers (a) when those teachers are siblings, (b) when those teachers are non-siblings? Conversely, is there a difference in effectiveness of sibling and nonsibling teachers (a) when those teachers are males, (b) when those teachers are females?

The tests of simple main effects are found in Table 3.<sup>6</sup> The results are: (a) There is a significant difference in the effectiveness of sibling and nonsibling teachers when they are females, but not when they are males; (b) There is a significant difference in the effectiveness of male and female teachers when they are siblings, but not when they are nonsiblings.

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<sup>6</sup>Ad hoc comparisons of male sib teachers vs. female nonsib teachers, and of male nonsib teachers vs. female sib teachers were also made, using Tukey "A" method. Neither of these differences was significant.

TABLE 3

SIMPLE MAIN EFFECTS IN THE ANALYSIS OF VARIANCE FOLLOWING  
A SIGNIFICANT INTERACTION BETWEEN SEX AND  
SIBLING STATUS OF THE TEACHER

Source	df	Mean Square	F	p
Sib - nonsib (male teachers)	1	48.59	3.40	.06
Sib - nonsib (female teachers)	1	79.34	5.54	.02
Sex of teacher (sibs)	1	224.26	15.67	.001
Sex of teacher (nonsibs)	1	0.81	0.07	.99
Within cells (from Table 1)	112	14.31	-	-

Table 2 indicates the magnitude and direction of the simple main effects, and Figure 1 provides a visual representation of the form of the interaction. The results indicate that:

1. Sisters are more effective than brothers when teaching younger siblings irrespective of the sex of the younger child.
2. Sisters are more effective in teaching younger siblings than girls are in teaching unrelated younger children.
3. Boys tend to be more effective in teaching unrelated younger children than in teaching younger sibs.
4. Boys and girls do not differ in effectiveness as teachers of unrelated younger children.

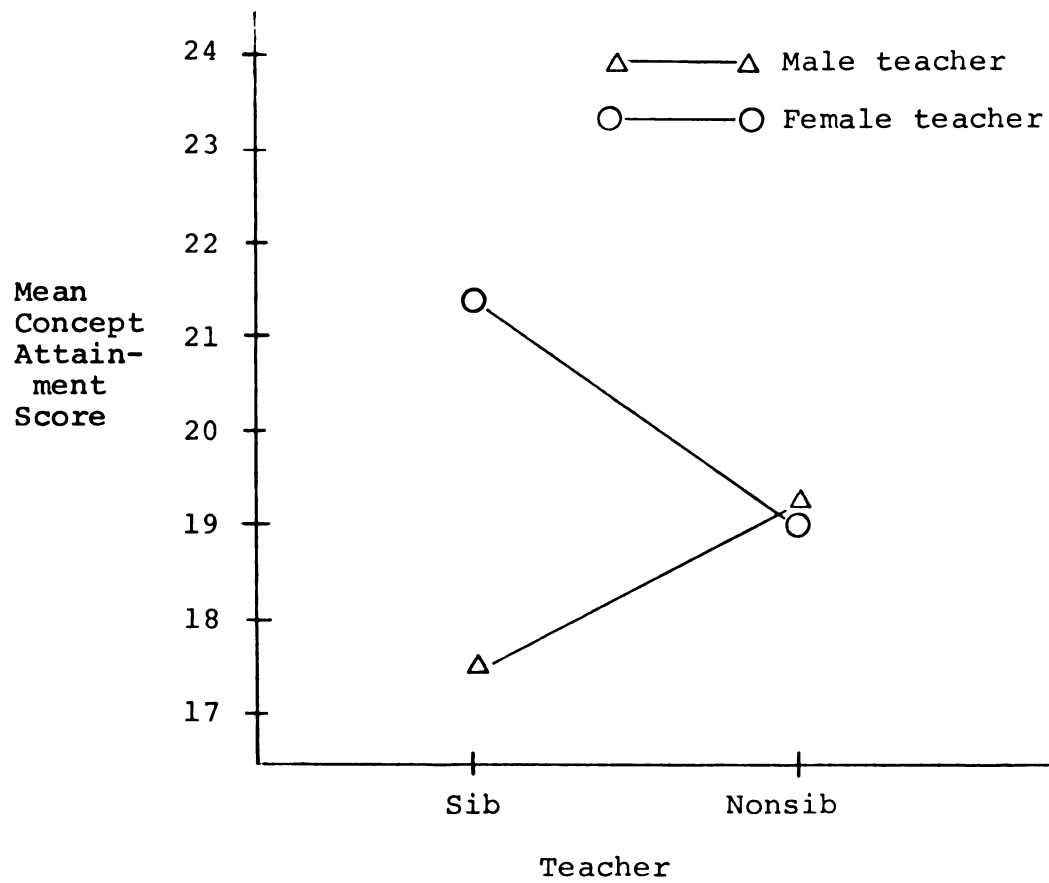


Figure 1.--Interaction between sex and sibling status of teacher.

### Comparisons Between Cell Means

Even though there was no significant higher order interaction between sex of teacher, sex of learner, and sibling relationship of the pair, it is of interest to compare the eight cells or subgroups of the study. Table 2 (lines 19 to 26) gives means and standard deviations for these groups, and Figure 2 depicts the relationship graphically. The Newman-Keuls test was used to assess the significance of differences in all pairwise comparisons between cell means. The results of these tests (Table 4) indicate that older sisters teaching younger brothers are significantly more effective (in terms of the learner's concept attainment score) than:

1. older brothers teaching younger brothers
2. older girls teaching younger girls
3. older boys teaching younger girls
4. older brothers teaching younger sisters

Other differences between subgroups were not significant.

### Concept Attainment Score and Reported Reasons for Identification of Examples of the Concept

During the concept attainment test, the learner was asked his reason for identifying a geometric figure as either a trapezoid or a nontrapezoid. The learners' answers were coded into the following categories:

1. Does not know.
2. Irrelevant reason. Learner used irrelevant or nonessential attributes to decide that



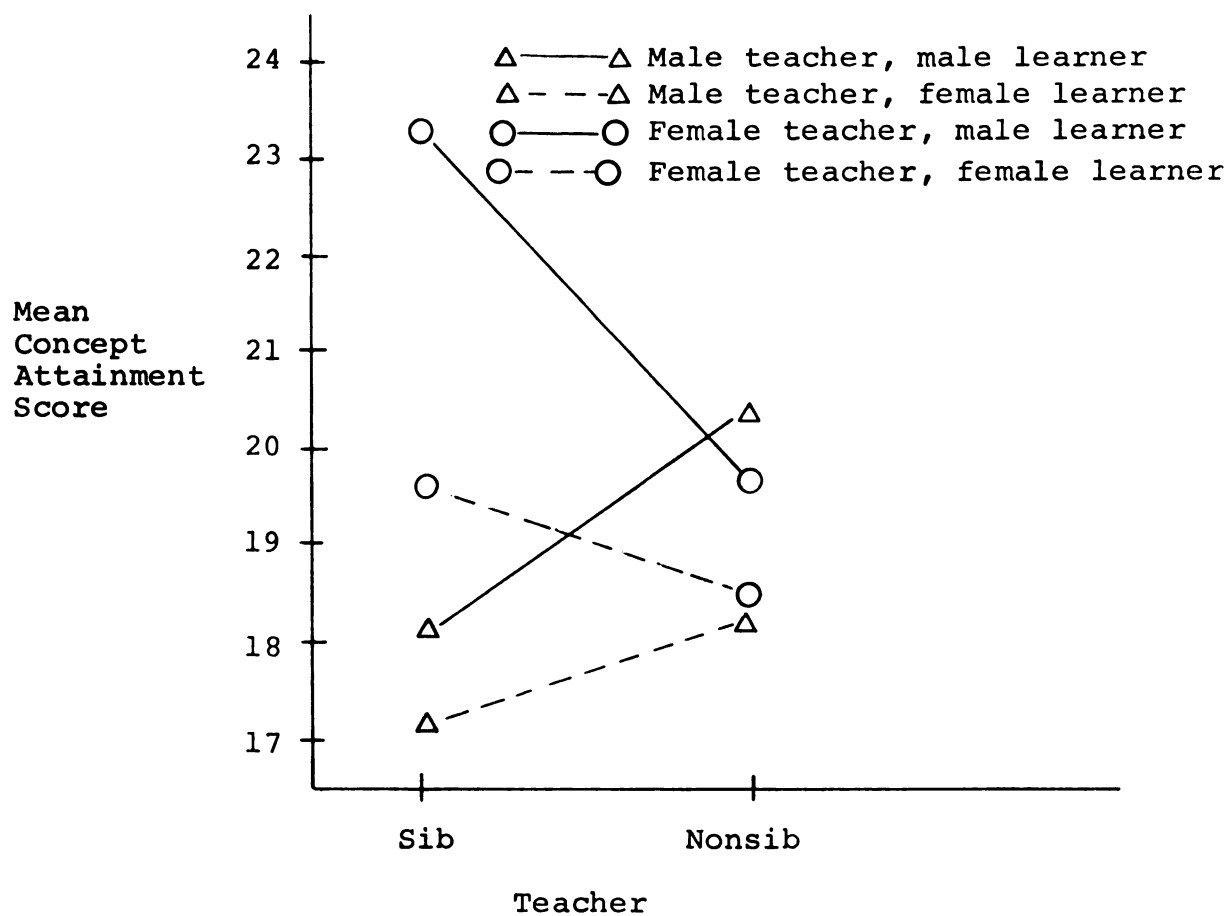


Figure 2.--Learners concept score as a function of sibling relationship, sex of teacher, and sex of learner.

TABLE 4  
NEWMAN-KEULS TESTS FOR THE SIGNIFICANCE OF DIFFERENCES  
BETWEEN ALL POSSIBLE PAIRS OF SUBGROUP MEANS

Means	Difference Between Means						
	M <sub>2</sub>	M <sub>3</sub>	M <sub>4</sub>	M <sub>5</sub>	M <sub>6</sub>	M <sub>7</sub>	M <sub>8</sub>
M <sub>1</sub> = 23.20	2.93	3.47	3.57	4.67*	4.80*	5.18*	6.13*
M <sub>2</sub> = 20.33	-	0.60	0.66	1.80	1.93	2.26	3.26
M <sub>3</sub> = 19.73	-	-	0.06	1.20	1.33	1.66	2.66
M <sub>4</sub> = 19.67	-	-	-	1.14	1.27	1.60	2.60
M <sub>5</sub> = 18.53	-	-	-	-	0.13	0.46	1.46
M <sub>6</sub> = 18.40	-	-	-	-	-	0.33	1.33
M <sub>7</sub> = 18.07	-	-	-	-	-	-	1.00
M <sub>8</sub> = 17.07	-	-	-	-	-	-	-

M<sub>1</sub> is the mean for sisters teaching younger brothers; M<sub>2</sub> is the mean for boys teaching younger boys; M<sub>3</sub> is the mean for girls teaching younger boys; M<sub>4</sub> is the mean for sisters teaching younger sisters; M<sub>5</sub> is the mean for girls teaching younger girls; M<sub>6</sub> is the mean for boys teaching younger girls; M<sub>7</sub> is the mean for brothers teaching younger brothers; M<sub>8</sub> is the mean for brothers teaching younger sisters.

