DOCUMENT RESUME

ED 057 399	24	CG 006 955

AUTHOR	Circirelli, Victor G.
TITLE	Concept Learning of Young Children as a Function of Sibling Relationships to the Teacher. Report from the Project on Variables and Processes in Cognitive Learning.
INSTITUTION	Wisconsin Univ., Madison. Research and Development Center for Cognitive Learning.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
REPORT NO	TR-175
BUREAU NO	BR-5-0216
PUB DATE	Oct 71
CONTRACT	OEC-5-10-154
NOTE	49p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Concept Teaching; *Elementary School Students; Interaction Process Analysis; *Learning Motivation; *Peer Teaching; Role Theory; *Sex Differences; Siblings; Tutoring

ABSTRACT

This study attempted to answer the question: Is a sibling relationship associated with concept learning of a younger child taught by an older 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 these children, 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 older child was trained in the concept and taught it to the younger child in a 10-minute session. Male learners scor[illegible] higher on the trapezoid concept attainment test than female [illegible]s; learners scored higher when taught by a female sib than when [illegible]t by a male sib or by a female nonsib. Girls teaching their sibs used a deductive teaching method more than other groups. Learners with higher concept attainment scores also showed greater awareness of relevant attributes of the concept. Results have implications for the selection of older children for use in school tutoring programs. (Author)

PA24

OE-BR
502216

UNIVERSITATIS WISCONSINENSIS SIGILLUM

NUMEN LUMEN

RESEARCH

COGNITIVE LEARNING

DEVELOPMENT

Technical Report No. 175

CONCEPT LEARNING OF YOUNG CHILDREN AS A FUNCTION OF SIBLING RELATIONSHIPS TO THE TEACHER

By Victor G. Cicirelli

Report from the Project on Variables and Processes in Cognitive Learning

Herbert J. Klausmeier, Robert E. Davidson, Joel R. Levin, Thomas A. Romberg, B. Robert Tabachnick, Alan M. Voelker, Larry Wilder, Peter Wolff
Project Investigators

Mary R. Quilling
Technical Development Program Director

Dorothy A. Frayer
Research Associate

Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
Madison, Wisconsin

October 1971

Published by the Wisconsin Research and Development Center for Cognitive Learning, supported in part as a research and development center by funds from the United States Office of Education, Department of Health, Education, and Welfare. The opinions expressed herein do not necessarily reflect the position or policy of the Office of Education and no official endorsement by the Office of Education should be inferred.

Center No. C-03 / Contract OE 5-10-154

NATIONAL EVALUATION COMMITTEE

Samuel Brownell
Professor of Urban Education
Graduate School
Yale University

Henry Chauncey
President
Educational Testing Service

Elizabeth Koontz
Wage and Labor Standards Administration, U.S. Department of Labor, Washington

Patrick Suppes
Professor
Department of Mathematics
Stanford University

Launor F. Carter
Senior Vice President on Technology and Development
System Development Corporation

Martin Deutsch
Director, Institute for Developmental Studies
New York Medical College

Roderick McPhee
President
Punahou School, Honolulu

***Benton J. Underwood**
Professor
Department of Psychology
Northwestern University

Francis S. Chase
Professor
Department of Education
University of Chicago

Jack Edling
Director, Teaching Research Division
Oregon State System of Higher Education

G. Wesley Sowards
Director, Elementary Education
Florida State University

RESEARCH AND DEVELOPMENT CENTER POLICY REVIEW BOARD

Leonard Berkowitz
Chairman
Department of Psychology

Russell J. Hosler
Professor, Curriculum and Instruction

Stephen C. Kleene
Dean, College of Letters and Science

B. Robert Tabachnick
Chairman, Department of Curriculum and Instruction

Archie A. Buchmiller
Deputy State Superintendent
Department of Public Instruction

Clauston Jenkins
Assistant Director
Coordinating Committee for Higher Education

Donald J. McCarty
Dean
School of Education

Henry C. Weinlick
Executive Secretary
Wisconsin Education Association

Robert E. Grinder
Chairman
Department of Educational Psychology

Herbert J. Klausmeier
Director, R & D Center
Professor of Educational Psychology

Ira Sharkansky
Associate Professor of Political Science

M. Crawford Young
Associate Dean
The Graduate School

EXECUTIVE COMMITTEE

Edgar F. Borgatta
Brittingham Professor of Sociology

Robert E. Davidson
Assistant Professor, Educational Psychology

Russell J. Hosler
Professor of Curriculum and Instruction and of Business

Wayne Otto
Professor of Curriculum and Instruction (Reading)

Anne E. Buchanan
Project Specialist
R & D Center

Frank H. Farley
Associate Professor, Educational Psychology

***Herbert J. Klausmeier**
Director, R & D Center
Professor of Educational Psychology

Robert G. Petzold
Associate Dean of the School of Education
Professor of Curriculum and Instruction and of Music

Robin S. Chapman
Research Associate
R & D Center

FACULTY OF PRINCIPAL INVESTIGATORS

Vernon L. Allen
Professor of Psychology

Frank H. Farley
Associate Professor of Educational Psychology

James Moser
Assistant Professor of Mathematics Education; Visiting Scholar

Richard L. Venezky
Assistant Professor of English and of Computer Sciences

Ted Czajkowski
Assistant Professor of Curriculum and Instruction

Lester S. Golub
Lecturer in Curriculum and Instruction and in English

Wayne Otto
Professor of Curriculum and Instruction (Reading)

Alan Voelker
Assistant Professor of Curriculum and Instruction

Robert E. Davidson
Assistant Professor of Educational Psychology

John G. Harvey
Associate Professor of Mathematics and of Curriculum and Instruction

Milton O. Pella
Professor of Curriculum and Instruction (Science)

Larry Wilder
Assistant Professor of Curriculum and Instruction

Gary A. Davis
Associate Professor of Educational Psychology

Herbert J. Klausmeier
Director, R & D Center
Professor of Educational Psychology

Thomas A. Romberg
Associate Director, R & D Center
Professor of Mathematics and of Curriculum and Instruction

