DOCUMENT RESUME

ED 092 076 IR 000 619

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TITLE An Instructional Device for Teaching Verbal Skills Through Structured Interactions Between Children in a Communication Game. Final Report.
INSTITUTION Stanford Univ., Calif. School of Education.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.f
REPORT NO NIE-P-1-I-101
PUB DATE Jun 74
NOTE 171p.; Ph.D. Dissertation, Stanford University

EDRS PRICE MF-$0.75 HC-$7.80 PLUS POSTAGE
DESCRIPTORS Behavioral Science Research; *Children; *Communication Skills; *Educational Games; Educational Research; Redundancy; *Stimulus Devices; Verbal Communication; Visual Stimuli
IDENTIFIERS Referential Communication Skills

ABSTRACT

Forty-eight pairs of children between the ages of 4 and 8 were the subjects of this study of the development of referential communication skills and the use of technology to structure interactions between people. A communication game device was used to present children with sets of four referents on separate screens. The referents were either nameable pictures, abstract figures, people figures, or relational figures. One child of each pair described a referent, and the other child selected the referent described to him by pushing the button under the correct figure. The only variable pertaining to the subjects which was found to be significant was age. Sex, I.Q., birth order, and socioeconomic level were not related to performance. Large individual differences in performance were noted and suggested as a base for further study. Errors varied according to referent type. Context redundancy and descriptive salience reduced errors. Errors decreased across trials for the people referents. Cautious optimism is expressed regarding the training of referential communication skills. The game device was felt to be an effective method of structuring educational interactions. (JG)

FINAL REPORT

AN INSTRUCTIONAL DEVICE FOR TEACHING VERBAL SKILLS THROUGH STRUCTURED INTERACTIONS BETWEEN CHILDREN IN A COMMUNICATION GAME

National Institute of Education Project No. 1-I-101

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School of Education
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ABSTRACT

AN INSTRUCTIONAL DEVICE FOR TEACHING VERBAL SKILLS THROUGH STRUCTURED INTERACTIONS BETWEEN CHILDREN IN A COMMUNICATION GAME

Two independent topics were addressed: the development of referential communication skills and the use of technology to structure interactions between people.

A game device used a slide projector to display sets of referents on separate screens to two children. One child described a referent and another child tried to select it from a set of 4 by pressing a button. Forty-eight pairs of children between the ages of 4 and 8 completed 64 referents. Four types of referents were used: namable pictures, abstract figures, people figures, and relational figures.

Performance improved rapidly with age. Sex, IQ, birth order, and socioeconomic level were not related to performance. Large individual differences were found.

Errors varied according to referent type. Context, redundancy, and descriptive salience reduced errors. Errors decreased across trials for the people referents.

Older children gave more adequate descriptions and asked more specific questions. Younger children asked more egocentric questions and described more trivial details and incorrect attributes.

The modest improvement in performance across trials allows cautious optimism regarding the training of referential communication skills. The game device was effective in structuring educational interactions. The use of technology as an intermediary between two learners deserves further study.

ACKNOWLEDGEMENTS

This dissertation is the work of many hands.

I was fortunate to have an exceptional dissertation committee. Dr. Robert G. Bridgham influenced me to come to Stanford, gave wise counsel throughout my studies, and sponsored the grant proposal leading to this study. Dr. Robert C. Calfee shared with me his fascination with experimental research and design, taught me to use statistical tools, and patiently guided me through the complexities of a fractional factorial design. Dr. Robert D. Hess, as teacher and friend, was generous with support, encouragement, and insights. Dr. Eleanor E. Maccoby inspired the original idea for this study. Her remarkable knowledge of research and children was an invaluable resource. To observe excellence first hand is truly an education.

Dick Brown and Ralph Williams translated the idea for the communication game into buttons, lights, and wires.

Lynn Curry, Annalee Elman, Kathy Fernandes, and others, helped me fathom the mysteries of fractional factorial analysis.

Bob Cullenbine, Janet Weston, and Eleanor Worden located schools, recruited children, and managed budgets.

Betcy Dietz and Lucy Williams tested children and coded transcripts.

Dorothy Fritz transcribed tapes, coded transcripts, and typed innumerable drafts of this dissertation.

The principals, teachers, and staffs of the following schools opened their doors to me: Lucille Nixon Elementary, Benjamin Cory Elementary, Barron Park Elementary, Bing Nursery School, and Sullivan Preschool.

During the period when this study was planned and conducted I received financial support from several sources: an Office of Education Research Traineeship, a Shell Companies Foundation Residency, and the Office of Education grant for the study itself.

Finally, I would like to thank the hundreds of children who took time out of their busy lives to try to teach me how people learn to communicate with each other. This work is dedicated to Pattie Crary Dickson, a child who loved children.

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CHAPTER I

REFERENTIAL COMMUNICATION SKILLS IN YOUNG CHILDREN

Statement of the Problem

Communication between people is important and people somehow learn to communicate. If we understood what variables were related to success in communication, perhaps we could find ways to help people learn to communicate better. The present study is an attempt at determining the relationship of certain variables to the communication "performance" of young children. Communication performance in this study will be defined in terms of success on a referential communication task.

Referential communication tasks require one person to describe a referent (picture, object, color, etc.) so that another person can select it from a set of referents. Usually the participants are seated across from each other at a table and are separated by a partition, forcing them to rely upon verbal communication. Common variations on this method require the speaker to tell the listener how to do something such as draw a picture, construct a model, follow a map, or assemble an array.

Communication performance in a referential communication task is defined by the degree of correspondence between the referent described and the response generated in the listener, that is, did the listener do what the speaker intended? Thus referential communication tasks provide a dependable objective criterion for communication performance within a controlled but not totally unnatural experimental setting.

If communication performance is defined as success on a referential communication task, then "communication skills" may be taken to be those abilities or behaviors of the participants which contribute to this

success. Needless to say, success on a referential communication task depends upon the skills of both the speaker and the listener.

It seems reasonable to expect that a variety of skills are involved in performance on referential communication tasks. For example, listening skills and speaking skills would be obvious candidates for inclusion in a battery of tests designed to measure a more global "communication skill." A brief review of the research on "listening" is instructive regarding the types of problems likely to be encountered in attempting to develop a measure of communication skills.

Research on listening was reviewed every three years during the period of 1955 through 1967 in the Review of Educational Research. A major review by Caffrey (1955) marked the beginning of this period of considerable research on listening. In the late 1950s several standardized tests for listening comprehension were developed. These tests then were used as the dependent measure in a variety of studies, especially training studies. The validity of the tests came under increasing criticism. Kelly (1967) and others showed that the listening test scores correlated highly (.7 -.8) with intelligence test scores and depended upon and correlated with reading ability. Most critical of all, the various listening tests correlated more highly with intelligence tests than with each other. Construct validity for "listening skill" as defined by these tests simply did not exist.

When efforts at defining "listening skill" have met with such limited success, one cannot be too optimistic about the development of a valid measure of a more general communication skill. Although referential communication tasks provide an objective measure of communication performance, this performance may not relate to communication performance

in other situations. The work of Mischel (1968) suggests that behavior is highly situation-specific. Despite the frequent reference in popular literature to "communication skill," the existence of the general ability implied by such phrases must be questioned.

Referential communication remains a complex process, even under the controlled conditions provided by the experimental setting. Mehrabian and Reed (1968) developed a framework describing some of the determinants of communication accuracy in referential communication tasks. They conceptualized communication situations in terms of the attributes of the speaker, listener, referents, channel, and message. Mehrabian and Reed review the results of research on each of these categories of attributes and offer specific hypotheses suggested by the research. Such a comprehension review will not be attempted in this paper.

In the following paragraphs, only certain important variables which have been studied in relation to referential communication performance will be discussed. Special attention will be given to referential communication studies involving young children. The discussion will treat in order: speaker and listener characteristics, types of referents, message quality, and effects of training. The chapter will end with a discussion of the use of educational technology to structure interpersonal interactions.

Speaker and Listener Characteristics

Age. The substantial changes in communication skills in young children between the ages of 3 and 8 have been documented by many researchers (Piaget, 1926; Vygotsky, 1962; Krauss and Glucksberg, 1969). These changes include a rapid growth in vocabulary and grammar, as well as in social behavior. Although referential communication skills

continue to develop and do not begin to reach adult competence until well into adolescence (Flavell, Botkin, Fry, Wright & Jarvis, 1968), nonetheless the development is striking during this period of early childhood.

Much theoretical discussion of changes in communication skills with age has been addressed to "egocentrism" in young children (Kohlberg, Yaeger, and Hjertholm, 1968). Egocentrism has been seen as limiting the ability of young children to communicate. Piaget (1926) distinguished egocentric and socialized speech. Egocentric speech is speech which is not addressed or adapted to the listener, and which is carried on with no apparent concern for indications of understanding by the listener, if one is present at all. Piaget concluded that understanding between children before the age of 7 or 8 "occurs only in so far as there is contact between two identical mental schemes already existing in each child (1926, p. 120)."

The degree to which egocentrism limits communication between children is controversial. Piaget (1926, p. 37) found that about 45 percent of the speech of two six-and-a-half year old boys was egocentric in a school setting. This proportion of egocentric speech would seem to be highly situation-specific, however. Rubin, Hultsch, and Peters (1971) calculated coefficients of egocentrism (ratio of egocentric utterances to total utterances) for four-year-old children in three different situations: child alone, child with another child, and child with a minimally responsive adult. The magnitude of the coefficients of egocentrism varied widely across situations from .88 to .32. Mueller (1972) videotaped pairs of children whose ages ranged from 3½ to 5½. He found that 85 percent of all utterances received replies or at least

attracted the listener's attention. Garvey and Hogan (1973) found even higher rates of social interaction than Mueller between dyads of 3½- to 5½-year-old children in spontaneous play. Shatz and Gelman (1973) report a series of studies which looked at the ability of 4-year-olds to adjust the complexity of their language when speaking to 2-year-olds. Despite the fact that most of the 4-year-old children gave egocentric responses on two tests of egocentrism, all of them reduced the length of their utterances when speaking to younger children. If egocentric speech is so susceptible to situational determinants, it does not seem that egocentrism should constitute an insurmountable barrier to communication between young children.

Age provides a convenient but indirect measure of development, but a fuller understanding of the development of referential communication skills must eventually be based upon direct measures of the actual abilities and behaviors which are changing with age. These changes likely include linguistic development in receptive and productive competence, cognitive development of abilities such as memory and information processing capacities, and social development of interpersonal skills. The various theoretical models of the development of these separate parts of the referential communication process must ultimately be brought to bear upon an analysis of the development of referential communication taken as a whole.