\* Significant at .05 level.

the figure was a trapezoid, e.g., a long side, points at the end of lines.

3. Same shape. Learner said example was a trapezoid because it had the "right shape."
4. Four sides. Learner cited one of the essential attributes for identifying a trapezoid.
5. Parallel lines. Learner cited the other and more difficult essential attribute for identifying a trapezoid.
6. Both essential attributes.

In Table 5, the coded reasons for concept identification have been tabulated in a bivariate distribution with the learner's concept attainment score. On inspecting the frequencies, it is apparent that many learners can identify the concept on an intuitive basis without being able to say why (as indicated by the "does not know" category), while others are able to identify the concept on the basis of only partial learning (as indicated by the use of only one of the essential attributes).

The first three categories of reasons for concept identification were combined into a category called "inadequate reasons," and the last three categories combined into a category called "adequate reasons" so that a chi-square test for association could be computed between reasons for identifying examples and the learner's concept identification score. The results, presented in

TABLE 5

LEARNERS' CONCEPT ATTAINMENT AND REASONS FOR  
IDENTIFICATION OF CONCEPT EXAMPLES

Reason	Concept Attainment Score	
	Low (1-19)	High (20-30)
1. Does not know	21	13
2. Irrelevant reason	25	5
3. Same shape	7	5
4. Four sides	4	36
5. Parallel lines	1	1
6. Both 4 and 5	1	1

Table 6, indicate a significant association between adequate reasons for identification of concept examples and concept attainment score.

Chi-square tests were also computed between factors which were significant in the analysis of variance and the adequacy of reasons for identification of examples. These are also presented in Table 6. While there is no significant difference in the reasons presented by male and female learners, there is a significant tendency for learners taught by their older sisters to present more adequate reasons for identification of examples. Also, when two extreme subgroups are compared, brothers taught by their older sisters presented significantly more adequate reasons than sisters taught by older brothers.

TABLE 6  
REASONS FOR IDENTIFICATION OF CONCEPT  
EXAMPLES AND OTHER VARIABLES

Variable	Frequency		df	Chi-Square
	Inadequate Reason	Adequate Reason		
1. Concept attainment score				
a. 1-19 (Below mean)	53	6		
b. 20-30 (Above mean)	23	38	1	35.08**
2. Sex of the learner				
a. Male	33	27		
b. Female	43	17	1	3.58
3. Sex and sibling relationship of teacher:				
a. Male sib	24	6		
b. Female sib	13	17		
c. Male nonsib	20	10		
d. Female nonsib	19	11	3	8.90*
4. Extreme subgroups				
a. Sisters teaching brothers	5	10		
b. Brothers teaching sisters	13	2	1	8.89**

\* Significant at the .05 level.

\*\* Significant at the .01 level.

### Analysis of Variables in the Teaching Situation

The 10-minute teaching session was tape recorded. The observer supplemented the recording with notes on the number of examples of the trapezoid concept presented, manner of presentation, and so on. While the original intent had been to count the occurrences of various kinds of teaching behavior, in actual practice the teachers in many of the teaching sessions spent so much time simply presenting examples that there was little variation in the frequency of other kinds of behavior. Therefore, many kinds of teaching behaviors were recorded by simply noting whether or not they occurred in the session.

The behaviors recorded were as follows:

1. Teaching method. A judgment was made by the observer as to whether the teaching method was deductive, inductive, or mixed.<sup>7</sup> In the deductive method, the teacher began by defining, describing, explaining, or demonstrating, and then presented examples. In the inductive method, the teacher began by presenting examples, asking the learner if the figure was a trapezoid. Mixed methods were those in which the teacher began with either a deductive or inductive approach and then clearly shifted to the other approach. Of the 120 teachers, 27 teachers

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<sup>7</sup>A graduate student also judged the teaching method on the basis of the observer's record of the teaching session for each of the 120 teachers; there was 86% agreement between the two sets of judgments.

used the deductive approach, 45 the inductive approach, and 48 the mixed approach.

2. Explained, described, or defined the concept. Scored "yes" if the teacher made any statement which served to explain, describe, or define what a trapezoid was, otherwise "no." Some 53 teachers scored "yes," 67 "no."

3. Demonstrated or illustrated attributes. Scored "yes" if the teacher made statements or gestures pointing out the four sides (or angles) of the trapezoid, or the pair of parallel lines. Scored "no" if such statements were absent. There were 67 "yes" and 53 "no."

4. Number of examples presented. A count of the number of examples, both positive and negative, which the teacher presented to the learner in the course of the teaching session; its frequency distribution is as follows:

<u>Total No. of examples</u>	<u>Frequency</u>
1-10	25
11-20	45
21-30	41
31-40	5
41-50	1
51-60	3

5. Number of positive examples. A count of the number of positive examples which the teacher presented to the learner during the teaching session; its frequency distribution is as follows:

<u>Number of Positive Examples</u>	<u>Frequency</u>
1-10	51
11-20	60
21-30	3
31-40	6

6. Choice of examples. Scored as "random" if the teacher presented examples to the learner in the order in which they happened to appear in the deck of example cards left by the experimenter; scored as "selective" if the teacher searched through the deck to find particular examples for presentation. Eighty-five teachers used examples randomly, and 35 were selective.

7. Presentation of examples. Scored as "sequential" if the teacher showed examples to the learner one at a time; scored as "simultaneous" if the teacher placed two or more examples before the learner at one time; scored as "other" if the teacher switched mode of presentation during the lesson. Some 48 teachers presented examples sequentially, 51 simultaneously, while 21 were in the "other" category.

8. First example. Scored as "positive" if the first example was positive; scored as "negative" if the first example was negative; scored as "not applicable" if the teacher presented two or more examples simultaneously. Some 32 teachers scored "positive," 26 "negative," and 62 "not applicable."



9. Teacher identified examples. Scored "yes" if the teacher himself identified the examples which he presented and "no" if he did not. There were 40 teachers scoring "yes," and 80 scoring "no."

10. Teacher asked learner to identify examples. Scored "yes" if the teacher asked the learner to state whether examples were trapezoids and "no" if the learner was not asked to identify examples. There were 99 "yes" and 21 "no."

11. Amount of feedback. When the learner identified an example presented to him, the teacher may have told him whether or not he was right. The amount of feedback was scored either as none, limited (whether correct or incorrect), extensive (correct or incorrect, plus reason for error), or "not applicable" (teacher did not ask learner to identify examples, or shift in method did not allow for feedback). Number of "none" scores was 17, number of "limited" scores was 63, number of "extensive" scores was 17, and number of "not applicable" scores was 23. The "none" and "not applicable" categories were combined for further analysis, as were the "limited" and "extensive" categories.

12. Kind of feedback. The feedback was scored "correct" when all of it was accurate, and "incorrect" if any of it was erroneous. Cases of no feedback were scored as "not applicable." There were 35 "correct" scores, 47 "incorrect" scores, and 38 "not applicable" scores.

13. Teacher asked questions. Scored "yes" if the teacher asked questions of the learner (other than to ask him to identify an example), otherwise "no." There were 33 "yes" scores and 87 "no" scores.

14. Teacher told learner what to do. Scored "yes" if the teacher directed the learner to do certain things in the teaching situation (such as count the number of sides of geometric figures, compare two figures, use sticks to measure lengths of sides, etc.); otherwise "no." There were 21 "yes" scores and 99 "no" scores.

15. Teacher asked learner to draw a trapezoid. Scored "yes" if the learner was asked to draw, otherwise "no." Since there were only 6 "yes" scores and 114 "no" scores, this item was not used in any further analysis.

16. Teacher gave hints. Scored "yes" if the teacher gave hints (e.g., it has four sides) to the learner regarding the identification of examples, otherwise "no." Since there were only 5 "yes" scores and 115 "no" scores, this item was not used in any further analysis.

(Without exception, the third-grade teachers were cooperative and businesslike in undertaking their tasks. However, some were more assured than others, some had doubts about their ability to learn and teach the concept, and some expressed curiosity about why they were there. Many became enthused when they were informed that they were to teach a younger child what they had

learned. When the first-grade learners entered the experimental room, they were a little quiet and reserved, but not necessarily ill at ease. Sibs, of course, knew each other, and in most cases nonsibs were acquainted, knowing the other as a friend of their own sister or brother.

Like the older children, the first graders were cooperative on approaching their learning task. In general, the atmosphere was businesslike and task oriented; there was little or no interaction of a personal nature, such as silliness, fooling around, bossiness, showing off, and so on.)

#### Teaching Session Variables and Concept Attainment

Correlational methods were used to investigate whether variables measured in the teaching situation were related to the learner's concept attainment score. The product moment correlation between concept attainment and the total number of examples was 0.06, while the correlation between concept attainment and the number of positive examples presented was 0.01, neither correlation being statistically significant. For nonquantitative teaching session variables, chi-squares tested the relations between the variables and the concept attainment score. (Subjects were dichotomized on the basis of their concept attainment scores: those scoring above

the mean and those scoring below the mean.) The results appear in Table 7. There were only two significant chi-squares. One reflected a tendency for the initial presentation of a positive example to lead to more effective learning. The other reflected the greater number of questions teachers asked of poor learners than of better learners.

#### Sib Status and Sex and Teaching Session Variables

Chi-squares for the relation between sex of learner and each of the teaching situation variables appear in Table 8. Only one was significant, a tendency for the teacher to ask more questions of female learners than of male learners.

Chi-squares between each of the teaching situation variables and the compound "sex of teacher and sib status of teacher," which was categorized into male-sib teachers, female-sib teachers, male-nonsib teachers, and female-nonsib teachers, are presented in Table 9. The following six relationships were statistically significant:

1. Girls teaching their sibs tended to use the deductive method more often than did other teachers, while boys teaching their sibs tended to use the inductive method more often than did other teachers.

