DOCUMENT RESUME

ED 071 764 PS 006 308

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TITLE Relationship of Sibling Structure and Interaction to Categorization Ability. Final Report.
INSTITUTION Purdue Univ., Lafayette, Ind.
SPONS AGENCY National Center for Educational Research and Development (DHEW/OE), Washington, D.C. Regional Research Program.
BUREAU NO BR-1-E-106
PUB DATE Sep 72
GRANT OEG-5-71-0047(509)
NOTE 35p.

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Age Differences; Behavior Development; *Cognitive Development; Cognitive Measurement; Data Analysis; Elementary Grades; Evaluation Methods; Experiments; Intellectual Development; Kindergarten; Research; Research Methodology; Research Reviews (Publications); *Sex Differences; *Siblings; Sorting Procedures; Tables (Data); *Task Performance; Technical Reports; Test Results; Visual Measures

ABSTRACT

This study identified behaviors of sibling pairs interacting on a cognitive task and related these behaviors to sibling structure variables (age and sex of each sibling and age spacing between them) and to measure of cognitive abilities of the younger sibling. Subjects were 160 sibling pairs randomly selected from appropriate subpopulations of two-child families: half the younger siblings were kindergartners, half second graders; half the older siblings were two years older, half four years older. The four possible sex combinations were equally represented. For half the pairs, the younger sibling carried out an initial object-sorting task alone. For the remainder, the older sibling helped the younger on sorting, and their behavior was recorded. Measures of the younger siblings' categorization abilities on a second object-sorting task were taken. Results showed that the assistance of the older sibling had a significant effect on the younger sibling's later categorization for six of the eight object-sorting variables. Children with siblings four years older made larger groups and left fewer ungrouped items than children with siblings two years older. Children with siblings of the same sex used fewer relational categories (according to the Wallach and Kogan criteria) than children with opposite sex siblings. Significant correlations were found between siblings' behaviors and the younger siblings' later categorization. (Author/KM)

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September, 1972

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
National Center for Educational Research and Development

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This study identified behaviors of sibling pairs interacting on a cognitive task, and related these behaviors to sibling structure variables (e.g., sex of sibling), and to measures of cognitive abilities of the younger sibling.

Subjects were 160 sibling pairs randomly selected from appropriate subpopulations of two child families: half the younger sibs were kindergartners, half second graders; half the older sibs were two years older, half four years older; the four possible sex combinations were equally represented.

For half the pairs, the younger sib carried out an initial object sorting task alone. For the remainder, the older sib helped the younger on sorting, and their behavior was recorded. Measures of the younger sibs' categorization abilities on a second object sorting task were taken.

Results were complex and involved many interactions, however the assistance of the older sib had a significant effect on the younger sib's later categorization for six of the eight object sorting variables. Children with sibs four years older made larger groups and left fewer ungrouped items than children with sibs.two years older. Children with sibs of the same sex used fewer relational categories than children with opposite sex siblings. Significant correlations were found between sibs' behaviors and the younger sib's later categorizations.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Relationship of Sibling Structure and Interaction to Categorization Ability

PROBLEM AND OBJECTIVES

INTRODUCTION

The abilities and achievement of children vary from child to child within the same family as well as from one family to another. Many investigators (Bossard & Boll, 1960; Harris, 1964) 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 (Dean, 1947; Lasko, 1954; Hilton, 1967), and this in turn leads to differences in achievement. However, other investigators (Irish, 1964; Koch, 1960; Sutton-Smith & Rosenberg, 1970), 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.

A child's siblings (in particular the older siblings of a later-born child) may be viewed as important socializing agents in his development. If siblings and parents were competing with each other for influence over a particular child in the family, the parents would be successful in most cases, since they have greater power, knowledge, and skills than a sibling. However, siblings are important socializing agents of other siblings in many situations simply because the parents are not present or are too busy to interact with the child (for example, in playing games); here the sibling is more influential than the parent by default. Secondly, there are situations where children would resist or be embarrassed to learn from parents (sexual or other taboo topics) or where parents would be inappropriate sources of information or poor models for behavior. 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)."

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

> "Sibling relationship can perform a number of functions. Brothers and/or sisters spend many hours together and share a wide range of activities . . . . Interactions with siblings

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

Minuchin (1967) in a study of low-income families, concluded that older siblings may influence their younger brothers and sisters more than the parents do.

Toman (1969) has presented the idea that the closer new relationships duplicate those of one's sibling childhood the more successful they will be.

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

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

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

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

STATEMENT OF THE PROBLEM

The problem to be investigated can be stated as two basic questions:

1. Is there a relationship between measures of sibling interaction (as an older sibling aids a younger sibling in an object sorting task) and the categorization ability of the younger sibling?

2. Does this relationship depend upon the sibling structure of the family, in particular the age and the sex of each of the children and the age spacing between them?

REVIEW OF LITERATURE AND RELATED RESEARCH

The abilities and achievement of each child in the family might be understood better if attention were given to both sibling structure and interaction as variables influencing the child directly or in conjunction with parent-child interactions. Certain positions in the sibling structure appear to be particularly disadvantageous for intellectual achievement, but little is known about the kinds of sibling interaction which may be related to such an outcome. The larger sibling structure literature will be reviewed first, and will consider both achievement and ability.

(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, age, sex, and birth order of each, and the age spacing between the children. Sibling interaction means the reciprocal interchange of nonverbal, emotional, and intellectual communication between siblings.)

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 overrepresentation of the first-born among the eminent (Altus, 1966; Schachter, 1963). Studies of birth order among older children and college students have generally demonstrated the superiority of the first-born over the later-born child on measures of IQ and school achievement (Altus, 1966; Lees & Stewart, 1957; Maxwell & Pilliner, 1960; Rosenberg & Sutton-Smith, 1964; Schachter, 1963; Walker & Tahmisian, 1967), although the situation appears to be reversed with preschool and kindergarten children (Abe, Tsuji, & Suzuki, 1964; Koch, 1954). It might be noted parenthetically that Bayley (1965) found no relation between birth order and sex of the child and mental and motor test scores from 1-15 months of age. Harris (1964), in a detailed analysis of the work of eminent and highly creative men, concluded that those among them who were first-born children tended to produce work of an abstract verbal nature, while the work of those who were later-born

children was characterized by practical inventiveness and precise, discriminating attention to detail. The superiority of the first-born child, particularly in verbal skills, is usually accounted for by his unique relationship with his mother.

Studies of more complex family patterns engendered when the child's birth order, sex, sex of sibling(s), and sibling spacing are taken into consideration have found their effect on the child's intelligence and achievement to be less simple than that claimed for birth order alone. Such findings are characterized by a great deal of interaction between variables, most frequently involving the sex of the child in relation to the sex of the sibling. Both Koch (1954) and Schoonover (1959) reported that, in the two-child family, boys and girls with a male sibling were superior in IQ and achievement to children with a female sibling. They concluded that, perhaps because of his greater freedom, the male is somehow more stimulating to his sib. Rosenberg and Sutton-Smith (1964), in a study of college students, confirmed this finding for quantitative scores on the ACE, but found that language scores were enhanced by the presence of a female sibling. When the three-child family was considered (Rosenberg & Sutton-Smith, 1966), the quantitative ACE scores were enhanced for girls who had two brothers, and for boys who had heterogeneous siblings (rather than two brothers or two sisters). In a third study (Rosenberg & Sutton-Smith, 1969), college males from two-child families scored higher on the ACE when there was a large (4-6 year) age spacing between them and their sibs, while females scored higher when they had a female sib with a close age spacing (1-3 years). Cicirelli (1967), in a study of sixth grade school children, found that in the two-child family first-born girls and second-born boys scored higher on IQ than second-born girls or first-born boys, while reading and arithmetic achievement was enhanced for children with a sibling of like sex close in age. In a portion of the study concerned with larger families, birth order was not significantly related to abilities or achievement in three- or four-child families; however, in the three-child family, IQ and reading achievement were significantly depressed for children who had two brothers (compared to children who had two sisters, or a sister and a brother).