Peter Wolff
Assistant Professor of Educational Psychology

M. Vere DeVault
Professor of Curriculum and Instruction (Mathematics)

Donald Lange
Assistant Professor of Curriculum and Instruction

B. Robert Tabachnick
Chairman, Department of Curriculum and Instruction

MANAGEMENT COUNCIL

Herbert J. Klausmeier
Director, R & D Center
V.A.C. Henmon Professor of Educational Psychology

Thomas A. Romberg
Associate Director

James Walter
Director
Dissemination Program

Dan G. Woolpert
Director
Operations and Business

Mary R. Quilling
Director
Technical Development Program

* COMMITTEE CHAIRMAN

STATEMENT OF FOCUS

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Project on Variables and Processes in Cognitive Learning in Program 1, Conditions and Processes of Learning. General objectives of the Program are to generate knowledge and develop general taxonomies, models, or theories of cognitive learning, and to utilize the knowledge in the development of curriculum materials and procedures. Contributing to these Program objectives, this project has these objectives: to ascertain the important variables in cognitive learning and to apply relevant knowledge to the development of instructional materials and to the programming of instruction for individual students; to clarify the basic processes and abilities involved in concept learning; and to develop a system of individually guided motivation for use in the elementary school.

CONTENTS

LIST OF TABLES AND FIGURES

ABSTRACT

This study of the attainment of the trapezoid concept by First Grade children when taught by Third Grade children attempted to answer the question: Is a sibling relationship associated with concept learning of a younger child taught by an older 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 these children, 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. Once the older child was trained in the concept, he taught it to the younger child in a 10-minute session. It was found that male learners scored higher on the trapezoid concept attainment test than female learners; learners scored higher when they were taught by a female sib than when they were taught by a male sib or by a female nonsib. Girls teaching their sibs used a deductive teaching method more than other groups. Learners 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.

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 well as 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 than 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 relationships 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

different, 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 (1968) 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 other words, peer play is essential for normal social development. 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 non-sib playmates, and who was usually "boss" in the play. He found that first-born children took high power roles with their younger sib- 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 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 effeots 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 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 aohievement.

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 reinforoement (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 the 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

DESIGN

A 2 × 2 × 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	Non-sib	Sib	Non-sib
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.

CONTROLS

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 6 years old with a sib 2 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.[1] 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 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 10, Footnote 5), 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

[1] 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.

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, carton paper, and building. 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.)

A set of various types of discriminably different trapezoids was constructed, varying in the length of the sides, size of the angles, and orientation of the figure. Of these, 15 different examples were selected and placed on cards. Fifteen other geometric figures (circle, rectangle, square, hexagon, etc.) to be used as negative examples were also constructed and placed on cards. The positive and negative examples were placed in a random sequence for presentation to the learner. [Appendix A contains 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.[2]

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 use in concretely 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 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

---

[2] 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.

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.[3]

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 the 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 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 10 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 was then 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; the level of difficulty of the task was determined and also whether the subjects responded appropriately to the instructional materials; and the grade level of children suited to the task was estimated. 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).

---

[3] 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.

III
RESULTS

The learners' 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.[4,5]

Table 1 is a summary of the analysis of 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 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 relation-

[4] 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 $\underline{F}$ 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 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.

[5] 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 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 × Sex T	1	126.08	8.81	.004
S-NS × Sex L	1	3.68	.26	.61
Sex T × Sex L	1	6.08	.42	.52
S-NS × Sex T × Sex L	1	20.01	1.40	.24
Within Cells	112	14.31	-	-

ship to the learner.

In order to effectively 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 nonsiblings? 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.[6] 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.

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.

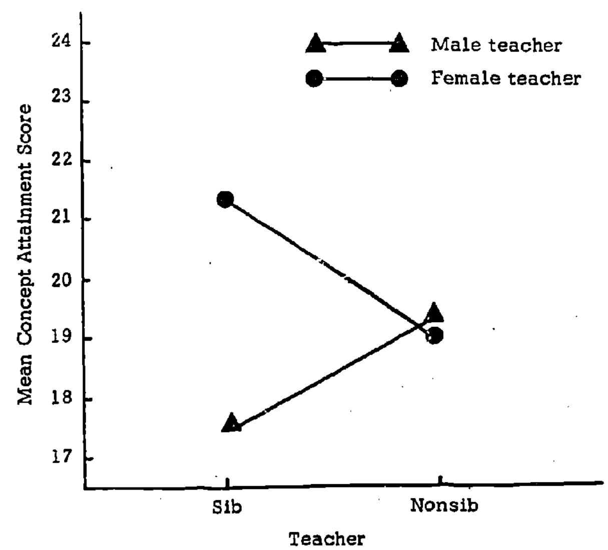


Figure 1. Interaction between sex and sibling status of teacher

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.

[6] *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 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

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	-	-

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, or
4. Older brothers teaching younger sisters.

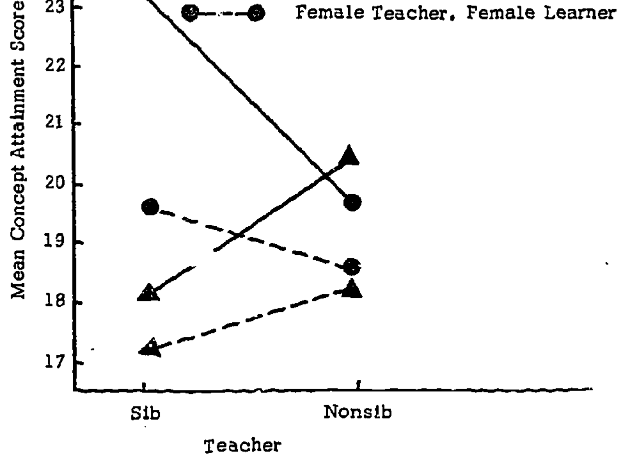


Figure 2. Interaction of sibling relationship, sex of teacher, and sex of learner.