TABLE 7

VARIABLES IN THE TEACHING SITUATION AND  
CONCEPT ATTAINMENT SCORE

Teaching Variable	Frequency		df	Chi-Square
	LOW <sup>a</sup>	HIGH <sup>b</sup>		
1. Teaching method:				
	Deductive	18		
	Inductive	20		
	Mixed	23	2	3.56
2. Teacher explained, described, or defined concept:	Yes	28		
	No	33	1	0.14
3. Teacher demonstrated or illustrated attributes:	Yes	38		
	No	23	1	0.10
4. Number of examples:	1-20	31		
	> 21	30	1	2.85
5. Number of positive examples:	1-10	28		
	> 11	33	1	0.29
6. Choice of examples:	Random	42		
	Selective	19	1	0.22
7. Presentation of examples:	Simultaneous	19		
	Sequential	30	2	5.84
	Other	9		



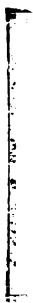


TABLE 8

## SEX OF THE LEARNER AND VARIABLES IN THE TEACHING SITUATION

Teaching Variable	Frequency		df	Chi-Square
	Male Learner	Female Learner		
1. Teaching method:				
	Deductive	17	10	
	Inductive	23	22	
	Mixed	20	28	2 3.22
2. Teacher explained, described, or defined concept:	Yes	29	24	
	No	31	36	1 0.82
3. Teacher demonstrated or illustrated attributes	Yes	36	31	
	No	24	29	1 0.84
4. Number of examples:	1-20	30	40	
	≥ 21	30	20	1 3.43
5. Number of positive examples:	1-10	26	32	
	≥ 11	34	28	1 1.20
6. Choice of examples:	Random	44	41	
	Selective	16	19	1 0.37
7. Presentation of examples:	Simultaneous	21	30	
	Sequential	30	18	
	Other	9	12	2 5.02



8. First example:	Positive Negative Not ap- plicable	19 15 26	12 11 37	2	4.11
9. Teacher identified examples:	Yes No	19 41	21 39	1	0.15
10. Teacher asked learner to identify examples:	Yes No	49 11	50 10	1	0.06
11. Amount of feedback:	None Some	18 42	22 38	1	0.60
12. Kind of feedback:	Correct Incorrect Not ap- plicable	16 27 17	19 20 21	2	1.85
13. Teacher asked questions of learner:	Yes No	10 50	23 37	1	7.05**
14. Teacher told learner what to do:	Yes No	14 46	7 53	1	2.82

\* Significant at the .05 level.

\*\* Significant at the .01 level.

TABLE 9

SEX AND SIBSHIP OF THE TEACHER AND VARIABLES  
IN THE TEACHING SITUATION

Teaching Variable	Frequency			Chi-Square
	MSa	FSb	MNSC	FNSd
1. Teaching method:				
Deductive	5	14	6	2
Inductive	17	3	12	13
Mixed	8	13	12	15
				6
				23.15**
2. Teacher explained, described, defined concept:				
Yes	11	21	10	11
No	19	9	20	19
				3
				10.91*
3. Teacher demonstrated or illustrated attributes:				
Yes	15	22	22	8
No	15	8	8	22
				3
				19.74**
4. Number of examples:				
1-20	15	20	20	15
> 21	15	10	10	15
				3
				3.43
5. Number of positive examples:				
1-10	11	19	12	16
> 11	19	11	18	14
				3
				5.48
6. Choice of examples:				
Random	19	16	26	24
Selective	11	14	4	6
				3
				9.90*
7. Presentation of examples:				
Simultaneous	11	16	13	11
Sequential	12	8	13	15
Other	7	6	4	4
				6
				4.77

8. First example:	Positive Negative Not ap- plicable	6 6 18	5 6 19	9 6 15	11 8 11	6 6.48
9. Teacher identified examples:	Yes No	6 24	15 15	9 21	10 20	3 6.30
10. Teacher asked learner to identify examples:	Yes No	27 3	21 9	28 2	23 7	3 7.56
11. Amount of feedback:	None Some	7 23	19 11	5 25	9 21	3 17.40**
12. Kind of feedback:	Correct Incorrect Not ap- plicable	10 14 6	6 6 18	13 12 5	6 15 9	6 29.24**
13. Teacher asked questions of learner:	Yes No	5 25	10 20	9 21	9 21	3 2.46
14. Teacher told learner what to do:	Yes No	3 27	8 22	8 22	2 28	3 7.10

<sup>a</sup>MNS = male sib teacher; <sup>b</sup>FS = female sib teacher; <sup>c</sup>MNS = male nonsib teacher; <sup>d</sup>FNS = female nonsib teacher.

\* Significant at the .05 level.

\*\* Significant at the .01 level.

2. Girls teaching their sibs tended to do more explaining, describing, and defining of the concept than did other teachers.
3. Girls teaching their sibs and boys teaching nonsibs tended to do more demonstrating and illustrating attributes of the trapezoid than did other teachers; girls teaching nonsibs did least of all.
4. Teachers of sibs tended to be more selective of the examples presented than teachers of nonsibs.
5. Girls teaching their sibs tended to give less feedback than other teachers, perhaps because of their greater use of deductive method made feedback less relevant.
6. Girls teaching nonsibs tended to give incorrect feedback more than other teachers.

The two extreme subgroups (in terms of their concept attainment scores) were sisters teaching brothers and brothers teaching sisters. Chi-squares were computed to determine if there was any association between membership in an extreme subgroup and each of the variables in the teaching situation. Unfortunately, for 7 of the 14 teaching situation variables, the expected cell frequencies were too small to permit computation of the

chi-square.<sup>8</sup> The results for the remaining variables are presented in Table 10. Only one of the relationships was statistically significant; older sisters teaching younger brothers explained, described and defined the concept more often than did older brothers teaching younger sisters. (Although the chi-square could not be computed, older sisters teaching younger brothers tended to use a more deductive approach and brothers teaching younger sisters tended to use a more inductive approach.)<sup>9</sup>

Teaching Method and Other Teaching  
Situation Variables

The results of the chi-square tests of the relation between the teaching method used throughout the teaching session and the more specific teaching behaviors appear in Table 11.

Teaching method was significantly associated with 9 of the 13 teaching situation variables for which chi-squares were computed. The use of the deductive method was associated with a tendency to:

1. Explain, describe, or define the concept.

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<sup>8</sup>However, for 3 of these variables, it was possible to calculate Fisher's Exact Test. For variable 3, the probability was .080; for variable 13, it was 1.00, and for variable 14, it was .168.

<sup>9</sup>The chi-square computed when the inductive and mixed teaching method categories were combined was 6.64, significant at the .01 level.

TABLE 10

CHI-SQUARE TESTS FOR ASSOCIATION BETWEEN VARIABLES IN THE TEACHING SITUATION  
AND SEX OF TEACHER AND LEARNER FOR TWO EXTREME SUBGROUPS

Teaching Variable	Frequency		Chi-Square <sup>c</sup>
	SBa	BSb	df
1. Teaching method:			
Deductive	10	3	
Inductive	0	8	Too few Cases
Mixed	5	4	2
2. Teacher explained, described, defined concept:			
Yes	13	5	
No	2	10	1
			6.81**
3. Teacher demonstrated or illustrated attributes:			
Yes	14	9	
No	1	6	1
			Too few Cases
4. Total number of examples:			
1-20	8	8	
> 21	7	7	1
			0.13
5. Number of positive examples:			
1-10	8	6	
> 11	7	9	1
			0.13
6. Choice of examples:			
Random	7	7	
Selective	8	8	1
			0.13
7. Presentation of examples:			
Simultaneous	7	7	
Sequential	5	5	
Other	3	3	2
			Too few Cases

8. First example:	Positive	2	3			
	Negative	4	3			
	Not applicable	9	9	1		Too few Cases
9. Teacher identified examples:	Yes	7	5			
	No	8	10	1		0.14
10. Teacher asked learner to identify examples:	Yes	8	13			
	No	7	2	1		2.55
11. Amount of feedback:	None	9	4			
	Some	6	11	1		2.17
12. Kind of feedback:	Correct	2	6			
	Incorrect	5	5			Too few Cases
	Not applicable	8	4	2		
13. Teacher asked questions of learner:	Yes	4	5			Too few Cases
	No	11	10	1		
14. Teacher told learner what to do:	Yes	5	1			Too few Cases
	No	10	14	1		

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<sup>a</sup>SB = older sister teaching younger brother; <sup>b</sup>BS = older brother teaching younger sister; <sup>c</sup>Chi-squares were corrected for continuity.

\* Significant at the .05 level.

\*\* Significant at the .01 level.

TABLE 11

## TEACHING METHOD AND OTHER VARIABLES IN THE TEACHING SITUATION

Teaching Variable	Frequency			Chi-Square
	D <sup>a</sup>	I <sup>b</sup>	M <sup>c</sup>	
2. Teacher explained, described, defined concept:				
Yes	17	9	26	
No	10	36	22	2 16.51**
3. Teacher demonstrated or illustrated attributes:				
Yes	22	14	37	
No	5	31	11	2 26.84**
4. Number of examples:				
1-20	18	19	33	
≥ 21	9	26	15	2 7.72*
5. Number of positive examples:				
1-10	17	14	27	
≥ 11	10	31	21	2 8.87*
6. Choice of examples:				
Random	14	38	33	
Selective	13	7	15	2 8.85*
7. Presentation of examples:				
Simultaneous	11	17	23	
Sequential	9	24	15	
Other	7	4	10	4 7.13
8. First example:				
Positive	8	11	13	
Negative	2	16	8	
Not applicable	17	18	27	4 9.29



9. Teacher identified examples:	Yes No	14 13	5 40	21 27	2	16.51**
10. Teacher asked learner to identify examples:	Yes No	18 9	40 5	40 8	2	5.71
11. Amount of feedback:	None Some	16 11	8 37	16 32	2	13.01**
12. Kind of feedback:	Correct Incorrect Not applicable	7 4 16	12 25 8	16 18 14	4	17.03**
13. Teacher asked questions of learner:	Yes No	12 15	3 42	18 30	2	16.09**
14. Teacher told learner what to do:	Yes No	8 19	5 40	9 39	2	3.87

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<sup>a</sup>D = deductive teaching method; <sup>b</sup>I = inductive teaching method; <sup>c</sup>M = mixed teaching methods.

\* Significant at the .05 level.

\*\* Significant at the .01 level.

2. Demonstrate or illustrate attributes of the concept.
3. Present fewer examples of the concept.
4. Present fewer positive examples.
5. Be more selective of examples presented.
6. Identify examples for the learner.
7. Give no feedback to the learner.
8. Give more correct feedback, when given.
9. Ask questions of the learner.

Inductive method was associated with the opposite tendencies. Thus, the relation of specific teaching behaviors to teaching method supports the observer's global judgment of teaching method.