Sex. Sex has been included as a variable in many studies of communication, apparently as a result of the ease with which it is observed and the availability of subjects of both sexes in approximately equal numbers. Sex was not related to communication skill in most studies reviewed (Heider, 1971; Rubin, 1972; Flavell, et al., 1968;

Garvey, 1972; Garvey & Hogan, 1973; Parisi, 1971; Mueller, 1972). Mueller (1972) did find that boys talked significantly more than girls but this was not related to communication success or failure. In the light of these findings it seems unlikely that large differences exist in the performance of boys and girls on referential communication tasks. Nevertheless, sex remains on a variable of interest. Even a finding of no significant differences between boys and girls would be of some relevance in a period when sex differences are receiving careful attention.

Birth order. The possible relationship of birth order to communication performance is of some theoretical interest insofar as it might shed some light on the socialization of communication skills. Vygotsky, writing from an environmentalist perspective, believed that adult-child interaction was most influential in the development of socialized (or non-egocentric) speech in children, whereas Piaget considered child-child interaction more important in extinguishing egocentric speech. If first-born children interact more with their parents than later-born children, then first-born children might be expected to show more mature language development than later-born children of the same age, according to Vygotsky's views.

Several studies have found that the interaction between parents and the eldest child is more intense and continuous than is the case with later-born children (Kammeyer, 1967; Lasko, 1954). Rubin et al. (1971) found that the presence of an adult decreased the proportion of egocentric speech in the child. They also found that first-born children

produced 12 percent less egocentric speech across three situations than did later-born children. There is evidence that first-born and only children tend to speak earlier and more precisely (Koch, 1956; Luria & Yudovitch, 1959). Breland (1972) analyzed the test scores of almost 800,000 National Merit Scholarship participants in terms of birth order, family size, and socioeconomic level. He found that the effect of birth order remained significant after controlling for other effects and that this effect was related only to the verbal component of the score. Belmont and Marolla (1973) studied a sample of nearly 400,000 men in the Netherlands. They found a small but consistent effect of birth order in favor of earlier-borns compared with later-borns and this effect remained when family size and social class were controlled.

Thus birth order might influence communication performance indirectly through two factors: egocentrism and verbal ability. To the degree that first-born children use less egocentric speech and have slightly higher verbal ability than later-born children, first-born children might be more successful on referential communication tasks.

Verbal ability. Verbal skills seem likely to contribute to communication performance. Krauss and Glucksberg (1969) found no correlation between accuracy on their task and the intelligence quotients of the subjects, but the IQ range of their subjects was restricted to above 100. Flavell et al. (1968) found little correlation between IQ and communication skill. In a study using the Krauss and Glucksberg figures, Rubin (1973) found a correlation of .76 between Peabody Picture Vocabulary Test IQ and "total communication score" for a sample of 20 children from each of grades K, 2, 4, and 6. The total communication score was based upon the number of meaningful attributes of the referents encoded by the

children and the number of new encodings produced when the children were requested to "tell more about it." In this study the IQs ranged from 71 to 140. It should be noted that this rather high correlation reported by Rubin is based upon an analysis of transcripts of the messages sent to an adult listener, rather than either a score for accuracy on the communication task or messages produced in child-child communication. Baldwin and Garvey (1970) report an average correlation of .38 between the mean IQ of dyads of fifth-graders and the combined accuracy score across three tasks. Olson, Case, and Wine (1972) found an average correlation of about .30 between the IQ of grade 6 and 12 decoders and their accuracy scores across two tasks when decoding teachers' messages. These results suggest that verbal ability is likely to be substantially correlated with communication performance, particularly when the accuracy score is based on child-adult communication.

Community. Relationships between community background and communication have been found in many studies. Krauss and Rotter (1968) report that middle-class speakers were more accurate as listeners and more often understood as speakers than lower-class speakers by both middle-class and lower-class subjects, but in this study class is confounded with race, making such an interpretation questionable. Hess and Shipman (1965) found differences in the encoding styles of middle- and lower-class mothers. Heider (1971) presented the Krauss and Glucksberg figures to 10-year-old boys and girls and asked them to describe them so that another child their age could pick the figure out of an array. Selections of these messages were later read to these subjects by the experimenter. Her lower-class sample was divided according to race. She found large differences between middle-class and lower-class children in the

number of words produced and the style of encoding as defined by the use of whole-inferential and part-descriptive encodings. Heider also found that middle-class encodings were more accurately decoded than lower-class encodings.

Fifth-grade children were studied in a series of dyadic communication tasks (Baldwin, McFarlane, & Garvey, 1971; Baldwin & Garvey, 1970; Garvey, 1972). The accuracy of the dyads was found to be related to socioeconomic backgrounds and, to a lesser extent, race (black versus white). Garvey found no significant stylistic differences between the socioeconomic groups. Cazden (1972) reviews these and other studies of social class differences in encoding style. In general, social class differences in accuracy scores seem more consistent in the literature than differences in encoding style.

Individual differences. Having discussed several human characteristics which might be related to communication performance, there is the additional question of the nature and magnitude of individual differences in communication skill.

Several studies have indicated that there is substantial individual consistency on communication tasks which is not completely accounted for by measures of verbal ability or other variables. Garvey (1972) found the consistency of accuracy scores for fifth-grade dyads to be rather high (K-R 20 = .72) across three rather different communication tasks in which the children had to communicate about pictures, model building, and map reading. Olson et al. (1972) found small partial correlations between performance on a verbal and a geometric decoding task remained after the effects of IQ were removed for sixth graders (r = .22) and twelfth graders (r = .32). This consistency could be attributed to

either consistent encoding by the teachers who formulated the messages or consistent decoding by the students. They concluded that some teachers were consistently superior in initially encoding and in recoding messages, but this consistency seemed unrelated to variables such as conceptual level, years of schooling, sex, or years of teaching.

In addition to general consistency of performance on communication tasks, one might wonder whether individuals were consistent on subskills underlying a more general communication skill. For example, does a person who tends to be a successful speaker also tend to be a successful listener? There is intriguing evidence that these two components of communication skill may not be highly correlated within individuals. Hogan and Henley (1970) had university students describe 10 abstract designs. Eight weeks later these students had to select a design in response to the descriptions of the other students. Individual encoding scores based upon the success of others responding to the individual's messages were not significantly correlated with individual decoding scores based upon the individual's success in responding to the messages of the other students. Heider (1971) also found no correlation between individual encoding and decoding skills within social class groups. This independence of encoding and decoding scores has been reported elesewhere (Brilhart, 1965; Johnson & Gross, 1968). Although each of these studies has serious methodological weaknesses, the relationship between encoding and decoding performance warrants further study.

Characteristics of Referents

Types of referents. Some referents are more difficult to describe than others. Abstract figures are clearly more difficult to describe than pictures of animals. Mehrabian and Reed (1968) suggest that the

difficulty of encoding a given referent is a function of the degree to which coding rules for the referent are well-defined and the complexity of the referent. Garner (1962) has attempted to define stimulus complexity in terms of uncertainty. Although a detailed review of research on stimulus complexity is not central to this study, it is worth noting that considerable progress has been made in understanding factors influencing stimulus complexity.

Studies of referential communication have used a variety of stimuli such as arrays of geometric shapes (Shantz & Wilson, 1972; Flavell et al., 1968), pictures varying on a number of attributes (Garvey, 1972), abstract figures, and others. Krauss and Glucksberg found that 3- to 4-year-olds were unable to communicate about either animal pictures or abstract figures, 4- to 5-year-olds were able to communicate about animal pictures but not abstract pictures, and children above five years of age were able to communicate about abstract figures to a degree which increased with age.

That young children can communicate about animal pictures but not about abstract figures points up the fact that the nature of the task strongly influences the conclusions drawn from the data. Shatz and Gelman (1973) state, "Evidence that young children have rudimentary communication skills depends upon both the domain in which a task is set and on the simplicity or naturalness of the task itself (p. 31)." The use of several types of referents in communication studies is essential in order to broaden the generalizability of any findings to other referent types.

Referent attributes. In addition to the broad variations in types of referents, there can be variations in the relevant attributes of the

referents. For example, a cartoon figure of a man could be tall or short, fat or thin, and so on. By varying the number and characteristics of these attributes, one can introduce systematic variations in referents used in a communication game. The effects of redundancy and salience as stimulus characteristics have been studied in research on perception and memory. These will be discussed briefly as they relate to variations in communication game referents.

Redundancy. Information in a referential communication task may be thought of as message content which could systematically influence the choice behavior of a receiver. Information theory has quantified information as $\log_2 n$ where there are n equally probable messages (Raisbeck, 1963). In terms of an array of four referents with equal probabilities of choice by a listener, this implies that a minimum two "bits" of information are essential in order to specify one choice out of four. A given array may permit these essential bits of information to be encoded redundantly. For example, if two of the four referents in the array are both "big" and "red," then "big" and "red" are mutually redundant. Either attribute is sufficient to communicate one bit of information. Redundancy in messages in referential communication tasks has generally been found to increase the accuracy of the listener (Mehrabian and Reed, 1968).

Descriptive salience. Some attributes of a referent are more likely to be noticed than others. And some attributes are more likely to be verbalized than others. These are not necessarily the same attributes. The likelihood of being noticed has been called "salience" by Trabasso and Bower (1968). They discussed a variety of ways in which the salience of a cue can be modified such as changing the number of irrelevant cues, increasing the intensity of the cue, and so on. In a communication game,

however, it is not enough that an attribute be noticed; the speaker must also verbalize the attribute. For example, children at a given age may categorize on the basis of shape, but if the shapes to be described are not easily namable forms such as "squares," the same children may not verbalize the shape. This probability of mention might be thought of as "descriptive salience."

Descriptive salience is the product of at least three probabilities. First, there is a certain probability of perception as discussed by Trabasso and Bower. Next, there is a probability of verbalization which would be a function of the frequency of occurrence of a label for the attribute in the language repertoire of the speaker. The repertoire of a given child will reflect both his group membership as well as his own unique experiences. Finally, there is a certain probability of "social editing" as suggested by Glucksberg and Krauss (1967). Social editing may be thought of as the process of evaluating potential responses in view of the needs of the listener prior to speaking.

A mathematical model for social editing has been proposed by Rosenberg and Cohen (1968). They characterized communication as proceeding through separate stages of selection and evaluation of responses.