Table 4

Newman-Keuls Tests for the Significance of Differences Between All Possible Pairs of Subgroup Means

Means	Difference Between Means						
	M_2	M_3	M_4	M_5	M_6	M_7	M_8
M_1 = 23.20	2.93	3.47	3.57	4.67*	4.80*	5.18*	6.13*
M_2 = 20.33	-	0.60	0.66	1.80	1.93	2.26	3.26
M_3 = 19.73	-	-	0.06	1.20	1.33	1.66	2.66
M_4 = 19.67	-	-	-	1.14	1.27	1.60	2.60
M_5 = 18.53	-	-	-	-	0.13	0.46	1.46
M_6 = 18.40	-	-	-	-	-	0.33	1.33
M_7 = 18.07	-	-	-	-	-	-	1.00
M_8 = 17.07	-	-	-	-	-	-	-

M_1 is the mean for sisters teaching younger brothers.

M_2 is the mean for boys teaching younger boys.

M_3 is the mean for girls teaching younger boys.

M_4 is the mean for sisters teaching younger sisters.

M_5 is the mean for girls teaching younger girls.

M_6 is the mean for boys teaching younger girls.

M_7 is the mean for brothers teaching younger brothers.

M_8 is the mean for brothers teaching younger sisters.

*Significant at .05 level.

Other differences between subgroups were not significant.

CONCEPT ATTAINMENT SCORE AND REPORTED REASONS FOR IDENTIFICATION OF CONCEPT EXAMPLES

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

1. Doesn't know.

2. Irrelevant reason. Learner used irrelevant or nonessential attributes to decide that 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 "doesn't 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 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

Table 5

Learners' Concept Attainment and Reasons for Identification of Concept Examples

Reason	Concept Attainment Score	
	Low (1-19)	High (20-30)
1. Doesn't 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

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.

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.[7] 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

[7] 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.

Table 6

Reasons for Identification of Concept Examples and Other Variables.

Variable	Frequency: Inadequate Reason	Frequency: Adequate Reason	df	Chi-Square
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

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 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:

Total No. of Examples	Frequency
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:

Number of Positive Examples	Frequency
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. There were 85 teachers who used examples randomly; 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.

Table 7

Variables in the Teaching Situation and Concept Attainment Score

Teaching Variable		Frequency Low[a]	High[b]	df	Chi-square
1. Teaching method:	Deductive	9	18		
	Inductive	25	20		
	Mixed	25	23	2	3.56
2. Teacher explained, described, or defined concept:	Yes	25	28		
	No	34	33	1	0.14
3. Teacher demonstrated or illustrated attributes:	Yes	35	38		
	No	24	23	1	0.10
4. Number of examples:	1-20	39	31		
	≥ 21	20	30	1	2.85
5. Number of positive examples:	1-10	30	28		
	≥ 11	29	33	1	0.29
6. Choice of examples:	Random	43	42		
	Selective	16	19	1	0.22
7. Presentation of examples:	Simultaneous	32	19		
	Sequential	18	30		
	Other	9	12	2	5.84
8. First example:	Positive	11	21		
	Negative	11	15		
	Not applicable	37	25	2	6.04*
9. Teacher identified examples:	Yes	19	21		
	No	40	40	1	0.06
10. Teacher asked learner to identify examples:	Yes	49	50		
	No	10	11	1	0.02
11. Amount of feedback:	None	37	43		
	Some	22	18	1	0.82
12. Kind of feedback:	Correct	17	18		
	Incorrect	23	24		
	Not applicable	19	19	2	0.01
13. Teacher asked questions of learner:	Yes	22	11		
	No	37	50	1	5.58*
14. Teacher told learner what to do:	Yes	12	9		
	No	47	52	1	0.65

a. Low = Learners scoring below the mean on concept attainment test
b. High = Learners scoring above the mean on concept attainment test

*Significant at the .05 level
**Significant at the .01 level

Table 8

Sex of the Learner and Variables in the Teaching Situation

Teaching Variable		Frequency: Male Learner	Frequency: Female Learner	df	Chi-square
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	19	12		
	Negative	15	11		
	Not applicable	26	37	2	4.11
9. Teacher identified examples:	Yes	19	21		
	No	41	39	1	0.15
10. Teacher asked learner to identify examples:	Yes	49	50		
	No	11	10	1	0.06
11. Amount of feedback:	None	18	22		
	Some	42	38	1	0.60
12. Kind of feedback:	Correct	16	19		
	Incorrect	27	20		
	Not applicable	17	21	2	1.85
13. Teacher asked questions of learner:	Yes	10	23		
	No	50	37	1	7.05**
14. Teacher told learner what to do:	Yes	14	7		
	No	46	53	1	2.82

*Significant at the .05 level
**Significant at the .01 level

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 were computed 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. The results 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.

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 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.[8] 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.[9]]

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,
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, and
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.

---

[8] 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.

[9] The Chi-square computed when the inductive and mixed teaching method categories were combined was 6.64, significant at the .01 level

Table 9

Sex and Sibship of the Teacher and Variables in the Teaching Situation

Teaching Variable		Frequency MS[a]	FS[b]	MNS[c]	FNS[d]	df	Chi-Square
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		
	$\geq$ 21	15	10	10	15	3	3.43
5. Number of positive examples:	1-10	11	19	12	16		
	$\geq$ 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	6	5	9	11		
	Negative	6	6	6	8		
	Not applicable	18	19	15	11	6	6.48
9. Teacher identified examples:	Yes	6	15	9	10		
	No	24	15	21	20	3	6.30
10. Teacher asked learner to identify examples:	Yes	27	21	28	23		
	No	3	9	2	7	3	7.56
11. Amount of feedback:	None	7	19	5	9		
	Some	23	11	25	21	3	17.40**
12. Kind of feedback:	Correct	10	6	13	6		
	Incorrect	14	6	12	15		
	Not applicable	6	18	5	9	6	29.24**
13. Teacher asked questions of learner:	Yes	5	10	9	9		
	No	25	20	21	21	3	2.46
14. Teacher told learner what to do:	Yes	3	8	8	2		
	No	27	22	22	28	3	7.10

a. MS = male sib teacher
b. FS = female sib teacher
c. MNS = male nonsib teacher
d. FNS = female nonsib teacher