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

Even though any attempt at summarizing the complex interactions between sibling structure variables found in the Koch, Rosenberg and Sutton-Smith, and Cicirelli studies will surely result in over-simplification, certain general trends exist in their results:

1. Ordinal position in the family bears less relation to intellectual ability and achievement in the three- and four-child family than in the two-child family.

3. There is some evidence (Cicirelli, 1967) for a developmental trend in the effects of birth order and sibling sex; that is, a sibling status associated with enhanced development of a child's abilities at a certain age may be less facilitating at a later state 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 makes it evident that a child's abilities and achievement are rather strongly influenced by the siblings who surround him during his early years; while these studies do not deal with sibling interaction as such, they suggest the sibling structure variables which should be taken into account in studies of sibling interaction.

Sibling interaction. There has been very little direct study of interaction between siblings. (Literature relating sibling structure variables to personality is not felt to be pertinent and will not be reviewed here.)

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

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

These studies indicate that children interact differently with their sibs than with their peers, and that such interactions depend on sibling structure variables. However, no attempt was made to relate sibling interaction to sibling achievement.

Cicirelli (1971) attempted to demonstrate sibling interaction to be an intervening mechanism between sibling status and sibling achievement, as he investigated the effect of older sibs and nonsibs of both sexes as teachers of younger children on a concept learning task.

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 the

children in each group, the older sibling 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, using a standardized teaching procedure involving a variety of teaching techniques. 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 and on magnetic tape. The younger child was given a concept attainment test to determine his mastery of the trapezoid concept. In the analysis of variance, there was a significant interaction between sex of the teacher and the sib-nonsib factor such that older sisters were significantly more effective teachers of younger siblings than were older brothers, while older boys and girls showed no significant differences in their effectiveness as teachers of unrelated younger children. (The highest scoring subgroup of the study was that in which older sisters were teachers of younger brothers, while the lowest scoring subgroup was that in which older brothers were teachers of younger sisters.)

In an analysis of recorded data from the 10-minute teaching session, it was found that girls teaching their siblings used the deductive teaching method and its associated behaviors (explaining and describing, demonstrating and illustrating attributes, selection of examples) more than did other groups. The greater effectiveness of girls as teachers of their sibs was explained on the basis of their greater willingness to assume a teaching role and their greater experience in supervising their younger siblings. The relative ineffectiveness of boys as teachers of their younger sibs was considered to be an effect of sibling competition.

The study demonstrated interaction between siblings to be important for their concept attainment and distinct from sibling structure effects. However, the kind of concept teaching task used was highly structured and allowed only a rather narrow range of behaviors to be displayed in the teaching-interaction session. That is, the children's behaviors were constrained by their ceptions of teaching and learning roles, and may not have been representative of "real-life" sibling interactions.

Also, family size was not held constant in this study but varied from 2 to 8, with an average size of 4. Sutton-Smith and Rosenberg (1970) point out that studies of the 2-child family not only offer greater simplicity, but in view of the trend toward population control, may be more relevant for application in the future.

The present study used an object sorting task capable of eliciting a broader range of behavior in the sibling interaction session so that the relationship between sibling interaction and abilities (or achievement) could be further clarified. The task was less structured than the task in the earlier study involving concept attainment, and thus was more likely to reveal the children's customary interaction patterns.

OBJECTIVES

The objectives of the study were: (1) To obtain measures of sibling interaction regarding an object sorting task, (2) to obtain measures of the categorization ability of the younger sibling on a subsequent task, and (3) to relate sibling interaction along with sibling structure variables to the categorization ability of the younger sibling.

METHOD

DESIGN

A 2x2x2x2x2 factorial design was used, with four sibling structure factors and one treatment factor. The sibling structure factors were sex of the younger sibling, sex of the older sibling, age of the younger sibling, and age spacing between the two siblings. Only children from two-child families were included in the study. Age of the younger sibling was either kindergarten age (5 years) or at second grade level (7 years); the two age spacings between siblings were two years and four years. Below is a diagram of the design:

Age of younger sib:	Kindergarten								Second-grade							
Age spacing:	2 years				4 years				2 years				4 years			
Sex of older sib:	M		F		M		F		M		F		M		F	
Sex of younger sib:	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Younger Sib Alone																
Younger Sib With Older Sib																

The treatment factor consisted of "alone" and "sib" conditions; in the "alone" condition, the child made an initial or practice categorization of the object-pictures of the object sorting task while alone; in the "sib" conditions, the child made the initial categorization with the help of his sib. Dependent variables were measures of the child's categorization ability, obtained during a second or "test" administration of an alternate form of the object sorting task.

POPULATION

The population of the study consisted of children from two central Indiana school systems involving a total of 22 elementary schools.

A population of sibling pairs from two child families was identified from school records, and divided into subpopulations of kindergarten children with second grade siblings, kindergarten children with fourth grade siblings, second grade children with fourth grade siblings, and second grade children with sixth grade siblings.

Each subpopulation was further subdivided into groups of boys with older brothers, boys with older sisters, girls with older brothers, and girls with older sisters. Samples of 10 sibling pairs were randomly selected from each of the 16 subpopulations; 5 of the 10 were assigned to the "sib" treatment condition and the remaining 5 assigned to an "alone" condition. There were 160 sibling pairs in all.

Of the 160 sibling pairs originally selected for the study, 24 pairs were lost and replaced from a randomly selected oversample list. (Reasons for loss of sample were as follows: older sibs of 7 pairs did not attend the same schools as their younger sibs, 6 pairs moved, 6 pairs failed to receive parental permission to participate in the study, and the younger sibs of three pairs rejected the task.)

TASK

The object sorting task described by Wallach and Kogan (1965) was used. The task consists of asking the subject to form groupings of familiar objects. A line drawing (5.0 cm. square) of each of 50 objects was mounted on a separate 6.5 cm. X 7.5 cm. card; the name o the object was printed below the drawing. Alternate forms of the task were used for the initial (practice or interaction) session and for the test session. The two forms of the task were adapted from the Object Sorting Tests of Clayton and Jackson (1961); the initial task was adapted by the experimenter while the test task was adapted by Wallach and Kogan. The adaptations involved a change from a verbal paper and pencil task to a pictorial manipulative task, as well as substitutions for certain objects difficult to depict unambiguously or judged to be unfamiliar to young children. The 50 pictures for each task were placed in random order.

The objects in the initial task (in order of presentation) were: bird, pins, hoe, bush, car, fountain pen, tulip, rifle, sled, cork, baseball bat, string, cigar, football, measuring spoon, bicycle, telephone directory, stool, comb, candle, sailboat, clock, pliers, screw, bee, umbrella, mittens, fork, hairbrush, sword, yardstick, cap, pan, nail file, lighter, shirt, fish, telephone pole, slipper, saw, boot, phonograph, spear, photograph, jacket, penny, thermometer, ship, scotch tape, airplane.