Research findings on each of these variables taken separately (perceptual salience, word frequencies, and social editing) suggest that these influences are not random, although the interactions of such variables will produce a complex pattern of responses which may appear almost random. Descriptive salience must be viewed as potentially important in determining performance in a referential communication task.

The presence or absence of context. In a referential communication task, the speaker may be required to describe a given referent in the

presence or absence of "context." The "context" is said to be present when the speaker can see all of the referents in the array from which the listener must choose. The context is said to be absent when the speaker can see only the referent which he is to describe.

Intuitively, it should be easier to tell someone how to choose a particular picture if the speaker knows something about the set of pictures from which the other must choose. If there is only one boat in the set, then "boat" is an adequate message. If there are four boats in the set, "the red sailboat" might be required for an adequate description. However, if the speaker can see only the stimulus which he is to describe, then it is difficult to know when an adequate description has been given and impossible to give an efficient description. One criticism of the work of Krauss and Glucksberg (1969) is that the speaker was not permitted to view the entire set of stimuli while describing the target stimulus, but would the children's messages have been different had the context been displayed? There is evidence that they would not.

Olson (1972) discussed a study by Ford (1971) in which young children were asked to describe a box so that another child would be able to identify it. The alternatives provided were varied, yet 4- and 7-year-old children tended to give a fairly constant number of attributes, no matter how many attributes were required for discrimination among the alternatives. Randhawa (1972) also found that the number of attributes encoded or decoded by children increased as a function of age, with 5- and 8-year-olds tending to level off at about 2 bits and 4 bits, respectively. The effects of context are of special interest because they provide indirect evidence regarding the mental processes of the speaker. Developmental changes in these processes are to be expected.

Position of target stimulus within the display. The ability to scan all stimuli before describing or choosing one is a rather complex skill. Vurpillot (1968) found that young children spend less time scanning than older children before making their judgement. This was apparently due to the tendency of young children to reach a decision upon an incomplete sampling of the stimulus. Also, young children may look only at the figure in the middle of a set. If the position of the target stimulus is carefully counterbalanced with all other variables of interest, it will be possible to look for differences in the probability of errors in the different positions within the display. In addition, such counterbalancing will prevent the confounding of other variables with response bias.

Message Quality

Simple sentences are more easily understood by young children than complex sentences which involve negations, subordinations, passives, and other transformations (Clark, 1973a; Olson, 1972). There are other characteristics of messages which affect communication success. These characteristics include not only the content and form of the message but also the function of the message in social interaction.

Olson et al (1972) compared the effects of messages which contained "basic" versus "elaborated" content and found only slight differences in decoding performance of first grade children. They interpreted the lack of an effect as due to the limited memory span in young children. In a follow-up study they compared messages which were given at a normal rate with similar messages given at a slower rate. The children were also allowed to view the referents while processing the information. Children performed much more successfully with the slower rate.

Garvey (1972) could account for 44% of the variance in accuracy scores for fifth-graders by a combination of three variables: orientation of the knower to the doer's situation, communication of essential information, and verification of solution. Communication of essential information depends upon the content of a message, while the other two variables are concerned with the social interaction between speaker and listener. Using ten measures of message and situation characteristics, Mueller (1972) was able to predict very accurately which messages were likely to produce a "social effect" on the other child when two 4-year-olds were playing together. Lack of clarity and incompleteness of grammar were most predictive of failure, while the attention of the listener was the most predictive of success. This latter finding emphasizes that communication success depends upon both speaker and listener.

The relationship of message characteristics to communication accuracy deserves further study. Until we have a more adequate understanding of what messages children understand best, efforts at improving communication skills will be hampered.

Learning Through Practice and Training

Referential communication studies generally treat accuracy as a basic measure of communication performance. While the relationship of this type of performance to the larger concept of communication skill is indeterminate, research on changes in such performance with practice or training may shed some light on the larger question of how people learn to communicate.

The effects of feedback regarding inadequate messages have been examined in several studies. Flavell et al. (1968) conducted several studies of children's communication performance. They found that children

in grades 2, 6, and 9 were able to improve their messages after being told that their first description was inadequate. Glucksberg and Krauss (1967) found that preschool children did not modify their messages when asked for more information by an adult listener.

Other studies have provided feedback regarding the success of the listener. Krauss and Glucksberg's design permitted the children to compare their stacks of blocks upon completion of a set of 6 items. This would seem to be a relatively weak form of feedback in that it would be difficult for the children to recall what they had said about each block. Flavell et al. (1968) also conducted two studies in which fifth graders were allowed to compare the intended and actual responses on each task. However, they report that the experimenter took a "passive and nondidactic" role with the result that there was some doubt whether the children understood that accuracy and efficiency of description were the intended outcomes. It is not surprising that such minimal feedback on performance usually results in insignificant improvement.

Subjects improvement over trials with a single set of referents is not sufficient to demonstrate learning which would transfer to a new task. Research (Krauss & Glucksberg, 1968; Glucksberg, Krauss, & Weisberg, 1966) indicates that preschool children could not communicate with peers about abstract figures, although they were able to perform perfectly in response to names which they had previously given to the figures. Children in grades K through 5 improved over trials, showing an ability to converge upon a common label for each figure. It would be especially interesting to look for evidence of transfer of skill in converging upon a common nomenclature when confronted with a new set of referents.

Attempts at didactic training of communication skills generally resulted in small or nonsignificant improvements. Recent work (Shantz, 1970; Shantz & Wilson, 1972) reports the effects of an intensive training program with 12 second graders in groups of 3 at a time. Training with various referents (arrays, photographs, abstract figures) involved practice in both describing and listening. Compared with a control group, the training group gave more adequate messages on a posttest. The greatest difference in favor of the experimental group occurred on the skill of giving only critical information. Editing to produce more efficient messages may be a skill which is responsive to training.

The pattern of results suggests that performance on communication tasks is likely to be fairly resistant to rapid modification. Insofar as the communication style of an individual reflects patterns of behavior acquired over a lifetime of practice, it is not reasonable to expect major changes from short-term intervention. Scattered research findings and common sense suggest that intervention likely to produce changes might include actual practice in communicating about a variety of referents with another person in a setting permitting ample feedback. Direct intensive training of the type conducted by Shantz and Wilson (1972 or interactions between children where the structure is provided by games or machines might facilitate the acquisition of basic communication skills. The "transactional instructional games" being developed by the late Lassar Gotkin (Gotkin, n.d.) deserve further development in this regard.

Structuring Interactions with Technology

People are more interested in people than machines. This is not to say that machines are not interesting and valuable in their place.

Rather it is to call attention to the fact that the predominant use of technology in education has been to put people in touch with things. Children sit in circles with headphones and listen to stories being read to them, or sit and watch films or television. More expensive technologies put children in touch with computers, some of which are somewhat responsive to the children. Even the most ardent advocates of "responsive environments" tend to think in terms of making machines which are responsive to people (Moore, 1967). These uses of technology can provide valuable sources of didactic training, but machines are machines and people are people.

By comparison, the use of technology to put people in touch with people has been neglected. There are many potentially productive uses of technology to structure interactions between people such that they learn from each other. The key word is structure. Telephones put people in touch with people but the telephone does not structure their interaction deliberately so as to increase educational outcomes.

Teachers facilitate learning by drawing on their greater experience and training to structure a learning environment in which the probability that children will encounter educationally significant experiences is greater than would occur naturally. It is true that children learn a great deal from each other in spontaneous play, but the school has a special responsibility for certain types of learning which may not occur spontaneously. Language and mathematics skills are examples of such skills. If we can find ways to structure certain kinds of social interaction between children such that educationally desirable outcomes occur, then we will make learning a social activity which is structured, nonetheless. We would also make it unnecessary for the teacher to always

be present as the structuring agent.

Games are one means of structuring interpersonal interactions. Educational games are designed with educational outcomes in mind. As such they represent a simple form of technology. The potential for using more complex technologies to structure interpersonal interactions is great. Computers and other machines are capable of putting two people into a variety of interactions where the machine provides structure. The people provide each other with flexible and creative feedback which cannot be provided by a machine. Furthermore, for language skills such as communication, the learning situation could more closely resemble the natural world of social interaction to which transfer of training is sought. Finally, this type of social learning has a certain appeal to one who takes a humanistic value position that learning should be more cooperative and interactive, but who, at the same time, views the element of structure as essential to the educational process.

Summary

This brief review of a few studies of referential communication can only serve to indicate the complexity of the phenomenon. It should be evident from this review that performance on a referential communication is highly dependent upon characteristics of the speaker and listener, the referents, and the nature of the experimental setting. The hypotheses listed below must be interpreted in terms of the specific characteristics of the task described in the next chapter.

Major Hypotheses

The major hypotheses to be tested in this study are:

1. Characteristics of the speaker and listener expected to correlate positively with performance in this referential communication task are:

age, higher verbal ability, higher socioeconomic background, and being first-born.

2. Sex of speaker and listener is not expected to correlate with performance.

3. The order of difficulty of the referents used in this study will be (from easy to difficult): namable pictures, people figures, relational monkeys, and abstract figures.

4. Performance will be higher on items where the relevant attributes have high descriptive salience.

5. Performance will be higher on items where there is redundancy in the relevant attributes.

6. Performance will be higher on items where the context is presented to the speaker.

7. The effects of context will increase with age.

8. Performance will increase across the items due to practice.

9. The number of questions asked by the listener will increase after training on questioning.

CHAPTER II

DESIGN OF THE STUDY

Overview of Chapter Two

The complexity of the communication process as discussed in Chapter I presupposes a complex experimental design. The experimental setting will be a referential communication task, using an interactional game device to present the referents. This chapter will discuss in order the characteristics of the game device, the overall testing sequence, the fractional factorial design, the types of referents, training procedures, and selection of the sample.

The Communication Game Device

A communication game device developed for use in this study is pictured in Figure 1. A slide projector presented sets of four referents to two children sitting at right angles to each other. The children could see each other but could not see the referents presented to the other child. The children were permitted and encouraged to talk back and forth. Underneath each referent was a button. One of the referents was marked with a dot on the side of the speaker (or "knower"). The speaker's role was to push the button under this marked referent and then tell the other child about it. The other child then tried to push the button under the referent described. If the first response was incorrect, a red light appeared on both sides indicating the referent which was incorrectly chosen. The pair continued until the button under the correct referent was pushed. The slide projector then automatically advanced to the next slide. Technical details about the device are included in Appendix A.