*Significant at the .05 level
**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 SB[a]	Frequency BS[b]	df	Chi-Square[c]
1. Teaching method:	Deductive	10	3		
	Inductive	0	8		Too few
	Mixed	5	4	2	cases
2. Teacher explained, described, defined concept:	Yes	13	5		
	No	2	10	1	6.81**
3. Teacher demonstrated or illustrated attributes:	Yes	14	9		Too few
	No	1	6	1	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		Too few
	Other	3	3	2	cases
8. First example:	Positive	2	3		
	Negative	4	3		Too few
	Not applicable	9	9	1	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
	Not applicable	8	4	2	cases
13. Teacher asked questions of learner:	Yes	4	5		Too few
	No	11	10	1	cases
14. Teacher told learner what to do:	Yes	5	1		Too few
	No	10	14	1	cases

a. SB = older sister teaching younger brother
b. BS = older brother teaching younger sister
c. 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 D[a]	I[b]	M[c]	df	Chi-Square
2. Teacher explained, described, defined concept:	Yes	17	9	26	2	16.51**
	No	10	36	22		
3. Teacher demonstrated or illustrated attributes:	Yes	22	14	37	2	26.84**
	No	5	31	11		
4. Number of examples:	1-20	18	19	33	2	7.72*
	≥ 21	9	26	15		
5. Number of positive examples:	1-10	17	14	27	2	8.87*
	≥ 11	10	31	21		
6. Choice of examples:	Random	14	38	33	2	8.85*
	Selective	13	7	15		
7. Presentation of examples:	Simultaneous	11	17	23	4	7.13
	Sequential	9	24	15		
	Other	7	4	10		
8. First example:	Positive	8	11	13	4	9.29
	Negative	2	16	8		
	Not applicable	17	18	27		
9. Teacher identified examples:	Yes	14	5	21	2	16.51**
	No	13	40	27		
10. Teacher asked learner to identify examples:	Yes	18	40	40	2	5.71
	No	9	5	8		
11. Amount of feedback:	None	16	8	16	2	13.01**
	Some	11	37	32		
12. Kind of feedback:	Correct	7	12	16	4	17.03**
	Incorrect	4	25	18		
	Not applicable	16	8	14		
13. Teacher asked questions of learner:	Yes	12	3	18	2	16.09**
	No	15	42	30		
14. Teacher told learner what to do:	Yes	8	5	9	2	3.87
	No	19	40	39		

a. D = deductive teaching method
b. I = inductive teaching method
c. M = mixed teaching methods

*Significant at the .05 level
**Significant at the .01 level

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 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

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

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, 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 noncorrelated with concept attainment, 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 nonsib 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 nonfamily 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 is 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 2 years apart. This means a great amount of interaction and hence optimum conditions for sibling rivalry (Rosenberg & 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 6-and 7-year olds with arithmetic with encouraging results (Quilling, Cook, Wardrup, & Klausmeier, 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, 1970). 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 research, in which the results are evaluated and actions revised accordingly.

GPO 823-077-5

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 eight 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 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.

REFERENCES

Abe, K., Tsuji, J., & Suzuki, H. The significance of birth order and age difference between siblings as observed in drawings of pre-kindergarten children. Folia Psychiatrica & Neurologica Japanica, 1964, 17, 315-325.

Adams, B. N. Kinship in an urban setting. Chicago: Markham, 1968.

Altus, W. D. Birth order and its sequelae. Science, 1966, 151 (3706), 44-49.

Anastasi, A. Intelligence and family size. Psychological Bulletin, 1956, 53, 187-209.

Bayley, N. Comparison of mental and motor test scores for ages 1-15 months by sex, birth order, race, geographical location, and education of parent. Child Development, 1965, 36, 379-411.

Bossard, J. H. S., & Boll, E. S. S curity in the large family. Mental Hygie , 1954, 38, 529-544.

Bossard, J. H. S., & Boll, E. H. The sociology of child development, 3rd Ed., New York: Harper, 1960.

Bronfenbrenner, U. Two worlds of childhood. New York: Russell Sage Foundation, 1970.

Cicirelli, V. G. Sibling constellation, creativity, I.Q. and academic achievement. Child Development, 1967, 38, 481-490.

Cloward, R. D. Studies in tutoring. Journal of Experimental Education, 1967, 36, 14-25.

Dean, D. A. The relation of ordinal position to personality in young children. Master's Thesis. State University of Iowa, 1947.

Eisenman, R. Complexity-simplicity: II. Birth order and sex differences. Psychonomic Science, 1967, 8, 171-172.

Harlow, H. F. Age-mate or peer affectional system. In Lehrman, D. S., Hinde, R. A., & Shaw, E. (Eds.), Advances in the study of behavior, Vol. II. New York: Academic Press, 1969, Pp. 333-383.

Harris, I. D. The promised seed. New York: Free Press of Glencoe, 1964.

Hess, R. D. & Shipman, V. C. Early experiences and the socialization of cognitive modes in children. Child Development, 1965, 36, pp. 869-886.

Hilton, I. Differences in the behavior of mothers toward first- and later-born children. Journal of Personality and Social Psychology, 1967, 7, 282-290.

Irish, D. P. Sibling interaction: A neglected aspect in family life research. Social Forces, 1964, 42, 279-288.

Koch, H. L. The relation of primary mental abilities in five- and six-year-olds to sex of child and characteristics of his sibling. Child Development, 1954, 25, 209-223.

Koch, H. L. The relation of certain formal attributes of siblings to attitudes held toward each other and toward their parents. Monographs of the Society for Research in Child Development, 1960, 25, 1-124.

Lasko, J. K. Parent behavior toward first and second children. Genetic Psychology Monographs, 1954, 49, 97-137.

Lippitt, P. Children can teach other children. Instructor, May, 1969.

Lippitt, R., & Lippitt, P. Cross-age helpers. NEA Journal, March, 1968.

Lees, J. P., & Steward, A. H. Family or sibship position and scholastic ability. Sociological Review (British), July 1957, 85-106.

Maxwell, J., & Pilliner, A. E. G. The intellectual resemblance between sibs. Annals of Human Genetics, 1960, 24, 23-32.

Mead, M. & Heyman, K. The Family. New York: Macmillan, 1965.