The objects in the test task were: arrow, picture, thread, glass, jacket, flashlight, refrigerator, sled, screwdriver, pot, clock, hanger, flower, lamp, pencil, wallet, lipstick, purse, pistol, candle, lamp post, comb, ruler, fork, chair, cup, book, stool, door, rowboat, letter, tree, cigarette, rake, scissors, rug, shoe, hammer, watch, hat, telephone, spoon, canoe, baseball, TV set, golf club, radio, tire, coin, key.

Instructions to the younger sibling during the initial session were as follows:

> Now we're going to play the picture game. I'll put the pictures on the table and I'm going to tell you what each one is. (The experimenter sets down five rows of ten pictures before the subject, naming each as it is placed on the table.)
>
> I want you to look at all the pictures and put all the pictures that belong together into groups. The groups can be big or little but I want you to be able to tell me why you put

the pictures in each group together. There are no right or wrong answers in this game. Everytime I play it with someone the groups change. So any way you want to make the groups is fine as long as you can tell me why you did it.

Once you make the groups you can change them. And if there are any pictures left over at the end that don't seem to belong anywhere just leave them alone. Do you see how to play the game? O.K. Now don't start yet.

Instructions to the older sib (for groups where older sib is present) were as follows:

(Older sib's name), you watch (Younger sib's name) putting these pictures into groups. If he needs help, then you can show and tell him what to do.

Final instructions in the practice session were:

Now take your time. There's no need to hurry. O.K., go ahead.

When the initial session was completed, the older sib was thanked and dismissed to go back to his class. Instructions for the test session with the younger sib were as follows:

Now we're going to play the picture game again. I'll put the pictures on the table and I'm going to tell you what each one is. (Experimenter places pictures on the table, as before, naming them.) Now take your time, there's no need to hurry. O.K., go ahead.

After each of the grouping tasks, the experimenter asked the younger sib the reason for each of the groupings formed.

It was felt that the task would provide a loosely structured situation wherein the older sib could give as little or as much guidance to the younger sib as he cared to, depending on the personalities and skills of the two children and their characteristic ways of interacting. According to Olver and Hornsby (1966), the ability to form superordinate categories and the size of the categories formed both increase with the age of the child, so that the older sibling should, in general, have a more advanced categorization ability as a basis for his advice to the younger sib.

PROCEDURE

In every school, a quiet room apart from the regular classrooms was made available for testing. In the "sib" condition, both children were seated at the same side of a large table with the older sib at the left of the younger sib; in the "alone" condition, the younger sib was seated alone at the table. The experimenter sat across the table while giving instructions, then moved off to the side while the children worked in order to make his observation and note-taking less obtrusive.

At the beginning of the session, the younger sibling or sibling pair was brought to the experimental room by the school secretary. The subject(s) were seated and instructed in the task. As the experimenter said, "O.K., go ahead," he started a stopwatch and a tape-recorder. To supplement the tape-recording of the session, the experimenter made a

running record of the interaction between the sibling pair, paying particular attention to nonverbal behaviors (facial expression, gestures, manipulation of pictures, etc.). The task was terminated in one of three ways. If the child grouped all of the objects, the session was stopped when he completed the last group. If the child announced that he could make no more groups, or if he sat without making any further effort toward grouping the remaining pictures, the experimenter asked "Do you see any more groups that you could make?" If the child answered "No," the session was stopped.

When the task was completed, the older sib was dismissed (for those groups in the "sit" condition), and the younger sib was asked to give his reason for making each group. Then the alternate set of object pictures was brought out and the younger sibling made the groupings alone.

MEASURES

Each grouping of objects made by the child was recorded on a data sheet, along with the child's stated reason from making that group. The time taken to complete the object sorting, expressed to the nearest tenth of a minute, was also recorded. The total number of groups, the number of items left ungrouped, and the mean number of items per group were computed from the raw data and used as variables in the analysis. In addition, each of the child's groupings was judged to be descriptive, inferential, or relational according to the Wallach and Kogan (1965) criteria. Briefly, descriptive groupings were based on similarity in objective, physical attributes among a group of objects; inferential groupings were based on a shared characteristic of the objects other than an objective physical attribute; relational groupings grow out of relationships between the objects grouped together. A "don't know" category was used when the child could not state a reason for his grouping. Percentages of each of the four types of groupings made by the child (descriptive, inferential, relational, and "don't know") were computed and used as variables in the analysis.

Two judges, working independently, coded each of the test protocols, then compared their judgments and resolved differences. The 160 subjects of the study made a total of 1802 groupings on the initial object sorting task and 1689 groupings on the test task. The percentage of agreement between the judges on the total of 3491 judgments was 89.6%.

Since the 80 subjects in the "alone" condition took both forms of the object sorting task in succession, an alternate-forms reliability coefficient could be computed for each of the eight measures used. These are presented in Table 1. These reliabilities compare favorably with an alternate forms reliability coefficient of .75 reported by Sloane, Gorlow, and Jackson (1963) for the "number of groups" measure in the adult forms of the Object Sorting Tests.

Table 1

Alternate Forms Reliability Coefficients for Object Sorting Task Variables (N = 80)

Measure	Reliability Coefficient
Sorting time	.47
Number of groups	.82
Mean no. of items per group	.84
Number of ungrouped items	.89
Percent descriptive groups	.71
Percent inferential groups	.73
Percent relational groups	.58
Percent "don't know" groups	.80

The interaction session between the two siblings was both manually recorded and tape-recorded; following the session, data from the tape were integrated into the written record. The written record of the interaction session was then coded according to a system of categories developed in a previous investigation (Cicirelli, 1972) and in a pilot study, in which each discrete action or statement was assigned to a category. The categories used were as follows:

A. Older sib's verbalizations

1. Older sib gives an explanation or answers younger sib's questions.

2. Older sib tells younger sib what to do in a general way.

3. Older sib gives cues or hints to the younger sib.

4. Older sib questions younger sib.

5. Older sib gives a general category name to a grouping of objects.

6. Older sib names specific objects to be grouped.

7. Older sib gives encouragement or praise to the younger sib.

8. Older sib criticizes the younger sib or informs him of his errors.

9. Older sib engages in verbalization irrelevant to task.

10. Older sib informs younger sib that his groupings, his statements, or his actions are correct.

11. Older sib verbalizes his own actions.

B. Older sib's nonverbal behavior

12. Older sib points to objects for younger sib to group.

13. Older sib adds object(s) to younger sib's grouping.

14. Older sib makes group himself.

15. Older sib makes facial expressions or gestures of encouragement or approval.

16. Older sib makes critical facial expression, hits younger sib, etc.

17. Older sib observes younger sib working.

18. Older sib re-arranges younger sib's groups.

C. Younger sib's verbalizations

19. Younger sib verbalizes his actions.

20. Younger sib asks questions or asks for help from older sib.

21. Younger sib accepts directions or help.

22. Younger sib rejects help from older sib or criticizes him.

23. Younger sib engages in verbal behavior irrelevant to the task.

24. Younger sib gives older sib directions.

25. Younger sib responds to older sib's question.

D. Younger sib's nonverbal behavior

26. Younger sib shows objects to older sib.

27. Younger sib accepts older sib's directions or help.

28. Younger sib rearranges a previously made group.

29. Younger sib works independently of older sib. (This implies that older sib is also working independently on the task.)