## IV

### DISCUSSION

The discussion of the results takes up the central finding of the study: the interaction between the sex of the teacher and the sibling relationship to the learner. Why are sisters more effective than brothers in teaching younger siblings? Why are sisters more effective in teaching their younger siblings than girls are in teaching unrelated younger children? Why are brothers not only less effective than sisters in teaching their younger siblings, but also less effective than boys teaching younger unrelated children? And finally, why is there little difference in the effectiveness of boys and girls as teachers of younger unrelated children, when girls (sisters) are so much more effective than boys (brothers) as teachers of their sibs? How can all these findings be explained?

The data on teaching method may provide an initial clue to an explanation. Table 12 presents data taken from Tables 2, 9, 10; it can be seen that there is a tendency for the groups making the greatest use of inductive teaching method to have lower scores on the

TABLE 12  
FREQUENCY OF USE OF VARIOUS TEACHING METHODS AND MEAN CONCEPT  
ATTAINMENT SCORE OF LEARNERS

Group	Frequency of Teaching Method			Mean Concept Attainment Score
	Deductive	Mixed	Inductive	
Sisters teaching sibs	14	13	3	21.43
Boys teaching nonsibs	6	12	12	19.37
Girls teaching nonsibs	2	15	13	19.13
Brothers teaching sibs	5	8	17	17.57
Sisters teaching brothers	10	5	0	23.20
Brothers teaching sisters	3	4	8	17.07

concept attainment test. This tendency is exaggerated when the two "extreme" subgroups (sisters teaching brothers and brothers teaching sisters) are considered. These data suggest the hypothesis that a deductive teaching method is more effective than an inductive method when older children teach young children a concept attainment task.

In other words, sisters teaching siblings were most effective, and made greater use of a deductive teaching method than did other teachers. On the other hand, brothers teaching sibs were least effective and made the most use of inductive teaching method. (Girls teaching younger unrelated children used a deductive approach less often than brothers teaching younger sibs, but they used a mixed approach almost twice as often. The conclusion here is that the amount of deductive teaching used in the mixed method is sufficient to account for the results.)

Table 5 indicates that those learners who had the highest concept attainment scores also gave more adequate reasons for identification of the concept examples. Deductive teaching may be more effective in concept attainment with young children in that it enables the young child to become aware of the relevant attributes of the concept at an age when he may be unable to abstract these attributes for himself from presentation

of examples. Also, a deductive teaching method provides the learner with appropriate verbal labels for concept attributes when these might not be in the young child's repertoire. (A deductive approach is not to be equated with a verbal approach to teaching. Both deductive and inductive methods can involve concrete objects, manipulation, examples, applications, and so on. However, a deductive approach tells and gives the rules followed by examples, while an inductive approach gives the examples and the learner must abstract the rules with varying degrees of guidance by the teacher.)

While the results of the study appear to give support for the position that a deductive approach is more effective than an inductive approach in teaching concepts to primary grade children, it must be cautioned that the relationship between teaching method and concept attainment is probably a limited one. The chi-square for teaching method and concept attainment score (dichotomized into high and low scores) was not significant (Table 7). However, in this case, the chi-square may not have been sensitive enough to detect a difference as other evidence does suggest the existence of at least a weak relationship.

Another finding was that on the average boys scored higher than girls on the concept attainment test. While this may be regarded as an instance of general

male superiority on tests involving mathematical and spatial ability (Tyler, 1965), it too fails to account for the findings since the male learner's achievement is not consistently superior but varies with the sex of the teacher and sibling relationship to the teacher in a similar pattern for both sexes (Figure 2). Another hypothesis is that the learner's abilities are different depending on his sex and the sex of the sibling (pp. 6-10), but this fails to account for the different results obtained when learners are taught by sibs or nonsibs; the general ability of the learner was found to be non-correlated with concept attainment (p. 30), and also there were no significant interactions involving the sex of the learner. The prediction from social reinforcement literature that nonsibs would be more effective than sibs was not supported.

However, the finding that female sibs were more effective as teachers of the younger child than were female nonsibs or male sibs can be interpreted in terms of role theory and sibling rivalry.

Girls tend to be more identified with their mothers and with their female school teachers than are boys (Koch, 1960; Sutton-Smith & Rosenberg, 1970), and thus it would seem that they are more ready to assume a teaching role. Also an older sister tends to have more responsibility for care of younger sibs than does an older brother, often being delegated caretaking or

teaching roles (Bossard & Boll, 1960; Mead & Heyman, 1965). Sisters consequently develop the role of teacher of younger siblings to a greater extent than do brothers; in fact, the older sisters in this study may have used a deductive teaching method as frequently as they did simply because they were more accustomed to telling younger siblings what to do. Also, according to Sutton-Smith and Rosenberg (1970), reasoning was a tactic used by older girls interacting with younger sibs.

Conversely, learners at the elementary school level may be more ready to accept a girl in the role of teacher, especially if she is their sister. (One of the first-grade learners in this study remarked that her third-grade teacher was no good because "boys can't be teachers.") It is hypothesized that the younger sib of an older sister is more motivated to learn from her because he perceives her in the role of a teacher, and his learning is more effective because he has developed habits of responding to the manner in which his older sister communicates.

This hypothesis is consistent with the research literature and can account for both the superiority of the sisters when they are teaching younger brothers and the greater effectiveness of the deductive teaching method.



However, it does not seem to account for the difference between brothers teaching younger siblings compared with boys teaching younger unrelated children. Why are brothers the least effective teachers? Perhaps the effects of sibling rivalry are greatest when the teacher is a male sib. There is a tendency for boys to react more intensely to sibling displacement, and sibling displacement by a newborn that occurs within 2-4 years is most intense (Koch, 1960; Rosenberg & Sutton-Smith, 1969). Thus older brothers, close in age to younger siblings, would demonstrate more hostility, competitiveness, and jealousy than would older sisters. Such sibling rivalry could well lead the younger sibs in turn to be defensive and resist learning from an older brother. Both Sutton-Smith (1969) and Adams (1968) speak of the effects of sibling rivalry between males of college age or older; Cicirelli (1967) found IQ and reading achievement to be depressed in children from three-child families who had two brothers. On the other hand, both Koch (1954) and Cicirelli (1967) found that in the two-child family, achievement was enhanced for boys with older male sibs. Thus, the situation is not entirely clear, but it may be that when sibling rivalry exists, the male sib is less motivated to teach his younger sib, or the younger is more resistant to learning. Sutton-Smith and Rosenberg (1970) reported that older boys

typically used "attack and offense" as power tactics in interactions with their younger sibs.

In summary, the younger sib's motivation to learn is increased when taught by an older sister because she is perceived as fitting the teacher's role, and younger siblings are less motivated to learn when taught by older brothers because of the greater sibling rivalry. (Boys and girls who taught younger unrelated children should be relatively equivalent in effectiveness; boys should be more effective than brothers, since less sibling rivalry would be involved, and girls should be somewhat less effective than sisters because the deductive method was not so frequently used and the learner may not be so motivated to accept a female non-sib as teacher.)

#### Sibling vs. Parent-Child Interaction

A further issue can be raised: Why should sisters use the deductive teaching method so markedly when they are teaching sibs? If this were a general approach to teaching developed from a parent-child relationship, then sisters should consistently apply this approach to the teaching of related and unrelated children. (All the girls in this study were actually older sisters with younger siblings; half of the "sisters" were randomly re-paired to teach unrelated children.) As we see from Table 12, 14 of 30 older sisters used the

deductive method while teaching sibs (and only 3 used the inductive method), while only 2 of 30 older girls used the deductive method while teaching nonsibs (and 13 used the inductive method). This difference suggests that the sister's use of a deductive teaching method is not a general characteristic of her, but is relative to the situation. Extending this idea, if parents treat older sisters and brothers differently, resulting in the development of different characteristics, then one would expect sisters to teach in a consistently different manner from brothers, regardless of who was the learner. But this is not the case. Not only do girls shift in their teaching approach depending on their sibling relationship to the learner, but this is also true of the older boys as teachers. Concept attainment by learners varied similarly depending on the sibling relationship to the teacher.

This shifting in teaching approach by the teacher and achievement by the learner depending upon the sib relationship strongly suggests that sibling interaction itself is an important determiner (along with parent-child interactions) of the role behavior of siblings. The sister's or brother's teaching role emerges out of the ongoing interaction between sibling pairs as they establish their customary patterns of communication and responsiveness.

As was pointed out in Chapter 1, sibling interaction itself has never been adequately studied. Using an interactional framework, one might think of the family as a system involving the following three subsystems: parent-parent interactions, parent-child interactions, and sibling-sibling interactions. Perhaps the sibling-sibling interactions can be studied in and of themselves, and their relations to the other subsystems. One might think of the peer group area of study as being subdivided into family peer groups and non-family peer groups. Within this framework, one can view sibling interactions as one example of peer group interactions, and hence bring to bear the existing research in that area for formulating hypotheses. Certainly this is extremely important, as sibling interactions may lead to the development of roles that transfer to nonfamily peer group interactions. Sutton-Smith (1966) has noted the reversal of power roles which occurred depending on whether a child was playing with his sibs or his nonfamily peers.

In today's world, interactions between peers are important to understand since the peer group is becoming an ever stronger agent of socialization. (The Russians and Israelis use the peer group to inculcate adult values; and in America peer group socialization is in defiance of adult values.) In any event, the sibling

relationship is one of extensive intimate daily contact, and it seems reasonable to assume that a sibling pair has established customary patterns of communication which would also serve for the educative function of their interaction. Thus, by studying interaction, one should be able to get valuable insight into the manner in which they influence each other's learning.

#### Directions for Future Research

Further studies are needed to determine whether the results can be extended to different children under different conditions. For example, the children in this study were two years apart. This means a great amount of interaction, and hence optimum conditions for sibling rivalry (Rosenberg and Sutton-Smith, 1969). Sibling rivalry should be less when the sibling spacing is greater, and therefore one might predict that fifth-grade boys would be relatively more effective teachers of first-grade brothers than were the third-grade boys of this study. Also, the effectiveness of sibs as teachers may be related to family size. One might speculate that as family size increases, the amount of mother-child interactions with a given child would decrease and the influence of older siblings would increase.