Quilling, M., Cock, D., Wardrup, J., & Klausmeier, H. J. Research and development activities in R & I Units of two elementary schools of Milwaukee, Wisconsin, 1966-67, Technical Report from the Wisconsin Research & Development Center, Madison, Wisconsin, No. 46, 1968.

Rosenberg, B. G., & Sutton-Smith, B. The relationship of ordinal position and sibling sex status to cognitive abilities. Psychonomic Science, 1964, 1, 81-82.

Rosenberg, B. G., & Sutton-Smith, B. Sibling association, family size, and cognitive abilities. Journal of Genetic Psychology,

1966, 109, 271-279.
Rosenberg, B. G., & Sutton-Smith, B. Sibling age spacing effects upon cognition. Developmental Psychology, 1969, 1 (6), 661-668.
Schachter, S. Birth order, eminence, and higher education. American Sociological Review, 1963, 28, 757-768.
Schoonover, S. M. The relationship of intelligence and achievement to birth order, sex of sibling, and age interval. Journal of Educational Psychology, 1959, 50, 143-146.
Stevenson, H. W. Social reinforcement of children's behavior. In Lipsitt, L. P., & Spiker, C. C. (Eds.), Advances in child development and behavior. Vol. II. New York: Academic Press, 1965. Pp. 97-126.
Stewart, R. H. Birth order and dependence. Journal of Personality and Social Psychology, 1967, 6, 192-194.
Sutton-Smith, B. Role replication and reversal in play. Merrill Palmer Quarterly, 1966, 12, 285-298.
Sutton-Smith, B., & Rosenberg, B. G. The sibling. New York: Holt, Rinehart and Winston, 1970.
Tyler, L. E. The Psychology of Human Differences. 3rd Ed., New York: Appleton-Century-Crofts, 1965.
Walker, C. E., & Tahmisian, J. Birth order and student characteristics: a replication. Journal of Consulting Psychology, 1967, 31, 219.

APPENDIX A
TRAPEZOID CONCEPT ATTAINMENT TEST

Wisconsin Research & Development
Center for Cognitive Learning

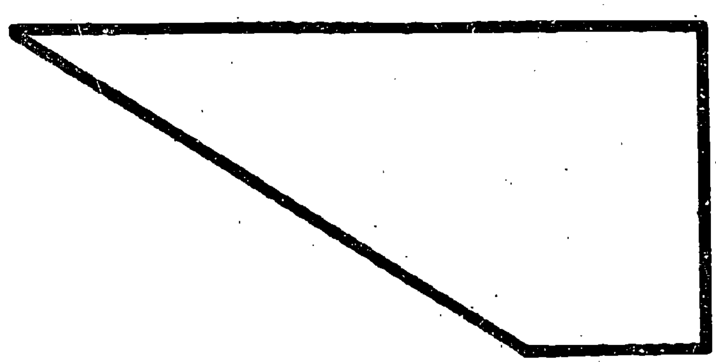
This is an achievement test designed to assess the child's attainment of the trapezoid concept. It consists of 30 geometric figures for the subject to identify, 15 trapezoids and 15 non-trapezoids arranged in a random sequence. Figures selected as examples of trapezoids varied in length of lines, size 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.

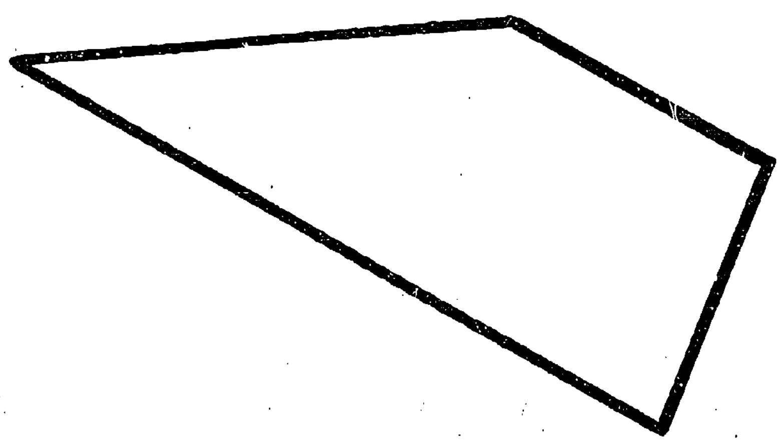
Content validity is assumed; internal consistency reliability is .63.

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

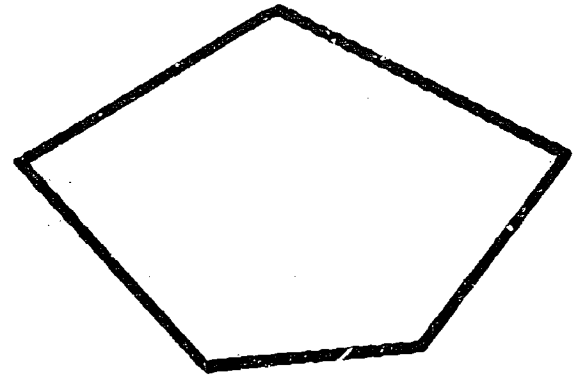
1. Is this a trapezoid?
   Yes_____
   No _____



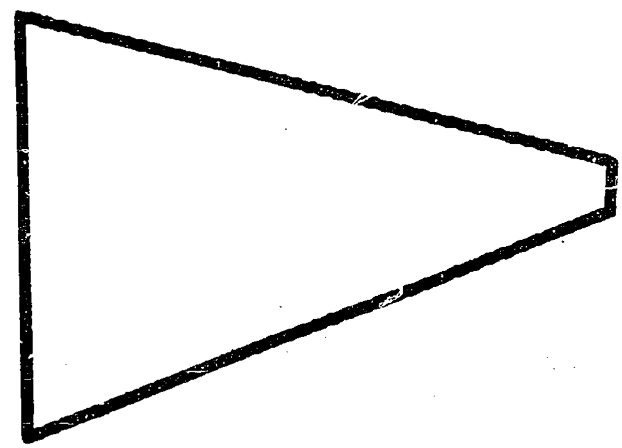
2. Is this a trapezoid?
   Yes_____
   No _____