Two judges working independently coded each of the interaction protocols of the 80 sibling pairs in the "sib" condition, then resolved any disagreements in coding. A total of 2846 verbalizations and actions were coded; the two judges agreed on 2463. Thus, the percentage of agreement was 86.5%.

RESULTS

OBJECT SORTING VARIABLES

Means and standard deviations for each of the eight measures obtained in the test administration of the object sorting task are presented in Table 2.

An analysis of variance was carried out for each of the eight variables; these were, of course, not completely independent. Table 3 summarizes those F-tests significant at the .05 level for each of the analyses.

Sorting time. There were no significant main effects in the analysis of variance for sorting time, but three of the interactions were significant; age spacing X sex of the older sib ($F = 5.23$; $df = 1,128$) age spacing X sex of the younger sib ($F = 7.07$; $df = 1,128$) and experimental treatment X age spacing X grade level ($F = 7.35$; $df = 1,128$). In the first of these interactions, children with sibs four years older took longer to complete the sorting if the older sib was a girl, while children with sibs two years older took longer to complete the sorting if the older sib was a boy. (See Figure 1.) In the second of these interactions (Figure 2), boys with sibs two years older took longer to sort than boys with sibs four years older, while girls with sibs four years older took longer to sort than girls with sibs two years older.

The three-way interaction was more complex although, on the average, children in the "sib" condition took longer to sort than children in the "alone" condition. Among children in the "sib" condition, kindergarten children took longer to sort when the sib was four years older, while second grade children took longer to sort when the sib was two years older; among children in the "alone" condition, kindergarten children took longer to sort when the sib was two years older, while second grade children took longer to sort when the sib was four years older (see Figure 3).

It is presumed that a longer sorting time reflects the time needed to form a greater number of groups, or larger groups, or conceptually more complex groupings. To support this, there is a weak, but statistically significant correlation ($r = .20$) between sorting time and number of groups. On the other hand, a longer sorting time may mean merely that the child has some difficulty in performing the task; this is given some support by a weak negative correlation ($r = -.18$) between sorting time and the percentage of groups for which the child was unable to provide a reason for grouping.

Number of groups. The analysis of variance for the number of groups resulted in significant main effects for the experimental treatment factor ($F = 4.01$; $df = 1,128$) and for grade level ($F = 4.97$; $df = 1, 128$), as well as for the grade level X sex of the younger sib interaction ($F = 4.72$; $df = 1,128$) and for the grade level X age spacing X sex of the older sib interaction ($F = 6.03$; $df = 1,128$).

Table 2

Means and Standard Deviations of Object Sorting Variables

Variable	Mean	SD
Sorting time (minutes)	7.36	3.25
No. of groups	10.64	5.80
Items/group	3.73	4.74
No. ungrouped items	19.52	14.00
% Descriptive	12.61	21.07
% Inferential	55.72	31.29
% Relational	22.80	24.87
% "Don't know"	5.91	18.21

Table 3

Summary of Analysis of Variance for Object Sorting Variables

Variable	Source of Variation	df	MS	F
Sorting time	AS x SO	1	47.96	5.23*
	AS x SY	1	64.77	7.07**
	E x AS x G	1	67.34	7.35**
	Error	128	9.16	--
No. of groups	E	1	126.02	4.01*
	G	1	156.02	4.97*
	G x SY	1	148.22	4.72*
	AS x G x SO	1	189.22	6.03*
	Error	128	31.40	--
Items/group	E x AS	1	166.00	7.52**
	Error	128	22.07	--
No. ungrouped items	E	1	1243.22	7.71**
	G	1	3724.90	23.08**
	E x AS	1	1092.02	6.76*
	G x SY	1	940.90	5.83*
	Error	128	161.42	--
% Descriptive	E x G	1	2066.41	4.74*
	Error	128	436.45	--
% Inferential	G	1	13450.56	14.79**
	E x AS x SY	1	3970.05	4.37*
	Error	128	909.37	--
% Relational	SO x SY	1	2822.40	4.07*
	Error	128	644.67	--
% "Don't know"	G	1	3010.22	8.80**
	Error	128	342.17	--

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

Note: E = experimental treatment; AS = age spacing; G = grade level; SO = sex of older sib; SY = sex of younger sib

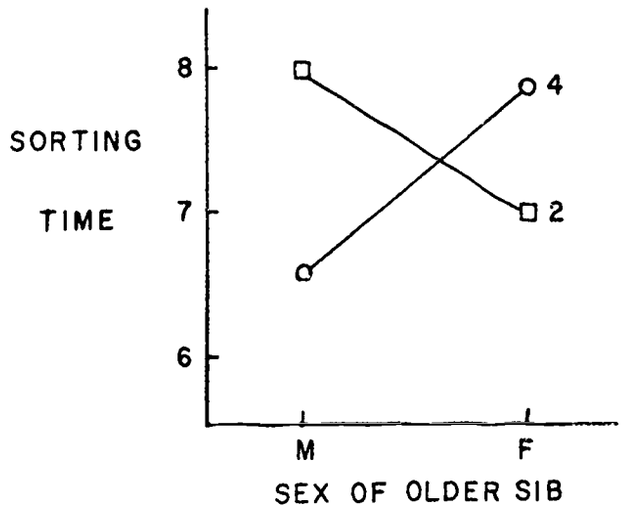

Fig. 1. Children's sorting time as a function of sex of older sib, for age spacings between sibs of two and four years.

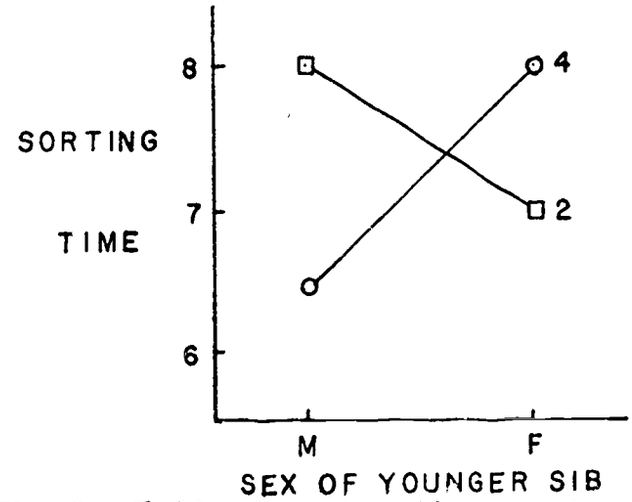

Fig. 2. Children's sorting time as a function of sex, for age spacings between sibs of two and four years.