The game device has several advantages for research on referential communication in young children. The use of photographic slides makes

it relatively easy to prepare a variety of referents. The game device itself insures a measure of experimental control over the presentation of the referents. Immediate feedback regarding the correctness of each response should facilitate learning. Eliminating the manipulative demands of referential communication tasks such as those used by Krauss and Glucksberg (1969) should make it easier for very young children to concentrate on communication. Permitting the children to see each other should help maintain the social interaction. Finally, children enjoy machines with buttons. The fact that the game is enjoyable makes it possible to sustain the attention of even young children across a long series of referents.

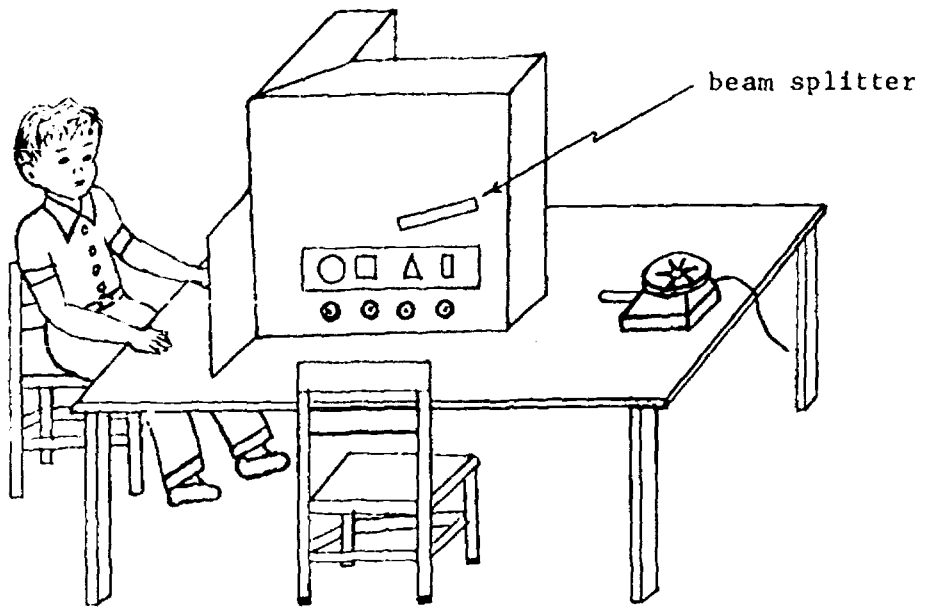


Fig. 1. The communication game device.

Testing Sequence

Each pair of children had to communicate about a total of 64 sets of referents. One member of the pair was randomly assigned to begin in the role of speaker. A practice set of slides familiarized the Ss with the game. See Appendix B. After the pair had completed 16 sets of referents, the children changed sides and reversed roles. Upon completion of the next 16 slides, the experimenter conducted a training session for about 5 minutes, after which the children again alternated in the roles of speaker and listener in the same fashion described above. Figure 2 indicates the task sequence.

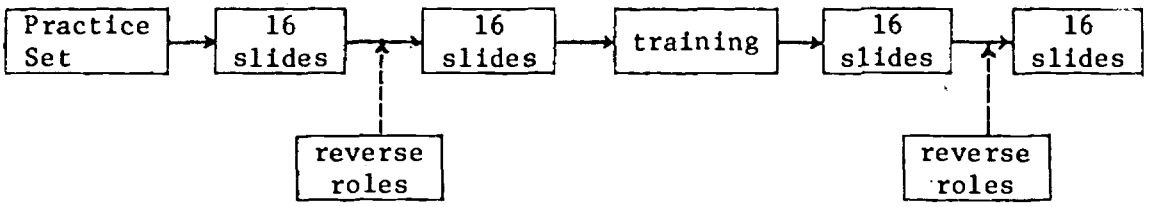


Fig. 2. Task sequence in the experiment.

Fractional Factorial Experimental Design

The number of variables of interest in this study of referential communication required an experimental design incorporating a large number of main effects as factors while keeping sample sizes within manageable limits. Fractional factorial designs are most useful for this purpose.

These designs reduce substantially the experimental effort which would be required by a full factorial design, while permitting the same number of factors to be examined. The price paid for these gains is the confounding of higher-order interactions with main effects and lower-order interactions (Winer, 1971; Anderson, 1968).

In this study a confounded blocks fractional factorial design was used. The between-Ss portion of the design was a one-half replication of a 2^5 factorial design crossed with 3 age levels. The within-Ss-portion of the design was a one-sixteenth replication of a 2^{11} factorial design. The variables are listed in Table 1.

TABLE 1

Variables in the Between-Ss and Within-Ss Design

Label	Variable	Levels
A	Age	3
X	Sex	2
O	Order of Birth	2
V	Verbal Ability	2
S	Community	2
Z	Blocks	2
	Between Ss =	2^5
A′	Communicative Salience	2
B	Redundancy	2
C	Context	2
D	Order of Types	2
E	Order of Types	2
F	Serial Position of Target	2
G	Serial Position of Target	2
H	Type of Stimulus	2
J	Type of Stimulus	2
K	Trial (sets of 16)	2
L	Trial (sets of 16)	2
	Within-Ss =	2^{11}

Confounding of Sources in the Design

The higher-order interactions which are confounded with main effects and lower-order interactions in fractional factorial designs are called "aliases." These aliases are assumed to be small relative to the main effects and lower-order interactions. Nonetheless, when interpreting

the results of a fractional factorial design, one must keep in mind that the main effects and lower-order interactions are confounded with (and hence, exactly equivalent to) the higher-order interactions.

Because the between-Ss portion is a one-half fraction of a 2^5 design, each main effect is aliased with one four-way interaction, and each two-way interaction is aliased with one three-way interaction. The one-sixteenth fraction of a 2^{11} which is the within-Ss portion of the design has a much more complex set of aliases. Each source is confounded with 15 aliases from the within portion plus 15 aliases from the block confounding. Fortunately, in the plan selected all two-way interactions aliased only with three-way or higher order interactions and are therefore interpretable.

Between-Subjects Design

Sixteen pairs in each of three age groups (3½ - 5, 5½ - 6½, 7 - 8 years old) were studied, a total of 48 pairs or 96 Ss. Ss were assigned to pairs of similar age, sex, birth order (first-born versus later-born), community, and verbal ability. The two communities were university community and middle-middle class suburban community. Ss were blocked on verbal ability as measured by the Peabody Picture Vocabulary Test (Dunn, 1965).

Included in the between-Ss portion of the design are two confounded "blocks" of within-Ss variables. Blocks in fractional factorial designs provide a check for possible differences in performance due to any particular combination of within-Ss variables. One-half of the Ss were run on block one and one-half were run on block two. Each block contained 64 items systematically varied according to the within-Ss specifications.

Within-Subjects Design

The within-Ss portion of the design was a one-sixteenth replicate of a 2^{11} fractional factorial design. The plan used in this study was Plan 16.11.64 selected from the collection of designs prepared by the United States National Bureau of Standards (1957). This plan defines two blocks of 64 items by specifications on 11 factors. The plan is shown in Table 2. The "item" numbers in Table 2 indicate the sequence of administration, while the "old" numbers refer to the design as printed in Plan 16.11.64.

The design specifications in Table 2 define the experimental conditions for each item in the set of referents. Variables A, B, and C specified the communicative salience, redundancy, and context conditions. Variables D, E, K, and L were used in combination as a means of ordering and counterbalancing the items in the sets of 64. Variables F and G specified the position of the target referent from left to right in the display. Variables H and J specified the type of referent.

Types of referents. Four types of referents were used: namable pictures, people figures, relational monkeys, and abstract figures. The referent sets are shown in Figures 2a and b. A complete description of the referents is included in Appendix C. These types of referents were selected to represent a range of difficulty in order to better understand what very young children are capable of communicating.

The four types of referents can only be described briefly. The namable pictures were pictures of common objects which even the youngest children were expected to be able to name. The people figures and the relational monkeys were varied systematically on four binary attributes. A binary attribute has two values such as "tall" and "short" for the

TABLE 2

Stimulus Specifications

BLOCK ONE

ITEM	DESCRIPTION										OLD
1.											1
2.			C		E		G	H	J		10
3.	A	B		D		F			J		9
4.	A	B	C	D	E	F	G	H			2
5.		B						H	J		25
6.		B	C		E		G				17
7.	A			D		F		H			18
8.	A		C	D	E	F	G		J		26
9.	A	B	C			F	G	H	J		42
10.	A	B			E	F					33
11.			C	D			G	H			34
12.				D	E				J		41
13.	A		C			F	G				49
14.	A				E	F		H	J		58
15.		B	C	D			G		J		57
16.		B		D	E			H			50
17.	A	B	C					H	J	L	4
18.	A	B			E		G			L	11
19.			C	D		F		H		L	12
20.				D	E	F	G		J	L	3
21.	A		C							L	28
22.	A				E		G	H	J	L	20
23.		B	C	D		F			J	L	19
24.		B		D	E	F	G	H		L	27
25.						F	G			L	43
26.			C		E	F		H	J	L	36
27.	A	B		D			G		J	L	35
28.	A	B	C	D	E			H		L	44
29.		B				F	G	H	J	L	52
30.		B	C		E	F				L	59
31.	A			D			G	H		L	60
32.	A		C	D	E				J	L	51
33.	A					F	G	H		K	14
34.	A		C		E	F			J	K	5
35.		B		D			G	H	J	K	6
36.		B	C	D	E					K	13
37.	A	B				F	G		J	K	21
38.	A	B	C		E	F		H		K	29
39.				D			G			K	30
40.			C	D	E			H	J	K	22
41.		B	C						J	K	37
42.		B			E		G	H		K	46
43.	A		C	D		F				K	45
44.	A			D	E	F	G	H	J	K	38
45.			C					H		K	62
46.					E		G		J	K	53
47.	A	B	C	D		F		H	J	K	54
48.	A	B		D	E	F	G			K	61
49.		B	C			F	G		J	K	L	15
50.		B			E	F		H		K	L	8
51.	A		C	D			G			K	L	7
52.	A			D	E			H	J	K	L	16
53.			C			F	G	H		K	L	24
54.					E	F			J	K	L	32
55.	A	B	C	D			G	H	J	K	L	31
56.	A	B		D	E					K	L	23
57.	A							H		K	L	40
58.	A		C		E		G		J	K	L	47
59.		B		D		F		H	J	K	L	48
60.		B	C	D	E	F	G			K	L	39
61.	A	B							J	K	L	63
62.	A	B	C		E		G	H		K	L	56
63.				D		F				K	L	55
64.			C	D	E	F	G	H	J	K	L	64