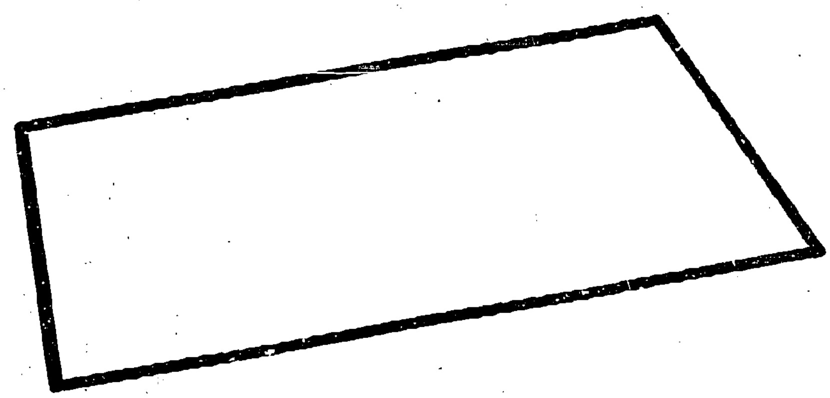
3. Is this a trapezoid?
Yes_____
No _____



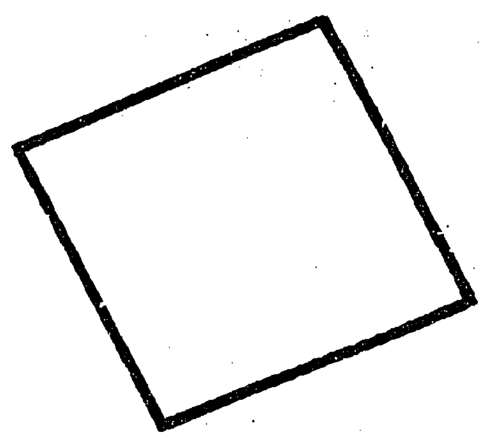
4. Is this a trapezoid?
Yes_____
No _____



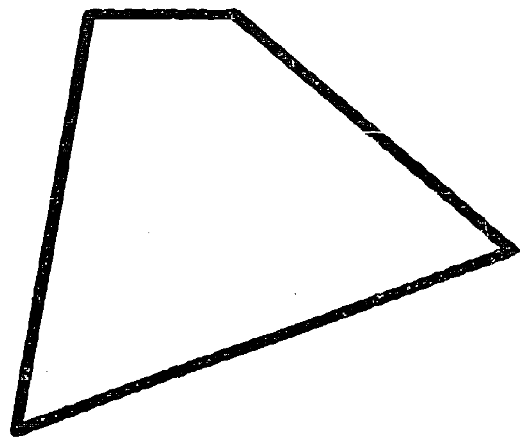
5. Is this a trapezoid?
Yes_____
No _____



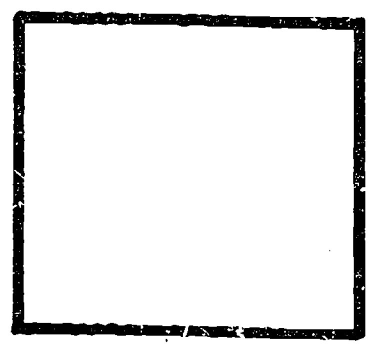
6. Is this a trapezoid?
Yes_____
No _____



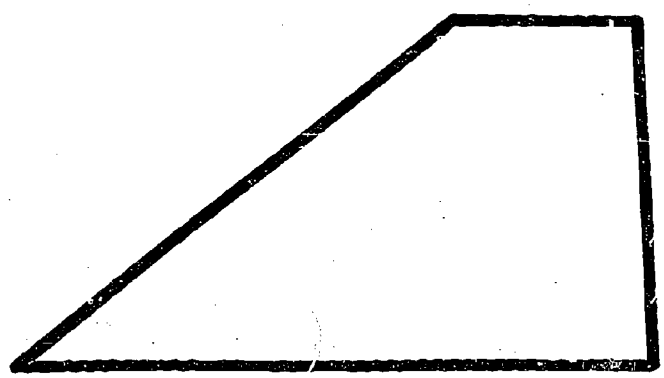
7. Is this a trapezoid?
Yes_____
No _____



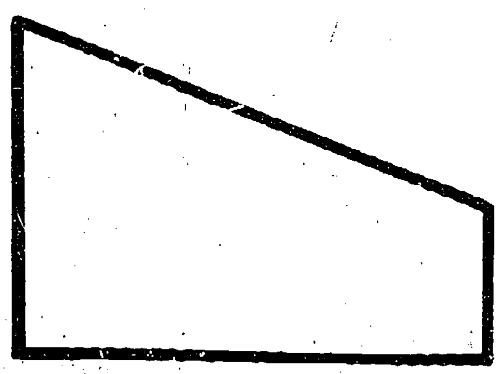
8. Is this a trapezoid?
Yes_____
No _____



9. Is this a trapezoid?
Yes_____
No _____

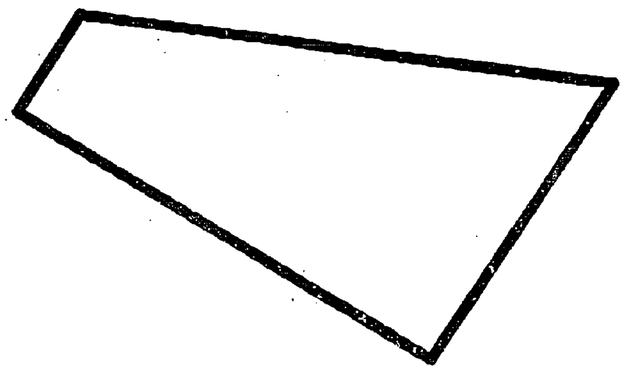


10. Is this a trapezoid?
Yes_____
No _____

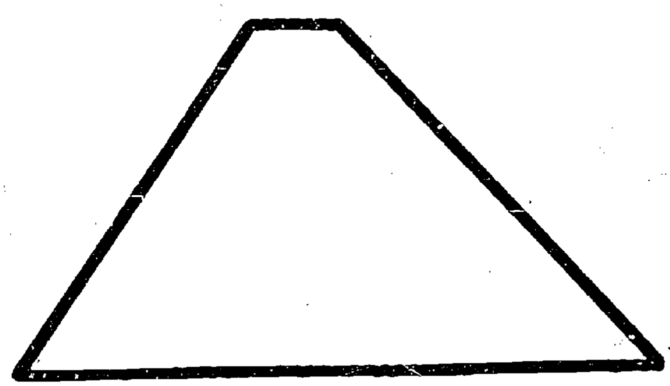


11. Is this a trapezoid?
Yes_____
No _____

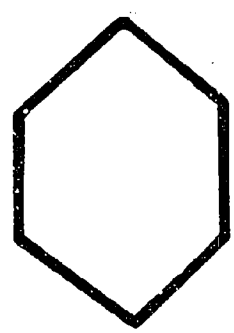
12. Is this a trapezoid?
Yes_____
No _____