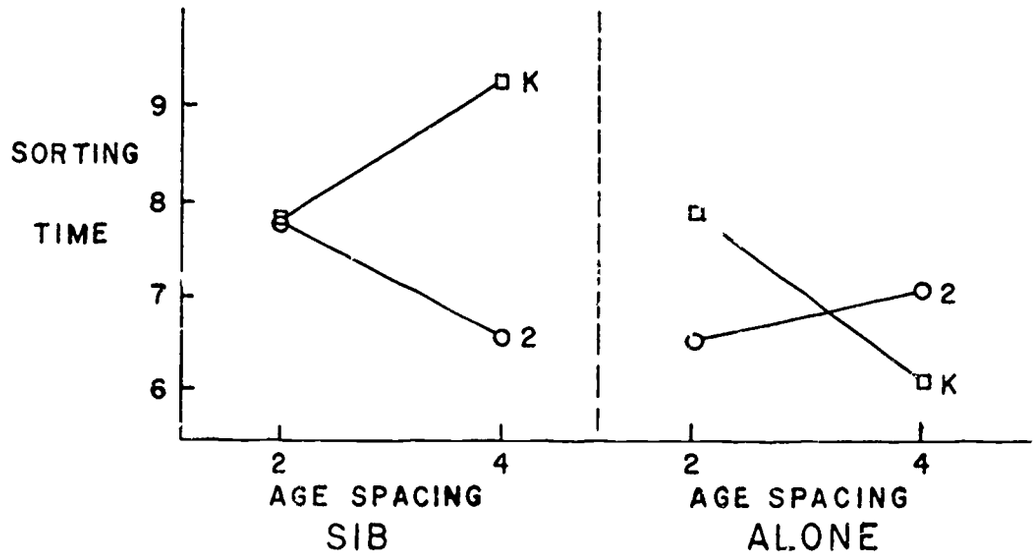

Fig. 3. Sorting time of children in kindergarten and grade two as a function of age spacing between sibs, presented for children in "sib" and "alone" conditions.

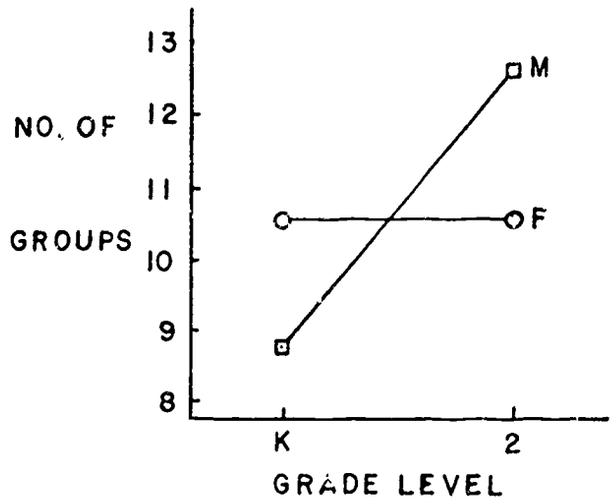

Fig. 4. Number of groups formed by boys and girls as a function of grade level.

In the main effect for the experimental treatment factor, the children in the "sib" condition made more groups (M = 11.52) than did children in the "alone" condition (M = 9.75).

While there was a significant main effect for grade level, indicating that second grade children made more groups than kindergarten children, this must be qualified considering the interactions involving the grade level factor. In the grade level X sex of younger sibling interaction, second grade boys made more groups than kindergarten boys, but second grade girls made no more groups than did kindergarten girls. Viewing the same interaction in another way, at kindergarten level, girls made more groups than boys, while at second grade level, boys made more groups than girls (see Figure 4).

For the three way interaction, among children with older sisters, second graders made more groups than kindergartners when their sibs were four years older but not when their sibs were only two years older; among children with older brothers, second graders made more groups than kindergartners at both age spacings (see Figure 5).

Number of items per group. There were no significant main effects in the analysis for the number of items per group, but the experimental treatment X age spacing interaction was significant (F = 7.52; df = 1,128). Among children with sibs four years older, those in the "sib" condition made larger groups than those in the "alone" condition, but among children with sibs two years older, those in the "sib" condition made smaller groups than those in the "alone" condition. (See Figure 6.)

Number of ungrouped items. The analysis of variance for the number of ungrouped items resulted in significant main effects for the experimental treatment factor (F = 7.71; df = 1,128) and for grade level (F = 23.08; df = 1,128), and in significant interaction effects for the experimental treatment X age spacing interaction (F = 6.76; df = 1,128) and for the grade level X sex of younger sib interaction (F = 5.83; df = 1,128).

On the average, children in the "sib" condition (M = 16.7) left fewer items ungrouped than children in the "alone" condition (M = 22.3); however, this finding is qualified by the interaction with age spacing. Among children with sibs four years older, those in the "sib" condition left fewer items ungrouped than those in the "alone" condition, while among children with sibs two years older, there was little difference between those in the "sib" and the "alone" condition. (See Figure 7.)

On the average, children in second grade left fewer items ungrouped (M = 14.7) than did kindergarten children (M = 24.4); however, the interaction of grade level with sex of the younger child qualified this result. Among kindergarten children, boys left more objects ungrouped than did girls, while among second grade children, girls left more objects ungrouped than did boys. (See Figure 8.)

Percent of descriptive categories. There were no significant main effects in the analysis of variance for the percentage of descriptive categories, but there was a significant experimental treatment X grade level interaction (F = 4.74; df = 1,128). Among kindergarten children, those in the "alone" condition used a higher percentage of descriptive categories than those in the "sib" condition, while among second grade children there was little different between the two conditions. (See Figure 9.)

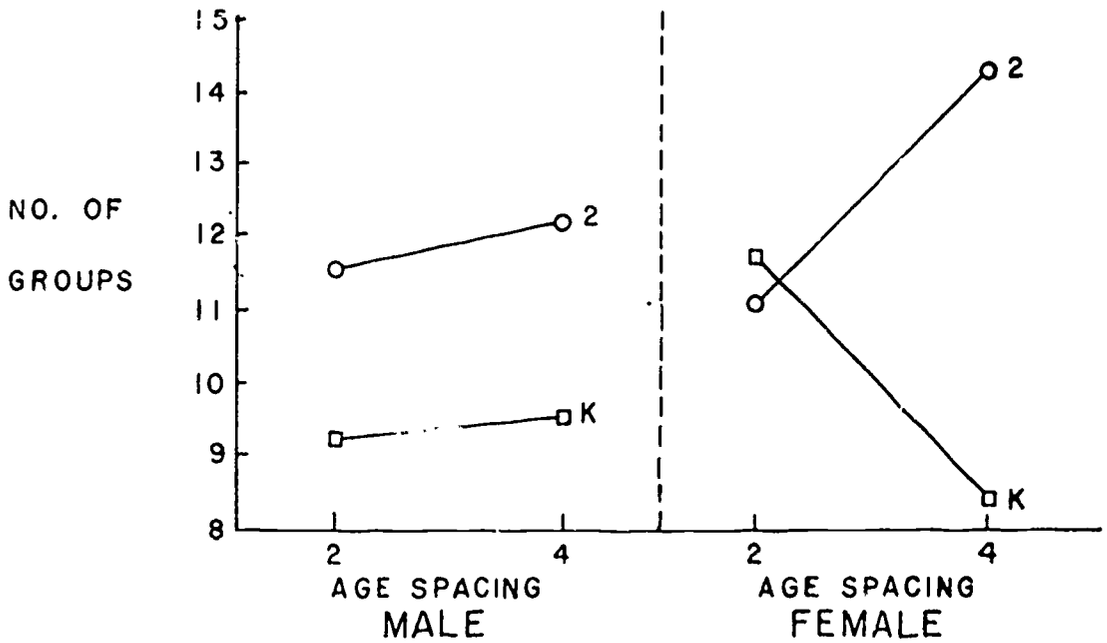

Fig. 5. Number of groups formed by children in kindergarten and grade two as a function of age spacing between sibs, presented for children with male and female sibs.