A series of studies, recently reported by Hess and Shipman (1965), may help point the direction in which future research on siblings should move. Hess

and Shipman attempted to observe and isolate aspects of maternal behavior (maternal teaching styles) related to the child's cognitive development. In these studies, a preschool child and his mother were observed in an interaction session, during which the mother was asked to teach three simple tasks to the child. Mothers from four different socioeconomic status groups were found to differ on language usage (particularly on use of abstract terms and complex syntactic structures), preferred modes of classificatory behavior, and various aspects of teaching style (e.g. praise, criticism), even though there was relatively little difference in the affective element of their interaction with their children. Both the children's performance on the tasks and their verbalization of the underlying principles were found to be correlated with the responses of the mothers. Working class mothers and children, for example, tended to act without taking time for reflection and planning, while the middle class mothers were more likely to encourage the child through verbal and nonverbal cues to reflect, to anticipate the consequences of his action, and in this way to avoid error.

This kind of approach may well lead to a better understanding of intrasibling influence. Particularly where the preschool child is concerned, it would seem that the older sibling (or siblings) would have the greatest influence on the younger sibling (rather than

vice versa), at least in intellectual tasks. Assuming this to be true, then the cognitive and teaching styles of the older sibling may well be important variables influencing the learning and cognitive development of the younger sibling. And, analogous to the Hess and Shipman work, such characteristic styles may be uncovered through observation of sibling interaction in an intellectual task. The task in the current study was perhaps too highly structured to allow this kind of individual variation in teaching.

#### Educative Implications

In summary, this study provides evidence to support the idea that sibling interaction can be a contributing factor to the concept attainment of younger children. Such results may have practical implications for schools using older children as tutors for younger children (provided the generalizations are cautiously made). For example, Cloward (1967) reports a successful program using high school students as tutors of fourth- and fifth-grade students. The Wisconsin Research and Development Center for Cognitive Learning conducted a study in which sixth-grade pupils helped six- and seven-year-olds with arithmetic with encouraging results (Report from Project MODELS, 1968). Also, the Center for Research on Utilization of Scientific Knowledge at the University of Michigan's Institute for Social Research

is actively promoting the establishment of "cross-age helping programs" in the schools (Lippitt, 1969; Lippitt & Lippitt, 1968). While not all outcomes of such programs are positive, children are being used more than ever as teachers of other children (Bronfenbrenner, 1970). Since it is common for children to have at least one sibling in the same school, the current findings would suggest that it would be advantageous to use girls as tutors of their younger siblings in such programs where possible, but to use boys or girls as tutors of nonsiblings. Of course such a recommendation should serve merely as a guideline for action type research, in which the results are evaluated and actions revised accordingly.



## V

### SUMMARY

Previous research has demonstrated that the achievement of a child is related to his position in the sibling structure of the family. This is frequently explained by differences in parental treatment, but interaction with siblings may also be an important factor.

The purpose of this study was to investigate the effect of older sibs and nonsibs of both sexes as teachers of younger children on a concept learning task. The specific questions of the study were:

1. Is the concept learning of a young child when taught by an older child affected by the fact of their being or not being siblings?
2. Is there a difference in the concept attainment of children when taught by older children who are male or female?
3. Is there a difference in the concept attainment of young boys and girls when they are taught by older children?

4. Does the effect of the sib or nonsib as teacher depend on his sex and also on the sex of the younger child?

Each of the 120 first-grade children in the study had an older sibling in third-grade; equal samples of 30 sibling pairs were drawn from the population of boys with older sisters, boys with older brothers, girls with older sisters, and girls with older brothers. For half of the children in each group, the older sib served as the teacher of his or her younger sib; the remaining half were re-paired so that the older child taught an unrelated first-grade child.

The experimenter trained the older child in the trapezoid concept to a given learning criterion in a 30-45 minute session. A standardized teaching procedure involving a variety of teaching techniques was used. Then the older child was asked to teach the trapezoid concept to a younger child. (The ensuing 10-minute teaching session was recorded on an observation schedule by the experimenter as well as on magnetic tape.) The younger child was then given a concept attainment test to determine his mastery of the trapezoid concept.

An analysis of variance in the  $2 \times 2 \times 2$  factorial design was carried out on the learner's concept attainment scores. Also chi-square tests of association were made to determine whether any relationship existed

between variables measured in the teaching situation and the learner's concept attainment.

The main results of the study can be summarized as follows:

1. Concerning the attainment of the trapezoid concept,
  - a. Regardless of their teachers, young boys achieved significantly greater attainment of a trapezoid concept than young girls. This is not unexpected in view of boys' superior spatial abilities.
  - b. Older sisters were significantly more effective teachers of younger siblings (boys or girls) than older girls were of unrelated younger children (boys or girls). On the other hand, older boys tended to be more effective teachers of unrelated younger children (boys or girls) than older brothers were of young siblings. However, the results were not statistically significant.
  - c. Older sisters were significantly more effective teachers of younger siblings (boys or girls) than older brothers. Older boys and girls showed no significant difference in their effectiveness as

teachers of unrelated younger children (boys or girls).

2. When the 8 subgroups of the study were compared, the subgroup in which the learners showed the highest concept attainment score was that in which older sisters were teachers of younger brothers. This subgroup differed significantly from the lowest scoring subgroup, that in which older brothers were teachers of younger sisters, as well as from subgroups in which older brothers were teachers of younger brothers, older boys were teachers of younger girls, and older girls were teachers of younger girls. No significant differences were found in other subgroup comparisons.
3. In subsequent analysis of the data, it was found that learners who had higher concept attainment scores also showed greater awareness of the relevant attributes of the concept, in contrast to those who either did not know the attributes, invented erroneous attributes, or who used irrelevant attributes.
4. An analysis of variables in the teaching situation indicated that these variables were not in general related to the learner's concept attainment score. However, it was found

that girls teaching their sibs used the deductive teaching method and its associated teaching behaviors (explaining and describing, demonstrating and illustrating attributes, selection of examples) more than did other groups. When the two extreme subgroups were compared, older sisters teaching younger brothers tended to use the deductive approach while older brothers teaching younger sisters tended to use the inductive approach.

By way of interpretation of the results, it was suggested that high concept attainment scores were related to the use of a deductive method of teaching by older sisters (which was part of a well-established communication system serving the educative function); that the learners were more ready to accept older girls than older boys in the role of teacher, and that girls were more ready to assume the teaching role than boys. Sibling rivalry between the older brother and his sibs was advanced as a possible reason for the relative ineffectiveness of male sibs as teachers.

Finally, it was suggested that sibling interaction itself is an important factor along with parent-child interaction in determining the role behavior of siblings. The sister or brother's teaching role relative to another sibling emerges out of the ongoing interaction

between the pair as they establish their customary pattern of communication and responsiveness.

Although the results of the study need to be extended in further research, they may find application to those school programs using older children as tutors of younger learners. These findings suggest that it would be best to avoid selecting boys and instead use girls as tutors of their younger siblings where possible, but to use either boys or girls as tutors of nonsiblings.

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## APPENDICES

APPENDIX A

TRAPEZOID CONCEPT ATTAINMENT TEST

## APPENDIX A

### TRAPEZOID CONCEPT ATTAINMENT TEST

Wisconsin Research & Development Center  
for Cognitive Learning

This is an achievement test designed to assess the child's attainment of the trapezoid concept. It consists of 30 geometric figures for the subject to identify, 15 trapezoids and 15 non-trapezoids arranged in a random sequence. Figures selected as examples of trapezoids varied in length of lines, size of angles, and the spatial orientation of the figure. Nonexamples were selected from such figures as hexagons, pentagons, quadrilaterals, parallelograms, rectangles, squares, triangles, and circles.

The subject is instructed to tell whether each figure is or is not a trapezoid after viewing it. His score is the number of items correct.

Content validity is assumed; internal consistency reliability is .63.

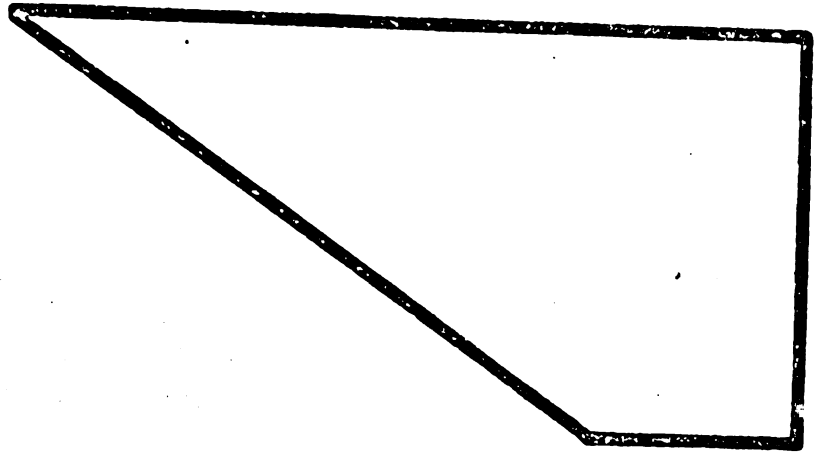
Instruction to subject: Look at each figure. If it is a trapezoid, say "Yes." If it is not a trapezoid, say "No."