BLOCK TWO

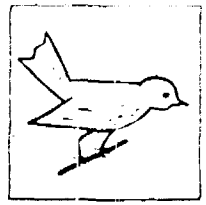
ITEM	DESCRIPTION										OLD
65.			C			F			J		73
66.					E	F	G	H			66
67.	A	B	C	D							65
68.	A	B		D	E		G	H	J		74
69.		B	C			F		H			82
70.		B			E	F	G		J		90
71.	A		C	D				H	J		89
72.	A			D	E		G				81
73.	A	B					G	H			98
74.	A	B	C		E				J		105
75.				D		F	G	H	J		106
76.			C	D	E	F					97
77.	A						G		J		121
78.	A		C		E			H			114
79.		B		D		F	G				113
80.		B	C	D	E	F		H	J		122
81.	A	B				F		H		L	76
82.	A	B	C		E	F	G		J	L	67
83.				D				H	J	L	68
84.			C	D	E		G			L	75
85.	A					F			J	L	83
86.	A		C		E	F	G	H		L	91
87.		B		D						L	92
88.		B	C	D	E		G	H	J	L	84
89.			C				G		J	L	99
90.					E			H		L	108
91.	A	B	C	D		F	G			L	107
92.	A	B		D	E	F		H	J	L	100
93.		B	C				G	H		L	124
94.		B			E				J	L	115
95.	A		C	D		F	G	H	J	L	116
96.	A			D	E	F				L	123
97.	A		C				G	H	J	K	70
98.	A				E					K	77
99.		B	C	D		F	G	H		K	78
100.		B		D	E	F			J	K	89
101.	A	B	C				G			K	94
102.	A	B			E			H	J	K	86
103.			C	D		F	G		J	K	85
104.				D	E	F		H		K	93
105.		B				F				K	109
106.		B	C		E	F	G	H	J	K	102
107.	A			D					J	K	101
108.	A		C	D	E		G	H		K	110
109.						F		H	J	K	118
110.			C		E	F	G			K	125
111.	A	B		D				H		K	126
112.	A	B	C	D	E		G		J	K	117
113.		B					G			K	L	71
114.		B	C		E			H	J	K	L	80
115.	A			D		F	G		J	K	L	79
116.	A		C	D	E	F		H		K	L	72
117.							G	H	J	K	L	95
118.			C		E					K	L	87
119.	A	B		D		F	G	H		K	L	88
120.	A	B	C	D	E	F			J	K	L	96
121.	A		C			F		H	J	K	L	112
122.	A				E	F	G			K	L	103
123.		B	C	D				H		K	L	104
124.		B		D	E		G		J	K	L	111
125.	A	B	C			F				K	L	119
126.	A	B			E	F	G	H	J	K	L	128
127.			C	D					J	K	L	127
128.				D	E		G	H		K	L	120

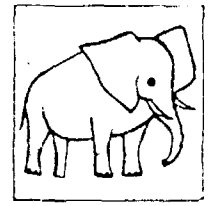
Variable Assignments

A = Salience (Low/High)
B = Redundancy (Low/High)
C = Context (Without/With)
D + E = Order of Types by Fours
F + G = Position of Target
H + J = Type of Stimulus
K + L = Trials by Sixteens

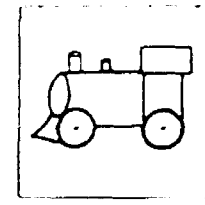
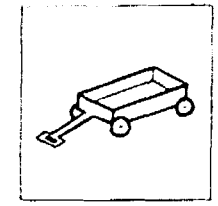
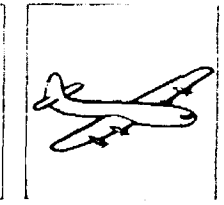
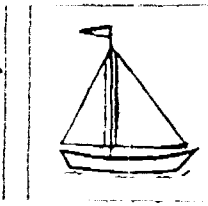
Figure 2a

Sets of Namable and Abstract Referents



Set 1 - Namable

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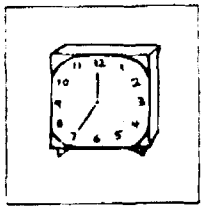
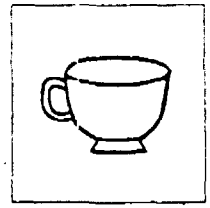
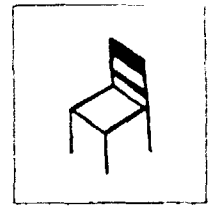
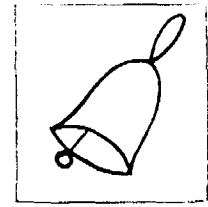

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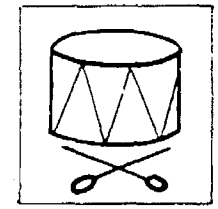

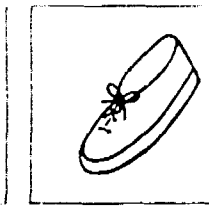

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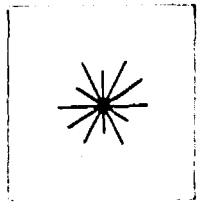


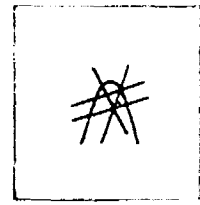

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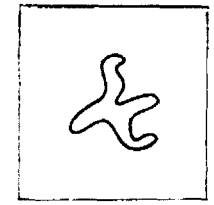
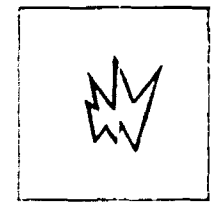
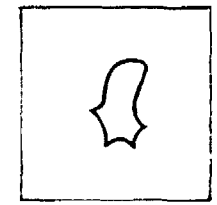
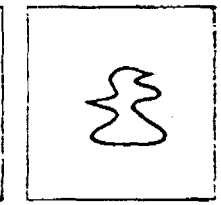

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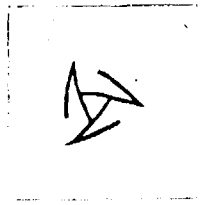
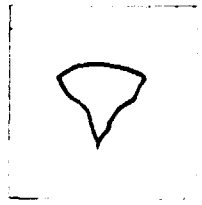
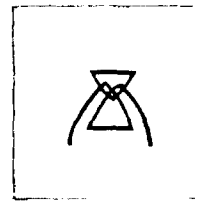
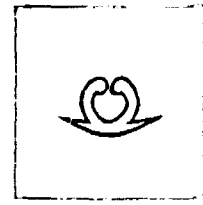
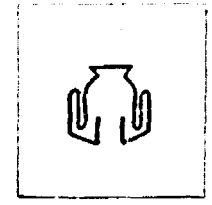
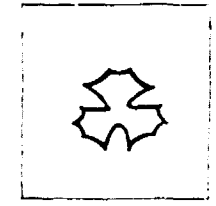
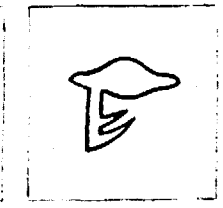





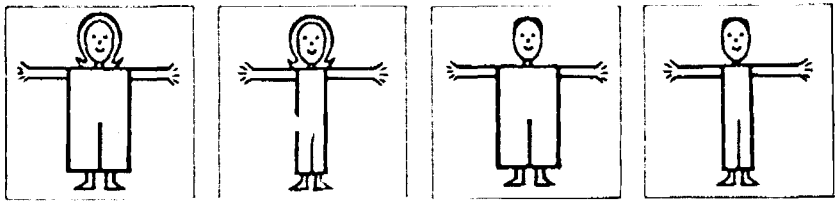
Set 7 - Abstract
(Krauss and Glucksberg)

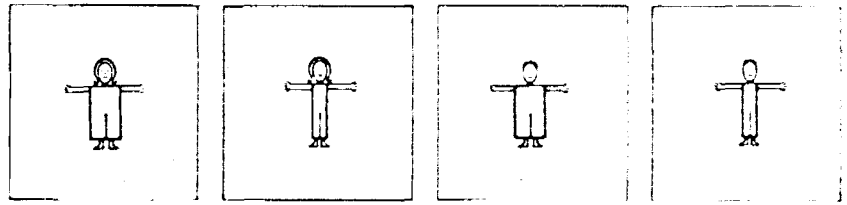
Set 8 - Abstract
(Krauss and Glucksberg)

Figure 2b

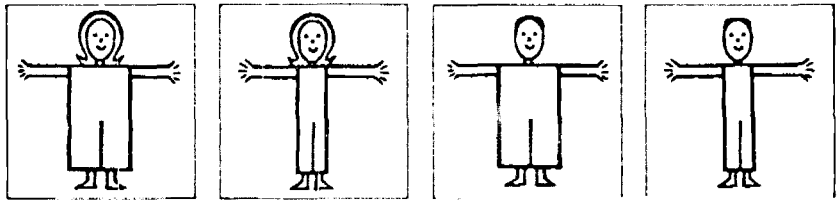
Sets of People and Monkey Referents



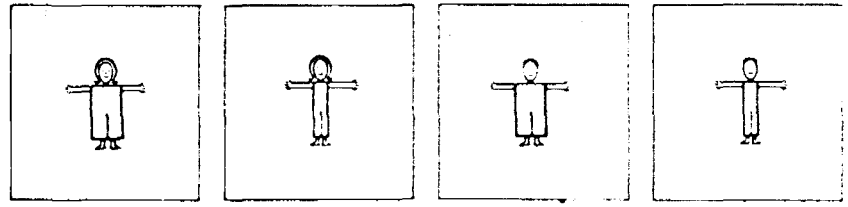
Set 9 - People



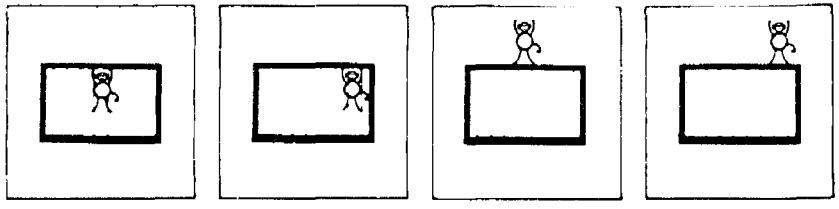
Set 10 - People



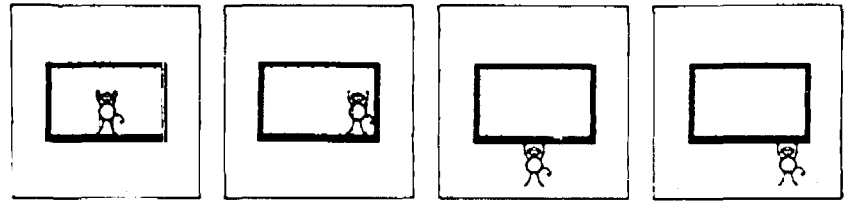
Set 11 - People (Colored in Red)