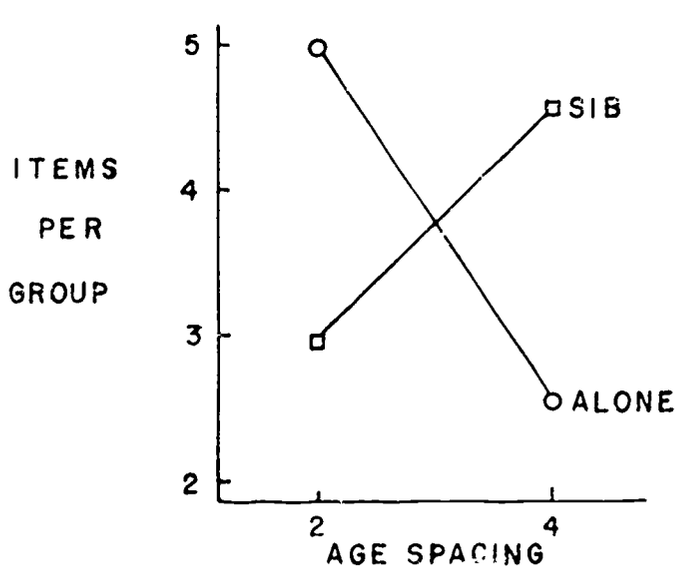

Fig. 6. Number of items per group for children in "sib" and "alone" conditions as a function of age spacing between sibs.

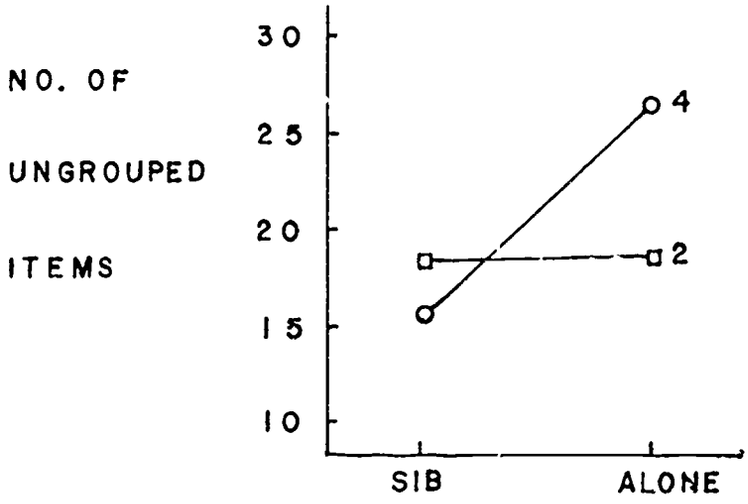

Fig. 7. Number of items left ungrouped by children as a function of experimental treatment, for age spacings between sibs of two and four years.

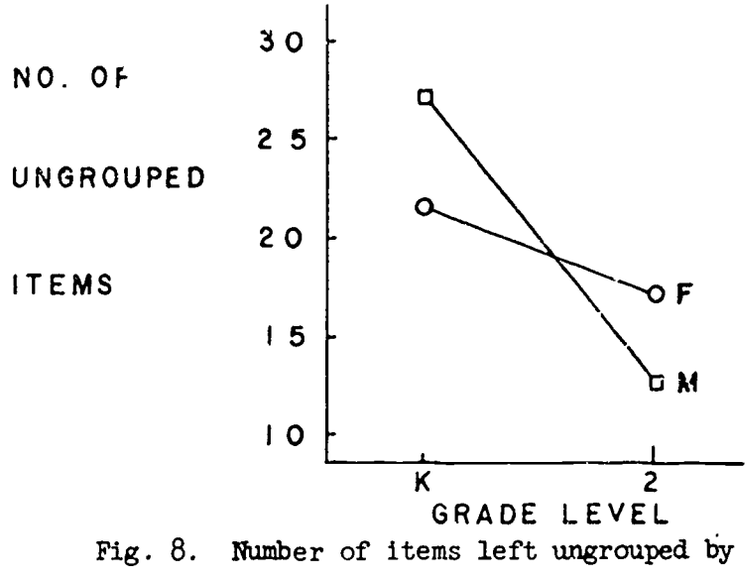

Fig. 8. Number of items left ungrouped by boys and girls as a function of grade level.

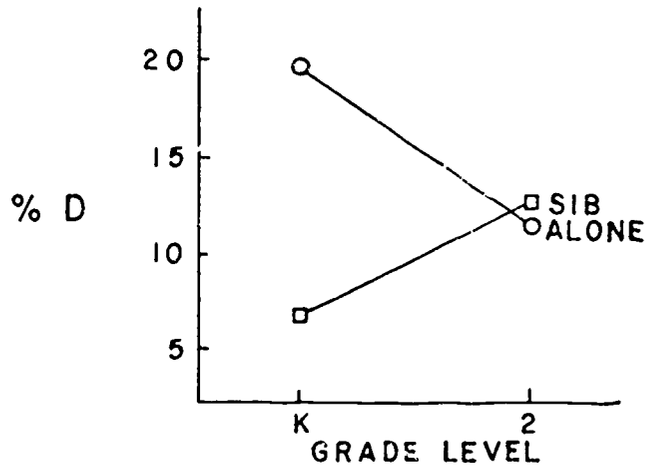

Fig. 9. Percent of descriptive categories used by children in "sib" and "alone" conditions as a function of grade level.

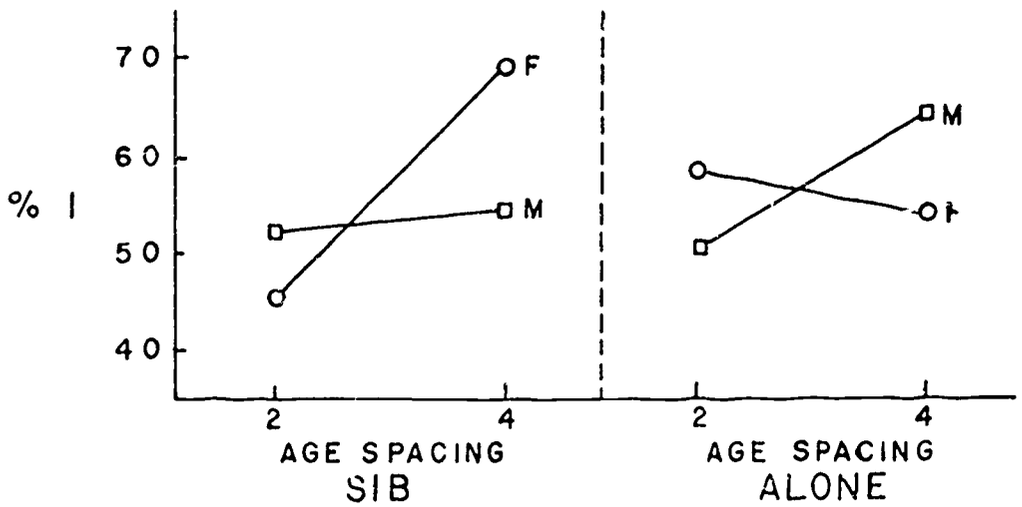

Fig. 10. Percent of inferential categories used by boys and girls as a function of age spacing between sibs, presented for children in "sib" and "alone" conditions.

Percent of inferential categories. In the analysis of variance for the percent of inferential categories, there was a significant main effect for grade level ($F = 14.79$; $df = 1,128$) and a significant effect for the experimental treatment X age spacing X sex of the younger sib interaction ($F = 4.37$; $df = 1,128$).