1. Is this a trapezoid?

Yes \_\_\_\_\_

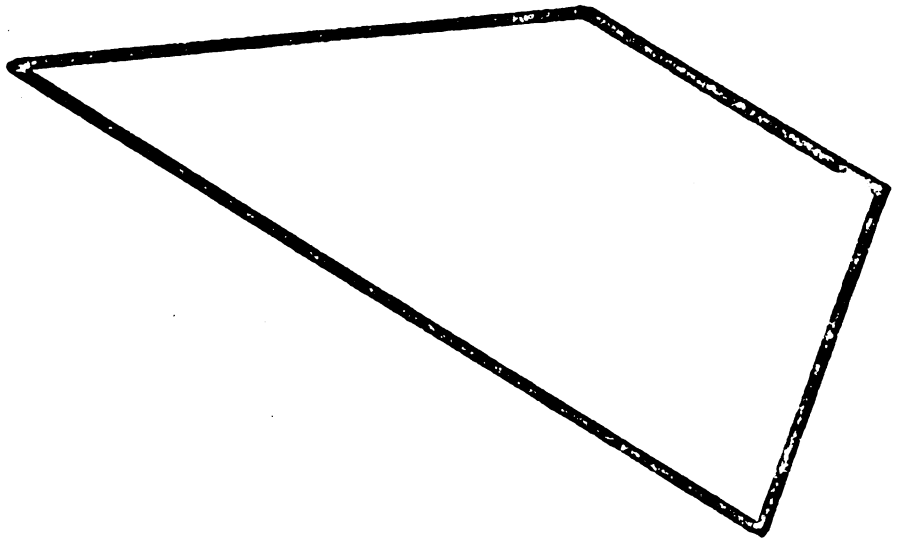
No \_\_\_\_\_



2. Is this a trapezoid?

Yes \_\_\_\_\_

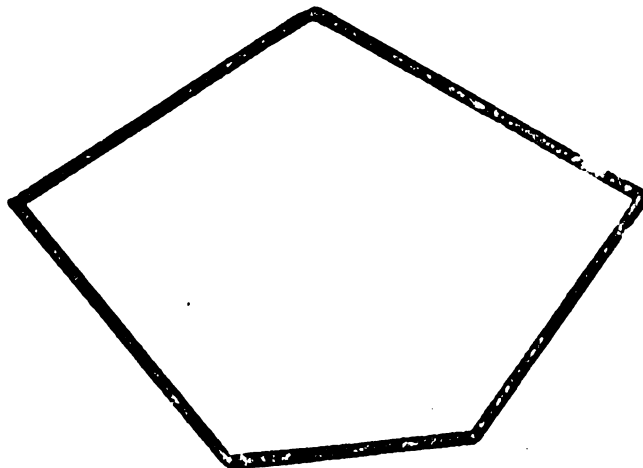
No \_\_\_\_\_



3. Is this a trapezoid?

Yes \_\_\_\_\_

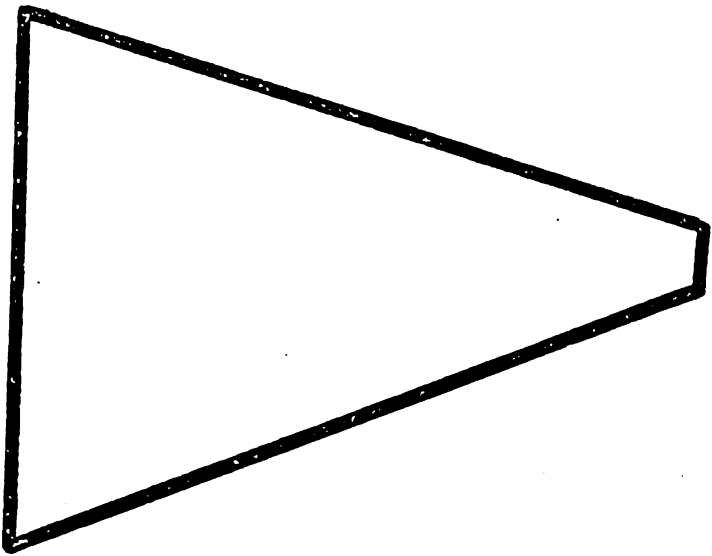
No \_\_\_\_\_



4. Is this a trapezoid?

Yes \_\_\_\_\_

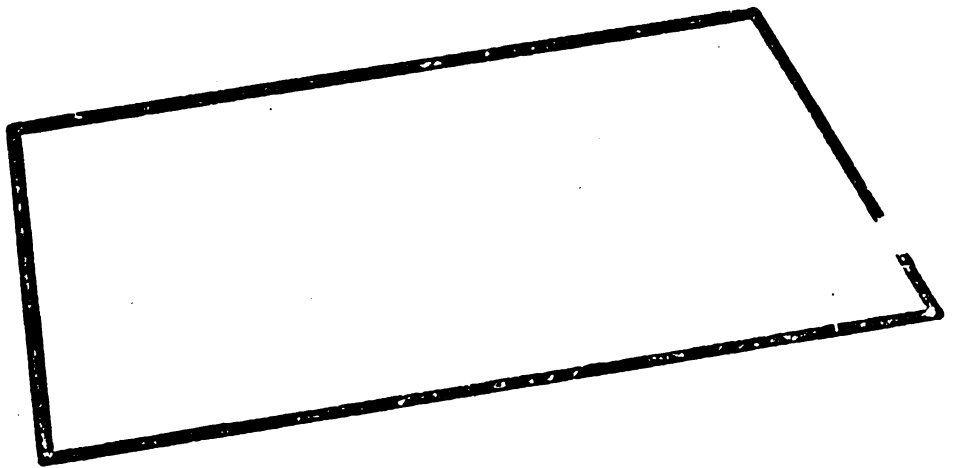
No \_\_\_\_\_



5. Is this a trapezoid?

Yes \_\_\_\_\_

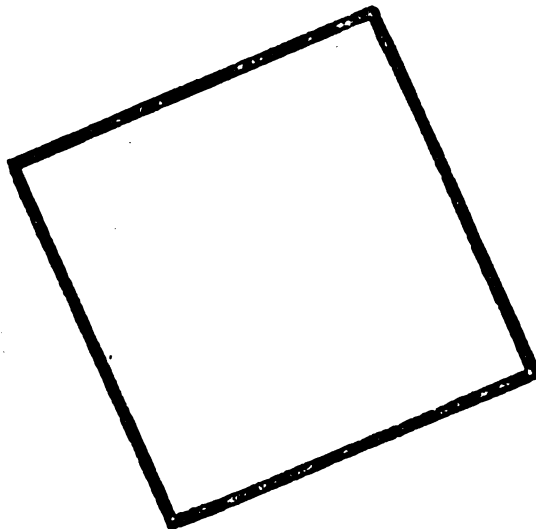
No \_\_\_\_\_



6. Is this a trapezoid?

Yes \_\_\_\_\_

No \_\_\_\_\_

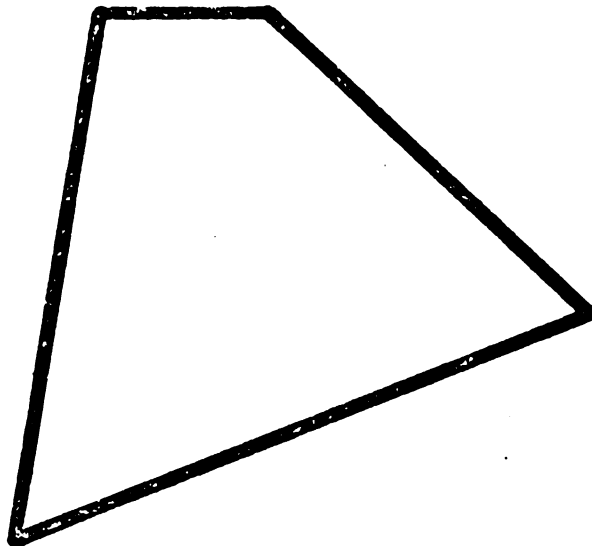




7. Is this a trapezoid?

Yes \_\_\_\_\_

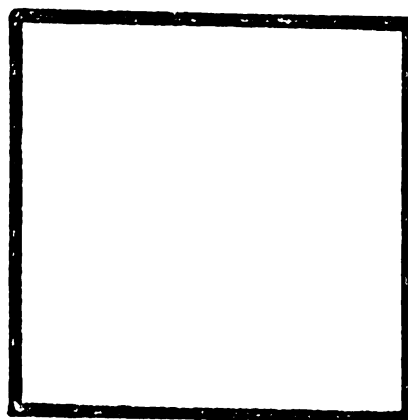
No \_\_\_\_\_



8. Is this a trapezoid?

Yes \_\_\_\_\_

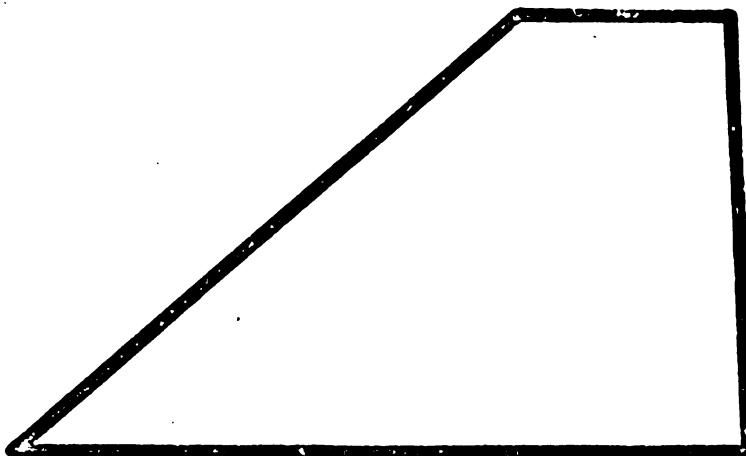
No \_\_\_\_\_



9. Is this a trapezoid?

Yes \_\_\_\_\_

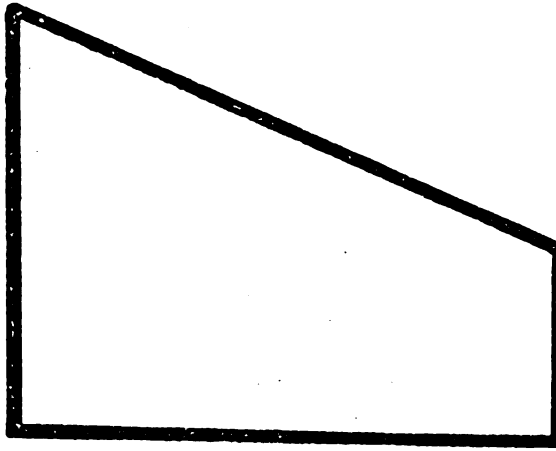
No \_\_\_\_\_



10. Is this a trapezoid?

Yes \_\_\_\_\_

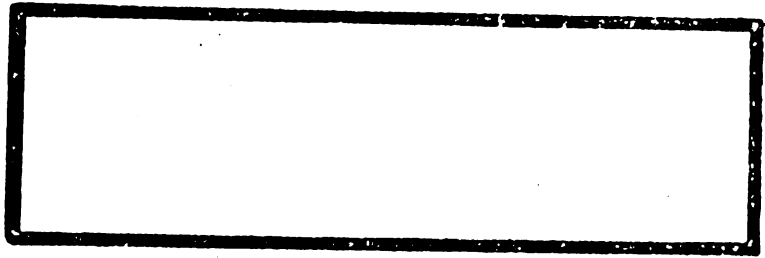
No \_\_\_\_\_



11. Is this a trapezoid?

Yes \_\_\_\_\_

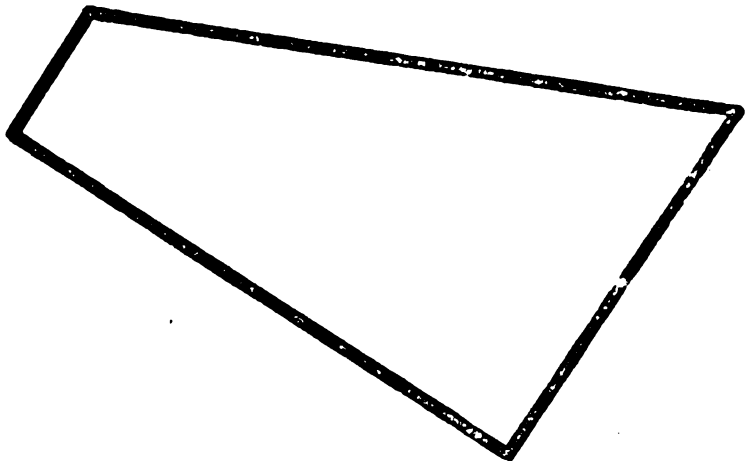
No \_\_\_\_\_



12. Is this a trapezoid?

Yes \_\_\_\_\_

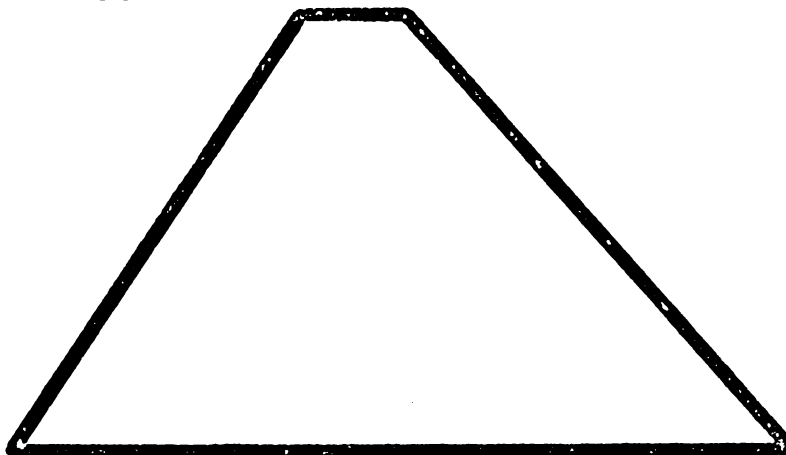
No \_\_\_\_\_



13. Is this a trapezoid?

Yes \_\_\_\_\_

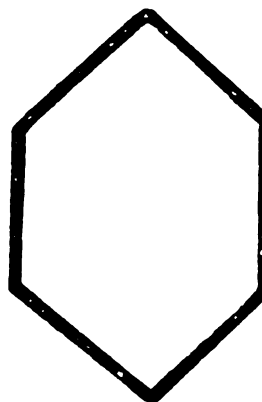
No \_\_\_\_\_



14. Is this a trapezoid?

Yes \_\_\_\_\_

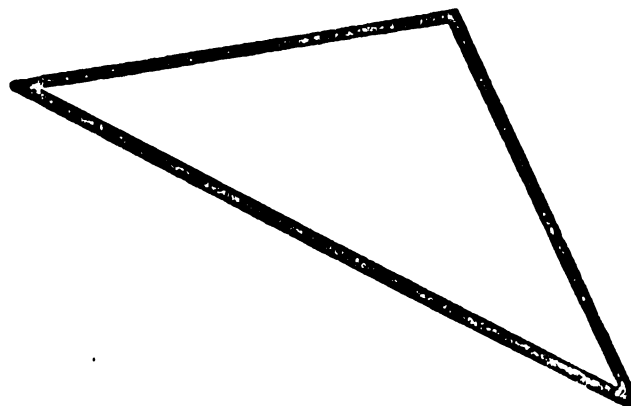
No \_\_\_\_\_



15. Is this a trapezoid?

Yes \_\_\_\_\_

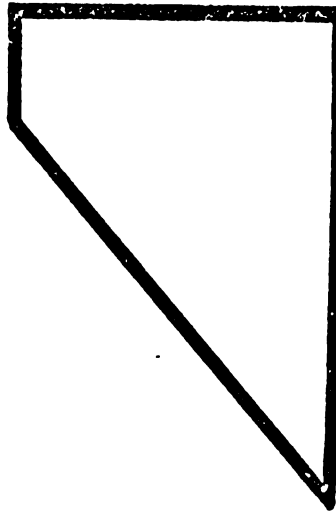
No \_\_\_\_\_



16. Is this a trapezoid?

Yes \_\_\_\_\_

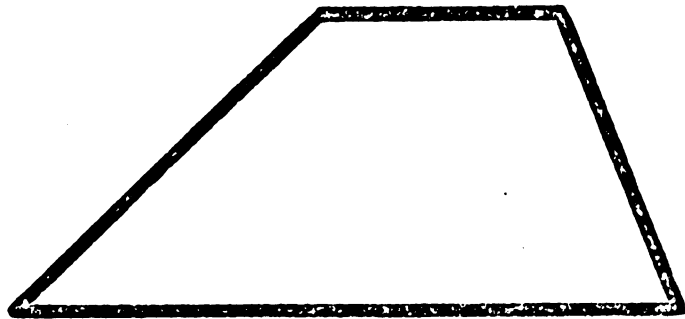
No \_\_\_\_\_



17. Is this a trapezoid?

Yes \_\_\_\_\_

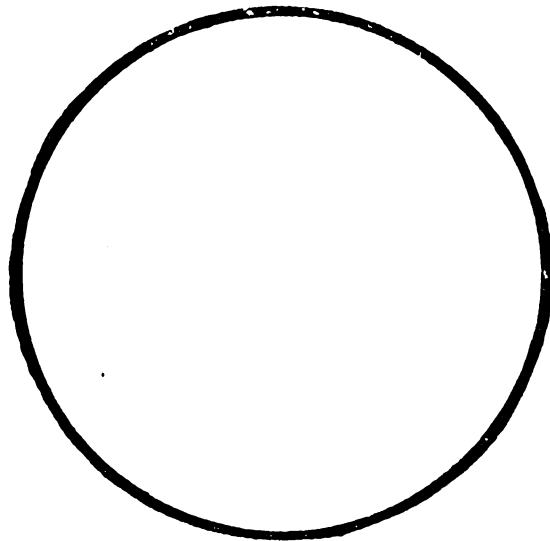
No \_\_\_\_\_



18. Is this a trapezoid?

Yes \_\_\_\_\_

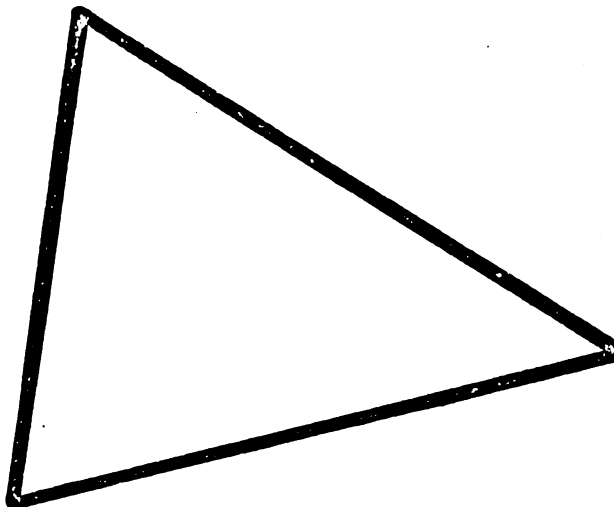
No \_\_\_\_\_



19. Is this a trapezoid?

Yes \_\_\_\_\_

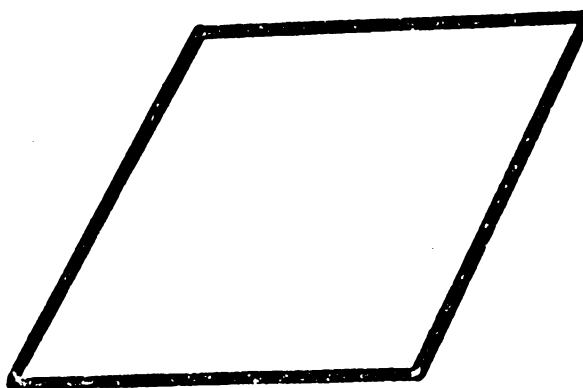
No \_\_\_\_\_



20. Is this a trapezoid?

Yes \_\_\_\_\_

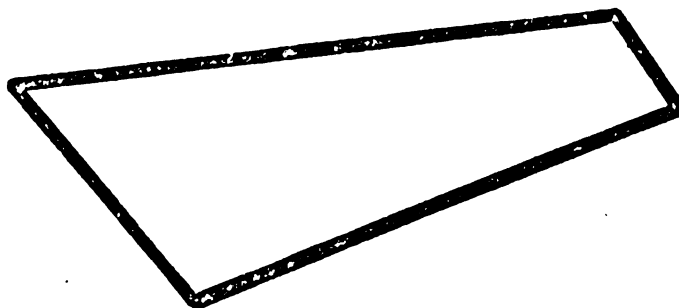
No \_\_\_\_\_



21. Is this a trapezoid?

Yes \_\_\_\_\_

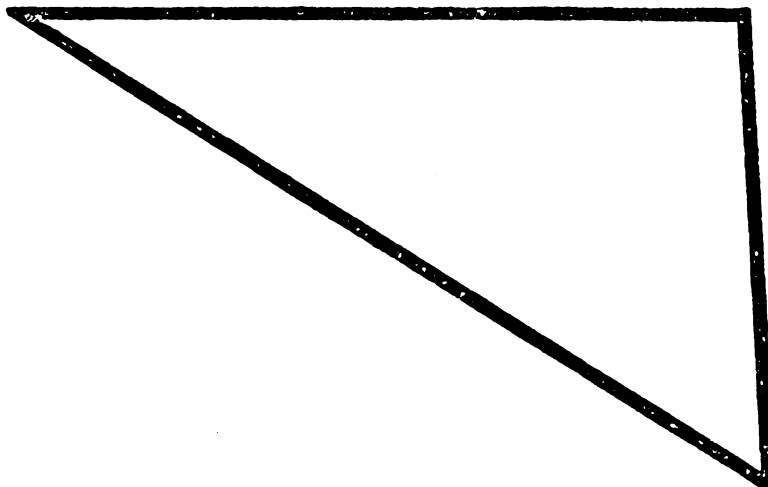
No \_\_\_\_\_



22. Is this a trapezoid?