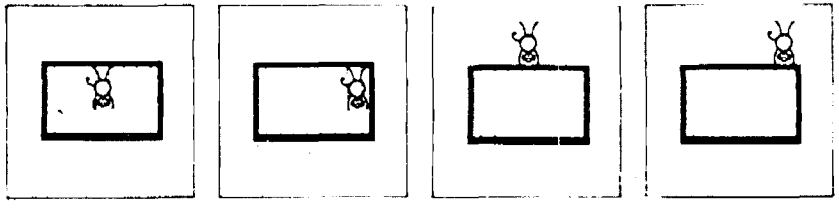
Set 12 - People (Colored in Red)



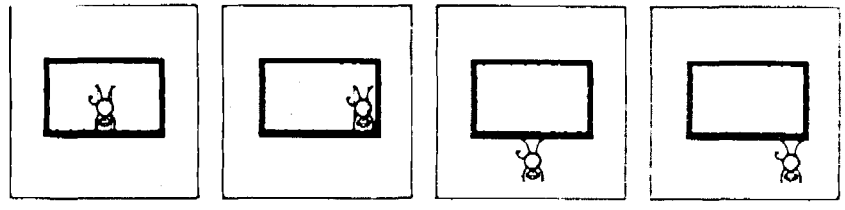
Set 13 - Monkeys



Set 14 - Monkeys



Set 15 - Monkeys



Set 16 - Monkeys

attribute "height." For the people referents the attributes were: tall - short, red - white, fat - thin, male - female. For the monkey referents the attributes were: upside-down - rightside-up, inside - outside, top - bottom, and center - side. The abstract figures included 8 items from the work of Krauss and Glucksberg (1969) and 8 original items. The abstract figures were intended to be the most difficult items to describe.

Context. In one-half of the instances the speaker was presented only the target referent by itself without the presence of the other three referents. In the other half the speaker saw the target in the context of the other three referents. This variation was included to determine whether children of a given age would make use of the context in describing a referent.

Descriptive salience and redundancy. The people and the monkey referents were intended to be intermediate in difficulty between the namable and the abstract referents. The use of sets of referents varying systematically on certain attributes would also permit a more systematic analysis of the content of children's messages. These sets of referents were constructed to vary on four binary attributes.

There are 1820 possible combinations of 4 referents selected from a set of 16 varying on 4 binary attributes. When possible orderings in a display are considered, the number is even larger. From this large number of possibilities, four different types of sets were selected which varied on descriptive salience and redundancy. These selections will be only briefly discussed here. A complete discussion of the rationale and procedures used in the selection of particular sets of referents used in this study is given in Appendix C.

Pilot tests of these sets of referents indicated that there were large differences among the four binary attributes in descriptive salience. For example, children were much more likely to verbalize that the monkey was "upside down" than "at the center of the cage." Although a complete investigation of this phenomenon was not central to the purposes of this study, it seemed worthwhile to introduce some systematic control over this source of variance into the design.

A simple technique was used to estimate the ordering of the attributes in the monkey referents and the people figures. Children were presented pairs of pictures which differed on two attributes and asked to tell how the pictures were different. Young children typically only verbalized one attribute. The ordering thus obtained corresponded closely to earlier estimates based on frequency counts on actual pilot tests.

The range of frequencies and the ordering seemed more consistent for the relational referents than for the people figures. For the monkey referents the ordering of attributes on descriptive salience from high to low was determined to be: (upside down, rightside up), (inside, outside), (top, bottom), and (center, side). For the people figures the ordering was: height, color, sex, and girth. The tentativeness of these salience orderings must be emphasized.

High and low redundancy were more easily defined and systematized. In the low redundancy condition only two of the four attributes were relevant, the other two attributes being held constant across the four members of the set. This condition might then be thought of as the "no redundancy" condition. In the high redundancy condition each attribute was completely confounded with another attribute. For example, each figure that was short might also be female in a given set. The high

redundancy condition might also be characterized as the "no irrelevant attributes" condition because none of the systematically varied attributes are irrelevant. (Other aspects of the referents remain irrelevant.) These procedures yield four conditions for both the people and the monkey referents. These were the high salience - high redundancy, high salience - low redundancy, low salience - high redundancy, and low salience - low redundancy conditions. It was hoped that these variations would permit a somewhat finer analysis of the sources of variance in communication performance associated with the nature of the referent.

Training Procedures

The training procedure was aimed at three behaviors which it was thought might lead to improved performance by the Ss. The children were trained to look at all four referents (when there were four) before describing the target, to say "at least two things about the picture" when they were knowers, and to ask questions when uncertain which one was meant when they were doers.

The training was direct and lasted about 5 minutes. The Ss were seated side by side and a set of 10 training slides with referents not used in the regular sequence were shown. As each slide was presented, the experimenter either described it or asked each child to describe it or ask a "good question." Although a standard sequence of training was followed, the training varied somewhat according to the responsiveness of the Ss. The experimenter used ample praise, repetition of good responses, and corrections of inaccurate or irrelevant descriptions. The standard training sequence is presented in Appendix D.

Sample Selection

The between-Ss design called for 48 pairs or a total of 96 children selected according to age, sex, birth order, and community. Children selected on these factors were then divided into a high and a low group according to Peabody Picture Vocabulary Test (PPVT) score. The pairs thus formed were assigned to one of the two confounded blocks of the fractional factorial design.

Obtaining Ss who met all of these criteria posed several problems. In order to have a more stable mean PPVT score about which to divide Ss into a high and a low group, approximately twice as many children were initially tested on the PPVT as were needed in the study. Thus, at a given age in a given community, a minimum of 32 children were required, 8 in each of the four sex by birth order cells. In actual practice an even larger pool of children was required due to unequal numbers of children naturally occurring in each sex by birth order cell. In the end, over 200 children were tested on the PPVT in order to obtain the necessary Ss from which to select high and low verbal ability groups.

The requirement of a large pool of children from which to draw a sample led to a restriction on the degree of difference in socioeconomic status between the two communities used in the study. Most schools serving low socioeconomic neighborhoods have a substantial number of ethnic minorities, many of them speaking Spanish or nonstandard English dialect. Socioeconomic status would have been confounded with ethnicity if such schools had been used. Furthermore, fractional factorial designs are especially vulnerable to the effects of "outliers" (atypical Ss).

The schools finally selected differed only slightly in socioeconomic status. The schools selected to represent one "community" served children

most of whom were from families associated with a university (graduate students, faculty). The schools selected for the other "community" generally served white, middle-class families. An examination of the incomplete school records on family occupations indicated that these families were generally engaged in white-collar nonprofessional occupations. The community factor in this study must therefore be seen principally as a test of whether children in a university community are atypical of middle-class white children in general.

Ss were divided into a high verbal ability and low verbal ability group on the basis of their PPVT raw score. Approximately 8 children were tested in each cell, then 2 high scoring and 2 low scoring children were selected at random from these 8. It had initially been planned to use the PPVT IQ for dividing the children on verbal ability, but the broad age spans provided in the PPVT Manual (1965) would have resulted in some children receiving widely different IQ scores for a given raw score where the children differed in age by one month. The use of raw scores provided a more valid measure of verbal ability but resulted in some degree of confounding of raw score with age in the youngest age group.

CHAPTER III

ANALYSIS AND RESULTS

Overview of Chapter Three

The results of the study will be reported under four general topics. First, the characteristics of the sample will be described. Next, the results using the number of errors as the dependent measure will be presented. Then specific analyses will be applied to dependent measures derived from the children's language. Some anecdotal material from the transcripts will be presented in Chapter Four.

Description of Sample

Letters describing the study and asking permission for the child to participate were sent to 232 families. Of the families contacted, only 9 declined, although 14 failed to respond and 10 of the responses came too late for the children to be included in the study. Five children refused to take the PPVT and were dropped from the sample and 2 children were absent on the test day. Overall, 83 percent of those contacted were in the subject pool from which the 96 participants were selected. These data are presented in Table 3 according to category. Inspection of Table 3 reveals no evidence of systematic bias in sample recruitment.

The characteristics of the subjects by age group are presented in Table 4. The mean ages of the three groups were almost exactly the desired ages of 4½, 6, and 7½. The PPVT raw scores increase as expected with age. The mean PPVT IQ is above average for all three age groups. Nevertheless, the standard deviations for the groups on PPVT IQ and raw score are only slightly less than those reported for the norms of the test (Dunn, 1965). The PPVT IQ range was from 88 to 145.

TABLE 3

Sample Recruitment

	Middle-SES Community				University Community			
	1st-Born		Later-Born		1st-Born		Later-Born	
Age 4-5								
Male	Contacted	15	Contacted	8	Contacted	9	Contacted	7
	No Response	-4	Declined	-1	Child Refused	-1	Child Refused	-1
	Declined	-1	Too Late	-1				
	Too Late	-1						
	Peabody Given	9	Peabody Given	6	Peabody Given	8	Peabody Given	6
Female	Contacted	11	Contacted	7	Contacted	9	Contacted	10
	No Response	-4	Declined	-1	Child Refused	-1	Child Refused	-1
					Child Absent	-1	Child Absent	-1
	Peabody Given	7	Peabody Given	6	Peabody Given	7	Peabody Given	8
Age 5½-6½								
Male	Contacted	10	Contacted	10	Contacted	5	Contacted	15
	Too Late	-1	Declined	-1	Declined	-1	Too Late	-7
	Peabody Given	9	Peabody Given	9	Peabody Given	4	Peabody Given	8
Female	Contacted	9	Contacted	8	Contacted	8	Contacted	16
					No Response	-1	No Response	-2
	Peabody Given	9	Peabody Given	8	Peabody Given	7	Peabody Given	14
Age 7-8								
Male	Contacted	8	Contacted	9	Contacted	10	Contacted	10
					No Response	-1		
					Declined	-1		
	Peabody Given	8	Peabody Given	9	Peabody Given	8	Peabody Given	10
Female	Contacted	9	Contacted	11	Contacted	7	Contacted	11
			No Response	-1	No Response	-1	Declined	-2
			Declined	-1				
			Child Refused	-1				
	Peabody Given	9	Peabody Given	8	Peabody Given	6	Peabody Given	9

TABLE 4

Characteristics of Subject Pairs by Age Group

	Age Group 4½ $\bar{X}$ (N=16)	6 $\bar{X}$ (N=16)	7½ $\bar{X}$ (N=16)	Total $\bar{X}$ (N=48)	F(2,45)
Age in Years	4.57	5.97	7.57	6.04	402***
(s.d.)	(0.45)	(0.20)	(0.16)	(1.27)	
PPVT Raw Score	53.8	62.7	72.7	63.1	27***
(s.d.)	(7.0)	(4.9)	(9.3)	(10.6)	
PPVT IQ	112.4	113.8	115.7	113.9	< 1
(s.d.)	(8.8)	(9.6)	(17.9)	(12.6)	

***p < .005

The mean age of the subject pairs within each between-Ss factor are presented in Table 5. There are no significant differences in age between the levels of any of the between-Ss factors.