In the main effect for grade level, second grade children used a greater percentage of inferential categories ($M = 64.9\%$) than did kindergarten children ($M = 46.6\%$).

In the three-way interaction, among children in the "sib" condition, girls used a higher percentage of inferential categories than boys when the sibs were four years older, but boys used a higher percentage than girls when the sibs were two years older; among children in the "alone" condition, these relationships were reversed. (See Figure 10.)

Percent of relational categories. In the analysis of variance for the percent of relational categories, there were no significant main effects, but there was a significant interaction between the sex of the older sib and the sex of the younger sib ($F = 4.07$; $df = 1,128$). Boys with older sisters used a greater percentage of relational categories ($M = 25.5\%$) than did boys with older brothers ($M = 17.1\%$), while girls with older brothers used a greater percentage of relational categories ($M = 28.5\%$) than did girls with older sisters ($M = 20.2\%$). (See Figure 11.) Viewed in another way, children with opposite sex siblings used a greater percentage of relational categories ($M = 27.0\%$) than did children with same sex siblings ($M = 18.6\%$).

Percent of "don't know" categories. In the analysis of variance, there was a significant main effect of grade level ($F = 8.80$; $df = 1,128$). Kindergarten children had a higher percentage of groupings in the "don't know" category ($M = 10.2\%$) than second grade children ($M = 1.6\%$).

SIB INTERACTION VARIABLES

The measures of the interaction between the two sibs were correlated with the object sorting variables. These correlations are presented in Table 4.

Sorting time was found to be significantly related to the following interaction behaviors of the sibs: older sib tells the younger sib (in a general way) what to do, older sib adds object(s) to younger sib's grouping, older sib makes groups himself, and younger sib accepts directions or help (nonverbal).

The number of groups formed was negatively related to the following behaviors of the older sib: older sib gives cues or hints, older sib questions younger sib, and older sib gives encouragement or praise. However, the number of groups was positively related to the older sib's nonverbal expressions or gestures of encouragement.

Number of items per group was not related to any of the sib interaction variables. However, the number of ungrouped items was significantly related to the following: younger sib verbalizes his actions (negative correlation), and younger sib working independently (negative correlation).

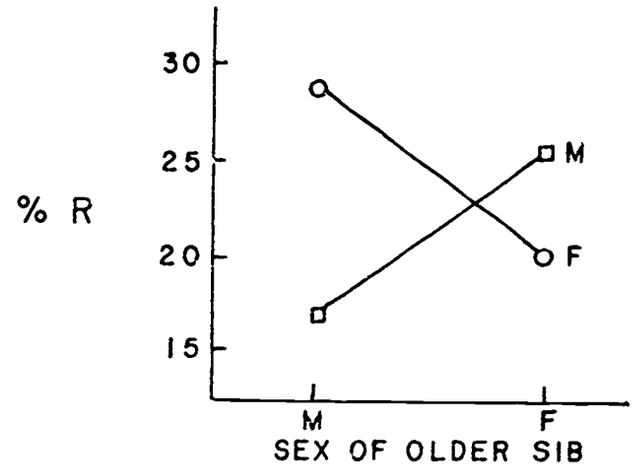

Fig. 11. Percent of relational categories used by boys and girls as a function of sex of older sib.

Table 4

Correlations of Sib Interaction Variables with Object Sorting Variables and Sibling Structure Factors

Interaction Variables	SY	SO	G	AS	ST	#G	I/G	#U	%D	%I	%R	%DK
1.0 explains	-19	00	07	00	20	-03	-07	-06	-10	23*	-04	-21*
2.0 tells what to do	05	10	00	00	22*	-05	-08	12	-14	-07	06	18
3.0 gives cues	21*	09	-02	06	18	-27*	02	13	-13	06	-01	05
4.0 questions Y	15	12	-17	10	19	-23*	-03	18	-11	08	-06	08
5.0 gives category name	-18	00	04	11	-01	-19	-13	09	-15	30*	-22*	01
6.0 names objects	-01	06	-08	07	-08	-10	-03	08	-16	11	-14	19
7.0 encourages	10	00	00	00	02	-22*	-01	12	-06	10	-17	06
8.0 criticizes	-19	10	-10	03	09	-12	-05	14	-14	-19	07	34*
9.0's irrelevant verbalization	11	00	00	-11	14	05	-07	10	-02	-17	18	-01
10.0 Confirms Y's group	02	10	-07	08	10	-09	-02	-04	-20	00	-05	24*
11.0 verbalizes action	22*	-21*	09	00	-13	-10	-03	00	11	-06	-01	-02
12.0 points to objects	-07	24*	05	16	19	11	-08	-08	-14	17	-07	-02
13.0 adds to Y's group	-03	25*	-15	15	26*	01	-03	01	-13	-14	-01	40*
14.0 makes group	03	02	-26*	-05	21*	06	-13	19	-10	-18	23*	00
15.Nonverbal encouragement	14	16	-12	-15	-03	31*	03	-15	-03	-27*	03	42*
16.Nonverbal criticism	-10	01	-08	-17	08	-05	-02	04	07	-20	01	26*
17.0 watches Y	-02	23*	11	-08	-14	-12	15	-07	09	-03	-06	14
18.0 rearranges groups	-08	-03	-14	-03	10	-16	-04	20	04	-22*	03	17
19.Y verbalizes action	-03	08	28*	04	-11	-07	02	-26*	-08	27*	-18	-10
20.Y asks questions	-08	-04	-02	-17	13	-12	-06	14	-01	-04	03	-18
21.Y accepts direction	09	07	-02	23*	18	-14	-03	03	-01	22*	-18	-10
22.Y rejects help	-07	-11	-11	-02	05	08	-10	-02	-17	-21*	28*	06
23.Y's irrelevant verbalization	00	-09	-19	-09	01	-07	-03	08	09	-15	-08	06
24.Y gives O direction	18	07	-25*	00	18	04	-06	07	-02	02	-02	02
25.Y responds to O	-11	-11	-11	-11	11	-08	-03	15	01	03	00	-04
26.Y shows object to O	-02	19	-18	07	04	-06	03	-01	-07	-25*	-13	68*
27.Y accepts direction, NV	12	23*	08	25*	27*	-04	-09	09	-17	24*	00	-16
28.Y rearranges groups	-07	00	08	08	19	16	-03	-18	01	00	00	02
29.Y works independently	09	-23*	03	-03	-06	17	-06	-29*	01	-12	16	-02

*Significant at the .05 level

Note: SY = sex of younger sib; SO = sex of older sib; G = grade level; AS = age spacing; ST = sorting time; #G = no. of groups; I/G = items per group; #U = no. of ungrouped items; %D = percent of descriptive categories; %I = percent of inferential categories; %R = percent of relational categories; %DK = percent of "don't know" categories. Decimal points have been omitted from all correlation coefficients.

The percentage of descriptive categories was not significantly related to any of the sib interaction variables.

The percentage of inferential categories was positively related to the following: older sib gives explanation or answers questions, older sib gives general category name, younger sib verbalizes his actions, younger sib accepts directions or help (verbal), and younger sib accepts directions or help (nonverbal). The percent of inferential categories was negatively correlated with the following: older sib's nonverbal expressions or gestures of encouragement, older sib rearranges groups, younger sib rejects older sib's help, and younger sib shows objects to older sib.