Yes \_\_\_\_\_

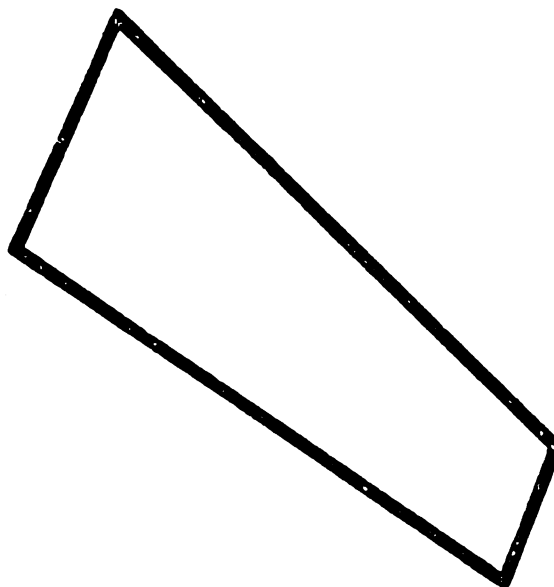
No \_\_\_\_\_



23. Is this a trapezoid?

Yes \_\_\_\_\_

No \_\_\_\_\_



24. Is this a trapezoid?

Yes \_\_\_\_\_

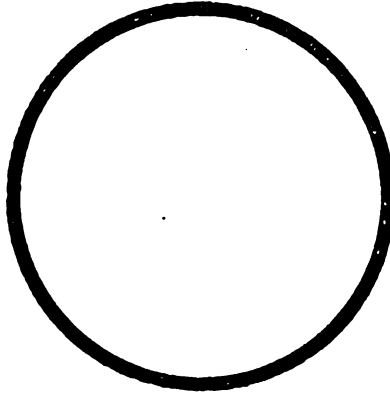
No \_\_\_\_\_



25. Is this a trapezoid?

Yes \_\_\_\_\_

No \_\_\_\_\_



26. Is this a trapezoid?

Yes \_\_\_\_\_

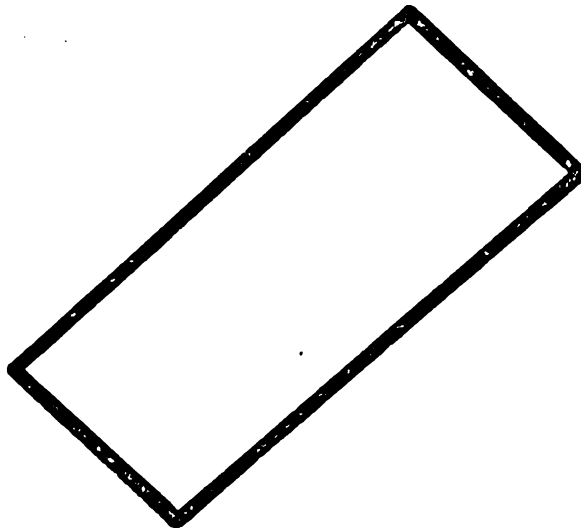
No \_\_\_\_\_



27. Is this a trapezoid?

Yes \_\_\_\_\_

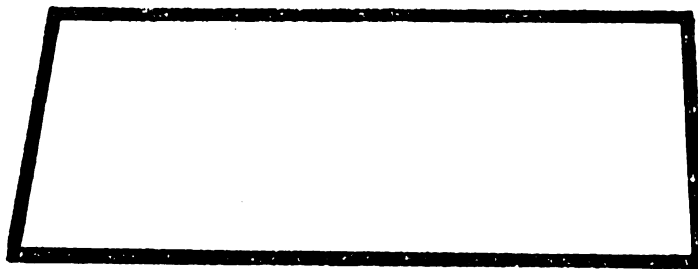
No \_\_\_\_\_



28. Is this a trapezoid?

Yes \_\_\_\_\_

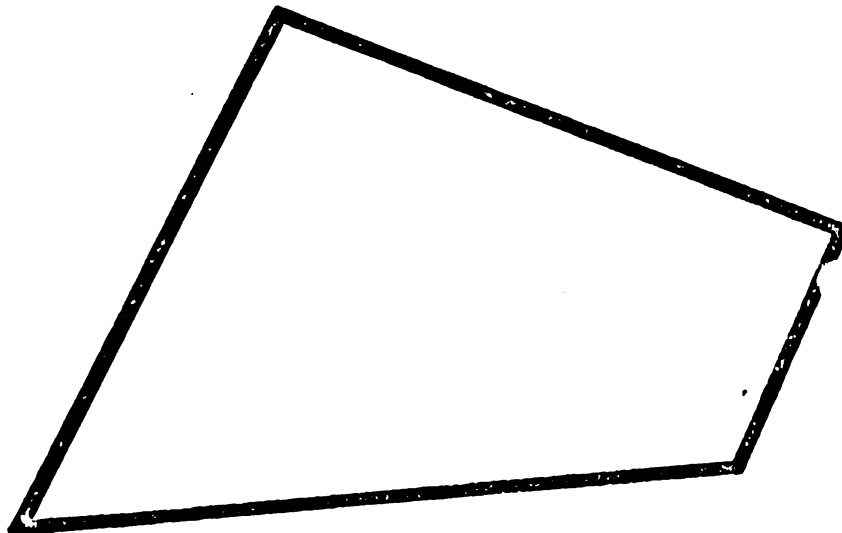
No \_\_\_\_\_



29. Is this a trapezoid?

Yes \_\_\_\_\_

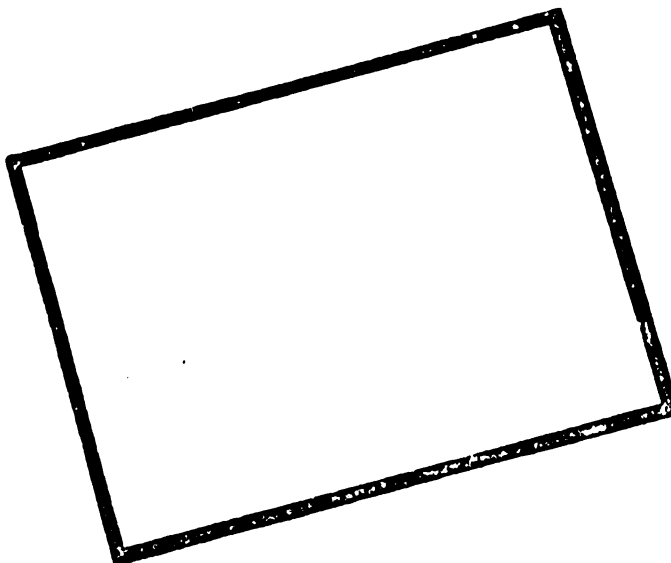
No \_\_\_\_\_



30. Is this a trapezoid?

Yes \_\_\_\_\_

No \_\_\_\_\_





**APPENDIX B**

**FREQUENCY DISTRIBUTION OF CONCEPT ATTAINMENT SCORES**

## APPENDIX B

TABLE B-1

## FREQUENCY DISTRIBUTION OF CONCEPT ATTAINMENT SCORES

Concept Attainment Score	Total Group	Females Teaching Males	Males Teaching Males	Males Teaching Females	Females Teaching Females
30	1		1		
29					
28					
27					
26	3		2	1	
25	6	3	1	1	1
24	12	6	2	1	3
23	9	5	2	1	1
22	14	4	2	2	6
21	6	3	2		1
20	10	3	2	3	2
19	10		2	3	5
18	8		3	4	1
17	11	3	4	1	3
16	7	3		3	1
15	8		2	5	1
14	4		1	1	2
13	4		2	1	1
12	4		1	1	2
11	3		1	2	
Total N	120	30	30	30	30

APPENDIX C

DATA SHEET

## APPENDIX C

### DATA SHEET-Older Child

School \_\_\_\_\_

#### I. Background data

a. Name \_\_\_\_\_ b. Otis IQ \_\_\_\_\_

#### II. Observation Schedule--Experimenter teaching older child.

##### a. Presentation of examples; identification of 4 sides.

- \_\_\_\_\_ Identifies 4 sides on first trial
- \_\_\_\_\_ Does not identify 4 sides on first trial
- \_\_\_\_\_ Uses irrelevant attributes instead of 4 sides (e.g. size, shape)
- \_\_\_\_\_ Mentions no attributes

##### b. Presentation of examples: Identification of parallel and nonparallel lines of trapezoid. (Subject judges distance between pairs of parallel and nonparallel lines as being equal or unequal.)

- \_\_\_\_\_ Subject makes all judgments correctly.
- \_\_\_\_\_ Subject makes one or two judgments incorrectly.