TABLE 5

Mean Age of Subject Pairs by Between-Ss Factors

	$\bar{X}$ (N=24)	S.D.	Difference of Mean	F(1,46)
Male	5.96	1.32	- .15	< 1
Female	6.11	1.24		
First-Born	6.05	1.34	+ .03	< 1
Later-Born	6.02	1.23		
High PPVT Score	6.10	1.19	+ .13	< 1
Low PPVT Score	5.97	1.37		
University Community	6.02	1.27	- .03	< 1
Middle-SES	6.05	1.30		
Block One	6.06	1.24	+ .05	< 1
Block Two	6.01	1.33		

The subject pairs are described by mean PPVT raw score and IQ in Tables 6 - 7. There is the expected significant difference between the two groups which were blocked on the basis of PPVT raw score. The two community groups differ in the expected direction on PPVT raw score and IQ, although this difference only reaches significance on the IQ score comparison. There are no significant differences on PPVT raw score or IQ for the other between-Ss factors.

As mentioned previously, the decision to block on the PPVT raw score rather than on IQ resulted in a confounding of ability with age in younger-Ss. The degree of this confounding is shown in Table 8. The difference in age between the high and low verbal ability groups is negligible in three of the six age by community groups. It is most pronounced in the youngest group in the university community where a difference of almost a half of a year exists.

Between-Subjects Factors

The results of an analysis of variance on the between-Ss factors are presented in Table 9. The results of the analysis of within-Ss factors are presented in Table 10. The dependent measure for these analyses is the total number of errors made by the pair of Ss. Thus the analysis is based upon the performance of pairs which were homogenous with respect to age, sex, etc.

The number of errors showed a highly significant decrease with age as expected. Sex was showed a marginal relationship with errors with girls making fewer errors than boys.

Verbal ability (as confounded with age) was also significantly related to errors. The age x verbal ability interaction was marginally significant, reflecting the confounding of verbal ability with age in the younger age level.

TABLE 6

Mean PPVT Raw Score of Subject Pairs by Between-Ss Factors

	$\bar{X}$ (N=24)	S.D.	Difference of Mean	F(1,46)
Male	64.0	(11.6)	+1.9	< 1
Female	62.1	(9.6)		
First-Born	63.4	(10.7)	+0.7	< 1
Later-Born	62.7	(10.7)		
High PPVT	68.3	(9.6)	+10.4	15.2***
Low PPVT	57.9	(8.9)		
University Community	65.2	(10.0)	+4.3	2.0 n.s.
Middle-SES	60.9	(10.9)		
Block One	63.0	(9.9)	0.0	0.0
Block Two	63.0	(11.4)		

***p < .005

TABLE 7

Mean PPVT IQ of Subject Pairs by Between-Ss Factors

	$\bar{X}$ (N=24)	S.D.	Difference of Mean	F(1,46)
Male	116.1	(13.0)	+4.3	1.5 n.s.
Female	111.8	(11.9)		
First-Born	114.4	(12.9)	+0.9	< 1
Later-Born	113.5	(12.5)		
High PPVT Score	123.0	(9.6)	+18.1	52.0***
Low PPVT Score	104.9	(7.7)		
University Community	117.7	(12.2)	+7.5	4.5*
Middle-SES	110.2	(12.1)		
Block One	113.7	(11.8)	-0.4	< 1
Block Two	114.1	(13.6)		

*p < .05
***p < .005

TABLE 8

Mean Age of High and Low Verbal Ability Groups by Age and Community

Age Group	Ability	Mean Age	S.D.	Difference of Mean
4½	University			
	Low	4.47	(0.38)	+0.25
	High	4.72	(0.62)	
	Middle-Class			
	Low	4.30	(0.45)	+0.49
	High	4.79	(0.28)	
6	University			
	Low	5.94	(0.07)	-0.11
	High	5.85	(0.04)	
	Middle-Class			
	Low	5.90	(0.21)	+0.29
	High	6.19	(0.24)	
7½	University			
	Low	7.64	(0.13)	-0.16
	High	7.48	(0.18)	
	Middle-Class			
	Low	7.59	(0.17)	-0.03
	High	7.56	(0.17)	

Supplemental analyses of the variance associated with the blocking on raw score indicate that this source is most parsimoniously explained as resulting from the age effect confounded with it. Figure 3 presents the scatterplot of errors against the mean IQ of the pairs. The correlation of IQ with errors ($r = -.22$) is not significant. This correlation is reduced when the slight correlation between age and IQ is partialed out ($r = -.20$). Table 11 presents these correlations. Analysis of variance for the three age groups taken separately reveal that the effects of the verbal ability factor are significant only in the youngest age group where the confounding is most pronounced. Although any interpretation of a confounded source is risky, the data suggest that IQ as

TABLE 9

Source Table for Between-Ss Factors for Total Errors

Source	df	Mean Square	F
Age (A)			
Linear	1	77.312	31.40***
Residual	1	0.379	< 1
Sex (X)	1	8.126	3.17†
Birth Order (O)	1	0.255	< 1
Verbal Ability (V)	1	20.345	7.93**
Community-SES (S)	1	0.083	< 1
Blocks (Z)	1	0.630	< 1
AV			
A Linear x V	1	9.523	3.87†
A Residual x V	1	0.987	< 1
Pooled Between-Ss Error	38	2.462	

**p < .01
***p < .005
†P < .10

defined as some ratio of verbal raw score divided by chronological age is not a major source of variance in performance on this communication task.

There were no effects of birth order, community, or the block confounding. The absence of any effects from the block confounding strengthens confidence that the fractional factorial design selected was successful in balancing the various factors built into the design.

Individual differences in performance were striking. Despite the regular and substantial improvement in performance with age, considerable overlap existed between the performance of some children in the youngest and the oldest age groups. Figure 4 shows the distribution of subjects by age group according to the total errors.

TABLE 10

Source Table for Within-Ss Factors for Total Errors

Source	df	MS_{source}	df	MS_{error}	F
Type of referent (T)					
Namable vs Others	1	198.338	45	0.696	285.05***
Abstract vs Systematic	1	35.771	45	1.250	28.61***
People vs Monkeys	1	0.260	45	0.880	< 1
Target Position (P)					
Linear	1	13.896	45	1.094	12.70***
Quadratic	1	5.672	45	0.815	6.96*
Residual	1	0.003	-	-	< 1
Trials (H)					
First vs Second Half	1	2.521	45	0.908	2.78
Residual	2	0.172	-	-	< 1
Context (C)	1	0.255	-	-	< 1
H for each type (T)					
People	1	4.688	45	0.961	4.88*
Monkeys	1	0.422	45	0.875	< 1
Abstract	1	1.095	45	1.421	< 1
C for each type (T)					
People	1	10.547	45	0.521	20.26***
Monkeys	1	0.521	45	0.426	1.22
Abstract	1	2.637	45	0.877	3.01†
H x C	1	4.380	45	0.510	8.58**
P x Age					
P Linear	2	2.452	45	1.094	2.24
P Quadratic	2	4.090	45	0.815	5.02*

*p < .05
**p < .01
***p < .005
†p < .10

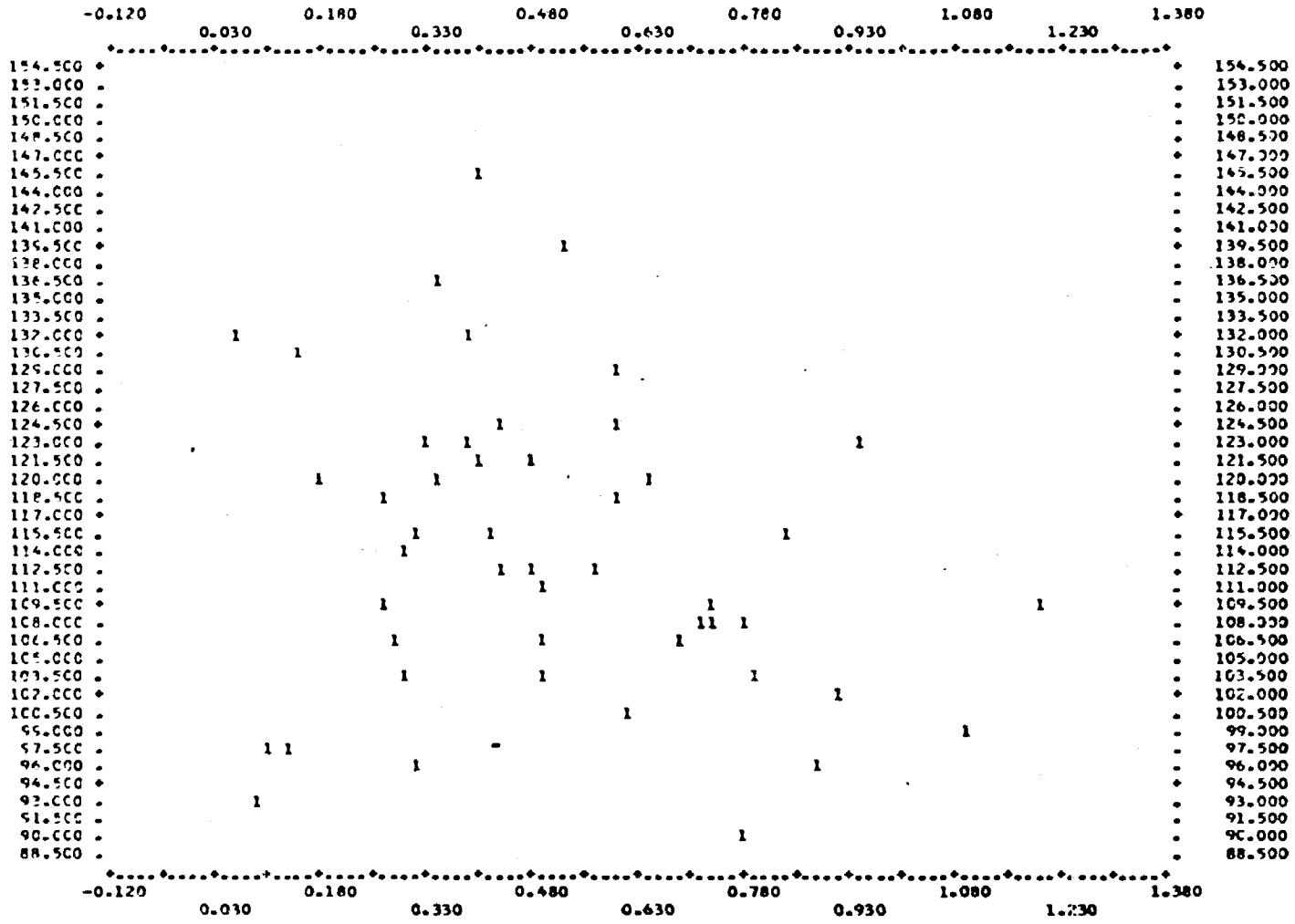


Fig. 3. Mean number of errors by mean IQ of pair.