The percentage of relational groupings was positively related to older sib making groups himself, younger sib rejecting older sib's help, and negatively related to the older sib giving a general category name.

The percentage of "don't know" categories was negatively related to the older sib giving explanation or answering questions and positively related to the following behaviors: older sib criticizes younger sib or informs him of his errors, older sib confirms younger sib's groups, older sib adds to younger sib's grouping, older sib makes expressions or gestures of encouragement, older sib makes critical expression or hits, and younger sib shows objects to older sib.

Point-biserial correlations were computed between the sex of the younger child, sex of the older child, grade level, and age spacing and the sib interaction variables. These are also reported in Table 4.

Sex of the younger sib was significantly related to two of the older sib's behaviors, such that the older sib showed a greater tendency to give cues or hints and to verbalize his actions when the younger sib was a girl.

Sex of the older sib was related in such a way that older sisters showed a greater tendency to point to objects for grouping, add objects to the younger sib's grouping, and to observe the younger sib working, while older brothers showed a greater tendency to verbalize their actions. The younger sibling was more likely to accept direction (nonverbal) when the older sib was a girl, and was more likely to work independently of the older sib when the older sib was a boy.

In regard to grade level, the older sib was more likely to make groups himself when the younger sib was of kindergarten age rather than a second grader. The kindergarten child was more likely to give directions to the older sib, and the second grade child showed a greater tendency to verbalize his actions than did the kindergarten child.

Age spacing was significantly correlated with the younger sib's acceptance of directions or help from the older sib (either verbal or nonverbal); the younger sib showed a greater tendency to accept direction when the older sib was four years older rather than only two years older.

In order to further study the relationship of the four sibling structure factors to the sib interaction variables, a 2 X 2 X 2 X 2 analysis of variance was carried out for sixteen of the sib interaction variables. (Variables were selected for analysis if their means were greater than one.) In general, the findings replicated the results of the correlational

analysis, but there were significant interactions in five of the analyses.

In the analysis for the variable "Older sib gives category name," there was a significant age spacing X grade level X sex of younger sib interaction ($F = 4.08$; df 1,64).

In this interaction, among kindergarten children, when sibs were four years older they gave category names more often when the younger sib was a boy than when he was a girl while when sibs were two years older, there was little difference in naming of categories for boys or for girls; among second grade children, when sibs were two years older they gave category names more often when the younger sib was a boy than when he was a girl while when sibs were four years older there was little difference in naming of categories for boys or for girls. Sibs who are four years older than kindergarten children and sibs who are two years older than second grade children are themselves in fourth grade; thus, one can say that when older sibs were in fourth grade they gave category names more often for boys than for girls, while for older sibs in second grade or in sixth grade, there was little difference in naming of categories for boys or for girls.

In the analysis of variance for the variable "Older sib names objects for grouping," there was a significant interaction between grade level and sex of the younger sib ($F = 5.80$; df = 1,64). Older sibs of kindergartners named objects for grouping more frequently for boys than for girls, while older sibs of second graders named objects more frequently for girls than for boys.

In the analysis of variance for the variable "Older sib criticizes," there was a significant interaction between age spacing and sex of the older sib ($F = 6.52$; df = 1,64). When the sibs were two years apart, older brothers criticized more than did older sisters, while when the sibs were four years apart, older sisters criticized more than did older brothers.

In the analysis of variance for the variable "Older sib verbalizes his actions," there was a significant interaction between age spacing and sex of the older sib ($F = 4.41$; df = 1,64). When the sibs were two years apart, older brothers verbalized their actions more than did older sisters, while when the sibs were four years apart, older sisters verbalized their actions more than did older brothers.

In the analysis of variance for the variable "Younger sib accepts directions or help (verbal)," there was a significant interaction between age spacing, sex of the older sib, and sex of the younger sib ($F = 4.85$; df = 1,64). Boys accepted directions from their older sibs more when the sib was four years older than when the sib was two years older; similarly, girls accepted directions more from an older sister when the sister was four years older than when the sister was two years older, but girls accepted directions more from an older brother when the brother was two years older rather than four years older.

DISCUSSION

Effects of a child's sibling could be manifest in two ways in this study. First, the child's responses in the test administration of the object sorting task can be viewed as partially determined by the long-term, cumulative interactions with his sib, and partially determined (for those subjects in the "sib" condition) by the task-specific interaction with his sib in the course of the experiment. The effect of the experimental treatment condition was significant, either as a main effect or as an interaction, in the analysis of variance for six of the eight measures obtained from the object sorting task, indicating that the younger child modeled his own performance after that of the older sib, or received direction from the older sib in regard to the task, or both. The effect of the sibling structure factors was significant in sex of the eight analyses as well, indicating that long-term cumulative effects of sibling interaction were involved.

The variables "number of groups" and "number of ungrouped items" are considered by Wallach and Kogan (1965) to be measures of categorization style; the number of items per group can also be included here. The experimental treatment was a significant main effect or interaction effect in the analysis of variance for each of these variables, indicating that older siblings did indeed influence the younger sib's performance on a subsequent object sorting task. Age spacing between siblings was a common sibling structure factor influencing these conceptual style variables, for among children aided by their sibs in the practice session, those with sibs four years older made larger groups and left fewer ungrouped items than those with sibs two years older. Those with older sisters four years older made more groups than those with other types of sibs.

The effect of the experimental treatment was not as clearcut in regard to the variables considered by Wallach and Kogan to represent conceptual style (percentages of descriptive, inferential, and relational categories). There were significant interaction effects for experimental treatment in the analysis of variance for the percent of descriptive categories and the percent of inferential categories, but not for the percent of relational categories. Older sibs appeared to inhibit the proportion of descriptive categories used by their younger sibs of kindergarten age. In the case of inferential categories, the interaction between the experimental treatment, age spacing, and sex of the younger sib was more complex, in that the "sib" condition appeared to reverse the age spacing and sex patterning exhibited by subjects in the "alone" condition.

The same-sex versus cross-sex patterning in the use of relational categories is an example of sibling effects of long standing. Here, children with sibs of the same sex used a smaller percentage of relational categories than did children with sibs of the opposite sex. Relational responding has typically been viewed as an indicator of a nonreflective or nonconceptual orientation (Sigel, 1972). However, Wallach and Kogan (1965) found the percentage of relational responses to be greater for fifth grade boys either high or low in both creativity and intelligence than for boys high in one but low in the other. It is of interest that Cicirelli (1967) found that verbal creative abilities were greater among

sixth grade children with sibs of the same sex close in age. Thus in this study, if same sex sibs were indeed more creative, this was not reflected in a greater use of relational categories.

Sigel (1972) found that it was possible for teachers to significantly influence kindergarten children's classification skills in a formal training program using approximately twenty minutes a day for twenty days. Following training, children showed an increase in grouping and an improvement in verbal labelling of groups. While no analysis was made for specific types of groups, Sigel reported that children used a wider variety of bases for grouping following training. It seems particularly noteworthy that in this study significant results were found following a single session with the older sib that averaged only seven minutes in duration.

Since use of inferential categories is indicative of more mature concept formation, it is encouraging for educators that such teaching behaviors of the older sib as giving explanations, answering the younger child's questions, and giving category names are related to increased use of inferential categories.

In considering the use of older sibs in teaching younger sibs, this study suggests that younger children are more willing to accept (and profit from) help when it is given by a sib separated by a four year age spacing than by a sib close in age, and particularly so when the sib is an older sister.

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