- \_\_\_\_\_ Subject makes more than two judgments incorrectly.

##### c. Definition of trapezoid.

- \_\_\_\_\_ Defines trapezoid on first trial
- \_\_\_\_\_ Defines after given hints on relevant attributes
- \_\_\_\_\_ Defines after being told relevant attributes
- \_\_\_\_\_ Defines after extensive coaching

##### d. Sorting

- \_\_\_\_\_ Time to complete sorting
- \_\_\_\_\_ Number of errors; nonexamples falsely identified as trapezoids
- \_\_\_\_\_ Number of errors; examples falsely identified as nontrapezoids.

##### e. Drawing

- \_\_\_\_\_ Number of trials needed to present adequate drawing (4 sides & parallel lines)

## III. Concept Attainment Test

Trial 1		Trial 2		Trial 3	
1	16	1	16	1	16
2	17	2	17	2	17
3	18	3	18	3	18
4	19	4	19	4	19
5	20	5	20	5	20
6	21	6	21	6	21
7	22	7	22	7	22
8	23	8	23	8	23
9	24	9	24	9	24
10	25	10	25	10	25
11	26	11	26	11	26
12	27	12	27	12	27
13	28	13	28	13	28
14	29	14	29	14	29
15	30	15	30	15	30

Trial 4		Trial 5	
1	16	1	16
2	17	2	17
3	18	3	18
4	19	4	19
5	20	5	20
6	21	6	21
7	22	7	22
8	23	8	23
9	24	9	24
10	25	10	25
11	26	11	26
12	27	12	27
13	28	13	28
14	29	14	29
15	30	15	30

Number of trial to criterion \_\_\_\_\_

# DATA SHEET - Younger Child

School \_\_\_\_\_

## I. Background Data

a. Name \_\_\_\_\_ d. Father's Occupation \_\_\_\_\_  
 b. Sex \_\_\_\_\_ e. MRT \_\_\_\_\_  
 c. Birthdate \_\_\_\_\_

f. Siblings, Birthdate and Sex

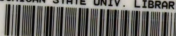
_____	_____	_____
_____	_____	_____
_____	_____	_____

## II. Recording of 10-minute teaching session.

## III. Concept Attainment Test.

Score	Reason	Score	Reason
1. _____	_____	16. _____	_____
2. _____	_____	17. _____	_____
3. _____	_____	18. _____	_____
4. _____	_____	19. _____	_____
5. _____	_____	20. _____	_____
6. _____	_____	21. _____	_____
7. _____	_____	22. _____	_____
8. _____	_____	23. _____	_____
9. _____	_____	24. _____	_____
10. _____	_____	25. _____	_____
11. _____	_____	26. _____	_____
12. _____	_____	27. _____	_____
13. _____	_____	28. _____	_____
14. _____	_____	29. _____	_____
15. _____	_____	30. _____	_____

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