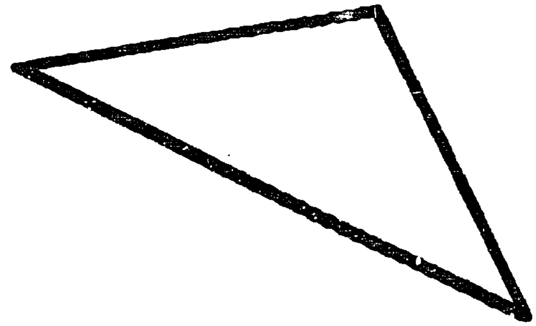
13. Is this a trapezoid?
Yes_____
No _____



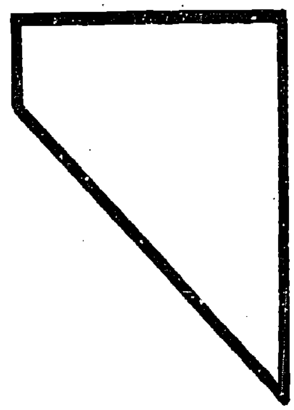
14. Is this a trapezoid?
Yes_____
No _____



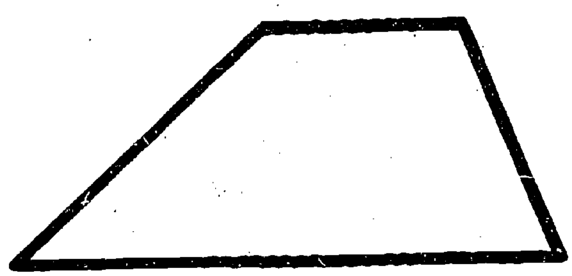
15. Is this a trapezoid?
Yes______
No ______



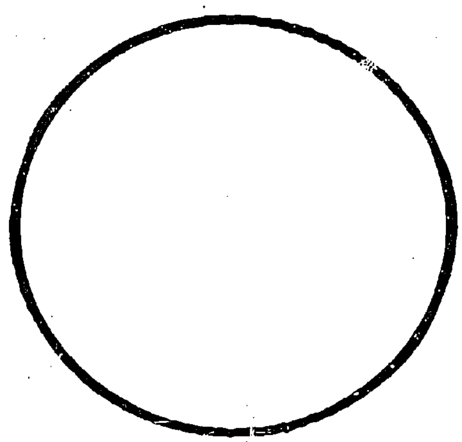
16. Is this a trapezoid?
Yes______
No ______



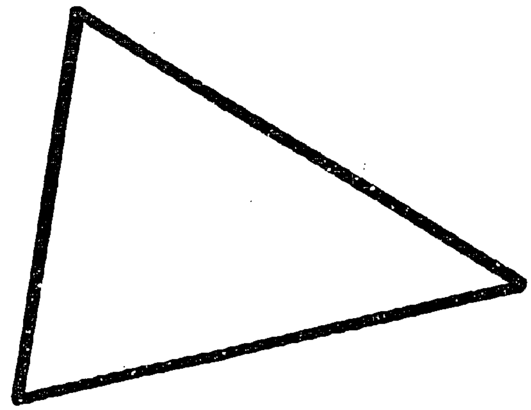
17. Is this a trapezoid?
Yes______
No ______



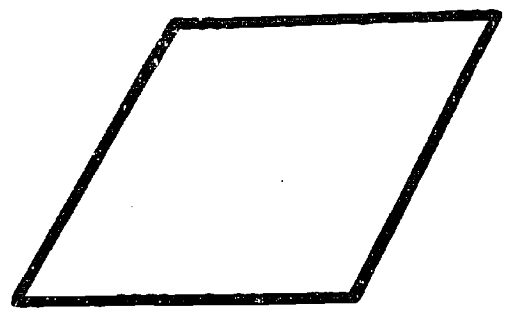
18. Is this a trapezoid?
Yes______
No ______



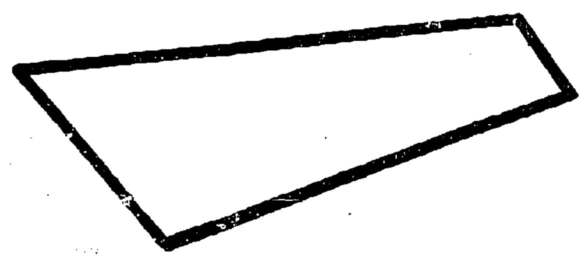
19. Is this a trapezoid?
Yes_____
No _____



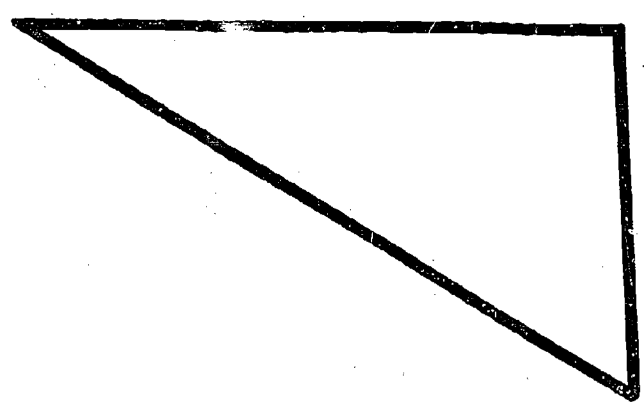
20. Is this a trapezoid?
Yes_____
No _____



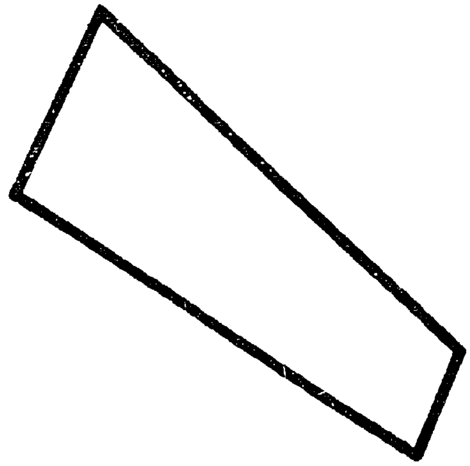
21. Is this a trapezoid?
Yes_____
No _____



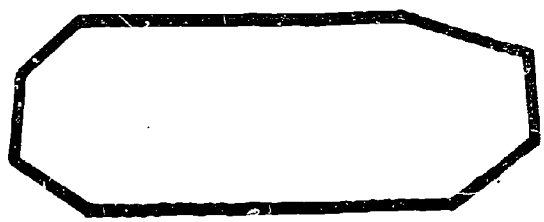
22. Is this a trapezoid?
Yes_____
No _____



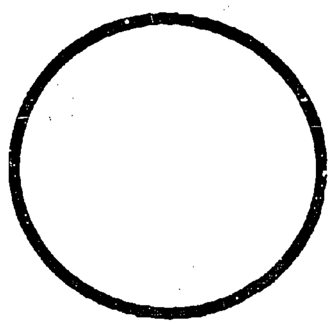
23. Is this a trapezoid?
Yes_____
No _____



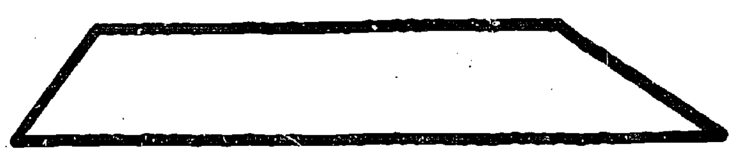
24. Is this a trapezoid?
Yes_____
No _____



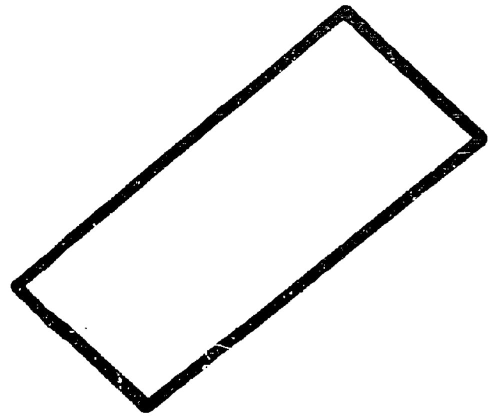
25. Is this a trapezoid?
Yes_____
No _____



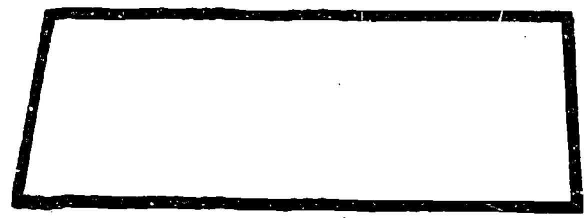
26. Is this a trapezoid?
Yes_____
No _____



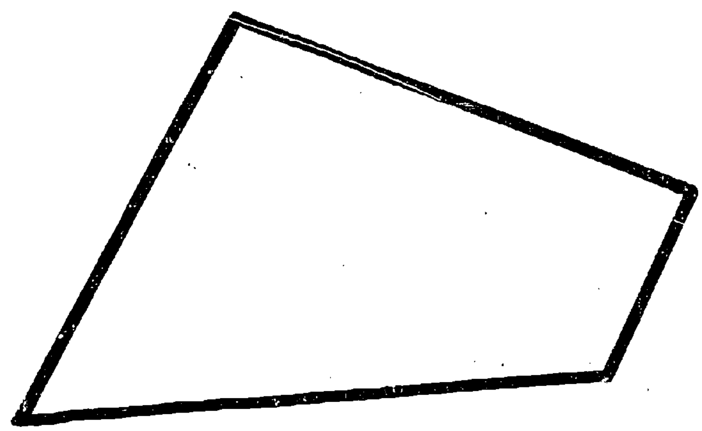
27. Is this a trapezoid?
Yes_____
No _____



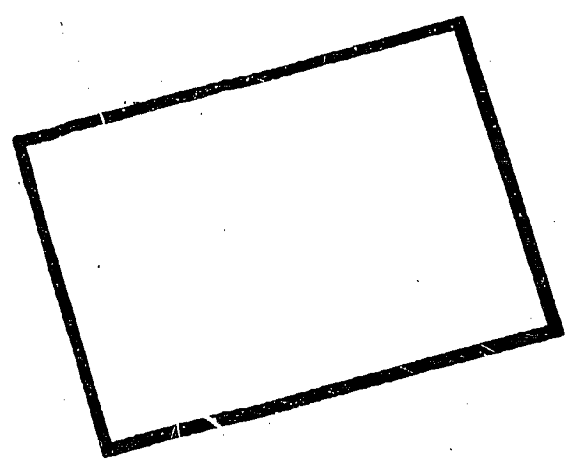
28. Is this a trapezoid?
Yes_____
No _____



29. Is this a trapezoid?
Yes_____
No _____



30. Is this a trapezoid?
Yes_____
No _____



APPENDIX B
FREQUENCY DISTRIBUTION OF CONCEPT ATTAINMENT SCORES

Table 13

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

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 and parallel lines)

III. Concept Attainment Test

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

Number of trials to criterion__________

DATA SHEET—Younger Child

School________________________

I. Background Data
   a. Name________________________
   b. Sex________________________
   c. Birthdate________________________
   d. Father's Occupation________________________
   ____
   e. MRT________________________

   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.	____	____________

GPO 825-077-2