TABLE 11

Correlations of Age, IQ, and PPVT Score with Errors

	2	3	4
1. Mean Age of Pair	.112	.759***	-.684***
2. Mean IQ of Pair	-	.720***	-.222
3. Mean PPVT Score		-	-.635***
4. Mean Errors			-

***p < .005, df = 46

As can be seen in Figure 4, several children, particularly in the youngest and the oldest groups, made a large number of errors compared to others in these age groups. In the case of the oldest children, some of the variance certainly resulted from children who did not take the game seriously or who found it difficult to grasp the fact that the game required cooperation instead of competition. Anecdotal evidence for the effects of competition will be presented in Chapter 4.

The four youngest pairs of children ranging in age from 3.8 to 4.1 years old seem to form a distinct group in Figure 4. The very youngest children are approaching a chance level in performance, possibly suggesting a lower age limit for this game.

Summary of between-Ss analysis. Of the between-Ss factors included in this study, only age showed a strong relationship to performance. Verbal ability, except as it is correlated with age, shows only a small and nonsignificant relationship to performance. There was a marginally significant tendency for girls to perform better than boys. There was no difference in the performance of the children from the two different

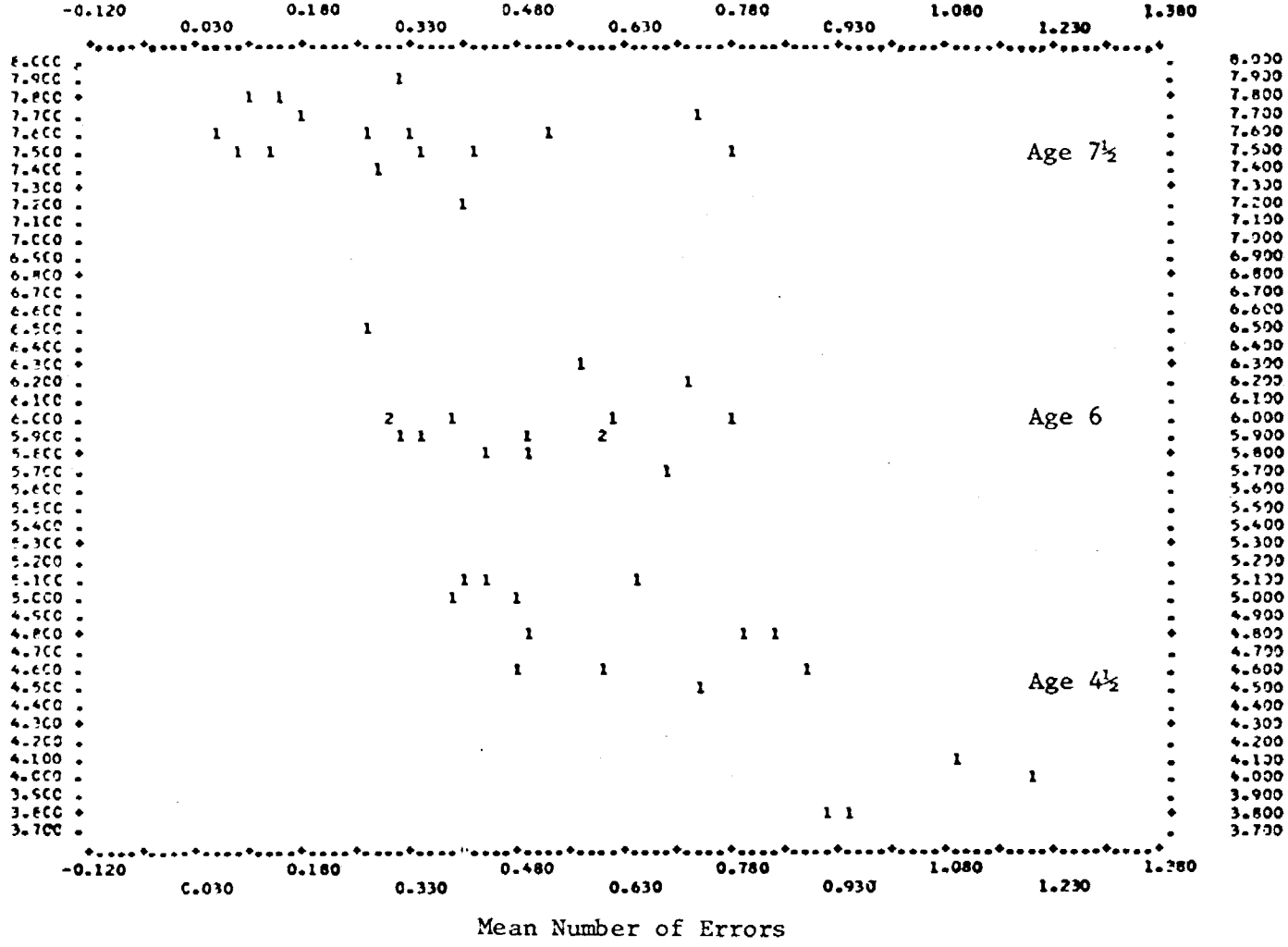


Fig. 4. Mean number of errors by mean age of pair in years and tenths.

communities used in this study, despite a significant difference in IQ. Birth order showed no relationship to performance.

Within-Subjects Factors

General. The effects of within-Ss factors which applied to all referent types will be discussed first. These results are presented in Table 10. Next the effects of descriptive salience and redundancy will be discussed in terms of the two systematic types of referents (monkey referents and people referents) to which these factors applied.

Type of referent. The largest source of variance in performance was associated with referent type. The three orthogonal contrasts shown in Table 10 for types of referents reveal that most of the variance was associated with the difference between the namable referents and the other three types. Even the youngest children were able to communicate almost perfectly about the namable referents. Indeed, the scattering of errors on namable referents across all three age levels is approximately the same, providing some estimate of the magnitude of errors due to carelessness or other random sources.

The abstract referents were significantly more difficult than the systematic referents (monkeys and people) but the two types of systematic referents were not significantly different from each other. The mean number of errors by type of referent by age are presented in Table 12.

Target position. Errors were significantly related to target position and this relationship showed a significant interaction with age. The significant linear component (of the main effect of target position reported in Table 10) reflects the tendency for errors to increase from left to right. The significant quadratic component reflects the tendency

for more errors at the leftmost and rightmost positions. These effects are seen in Figure 5.

TABLE 12

Mean Errors by Referent Type and Age Group

Referent Type	Age Group 4½ $\bar{X}$	6 $\bar{X}$	7½ $\bar{X}$
Namable	0.109	0.035	0.063
(S.D.)	(0.447)	(0.271)	(0.273)
People	0.910	0.465	0.289
(S.D.)	(1.083)	(0.776)	(0.562)
Monkeys	0.789	0.602	0.352
(S.D.)	(1.011)	(0.884)	(0.646)
Abstract	1.035	0.871	0.664
(S.D.)	(1.146)	(1.103)	(0.908)

Table 10 shows the significant interaction of age with the quadratic component of target position and a nonsignificant tendency for an interaction with the linear component. Figure 6 reveals the interesting nature of this pattern. The quadratic function is almost completely associated with the youngest age group, suggesting a tendency in the 4½-year-old children to choose the second position most frequently. The tendency of the 6-year-olds to choose a given target position shows an almost perfectly linear decrease from left to right, while the 7½-year-olds chose the four target positions with essentially equal frequency.

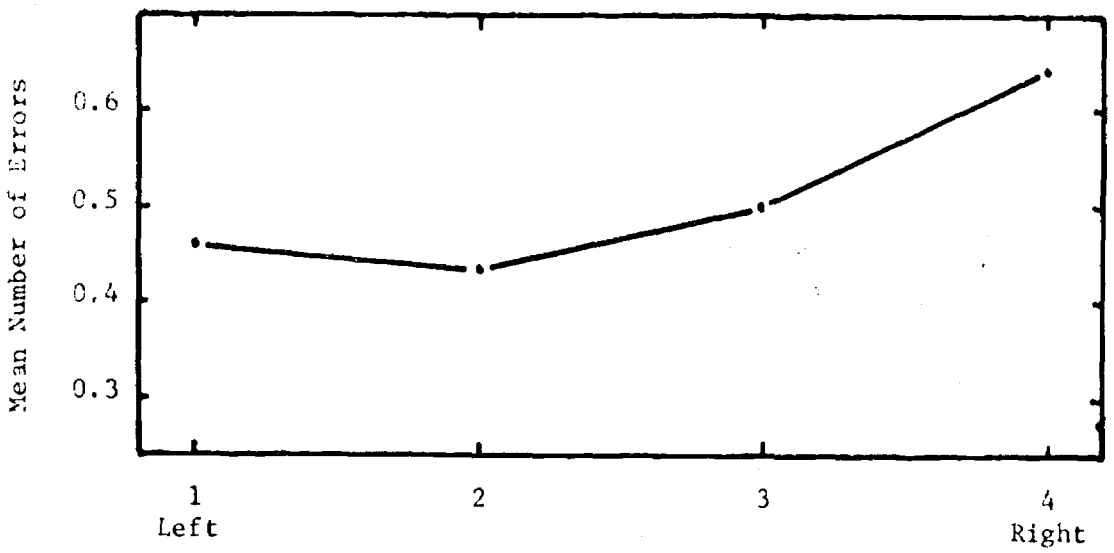


Fig. 5. Mean number of errors by target position from left to right.

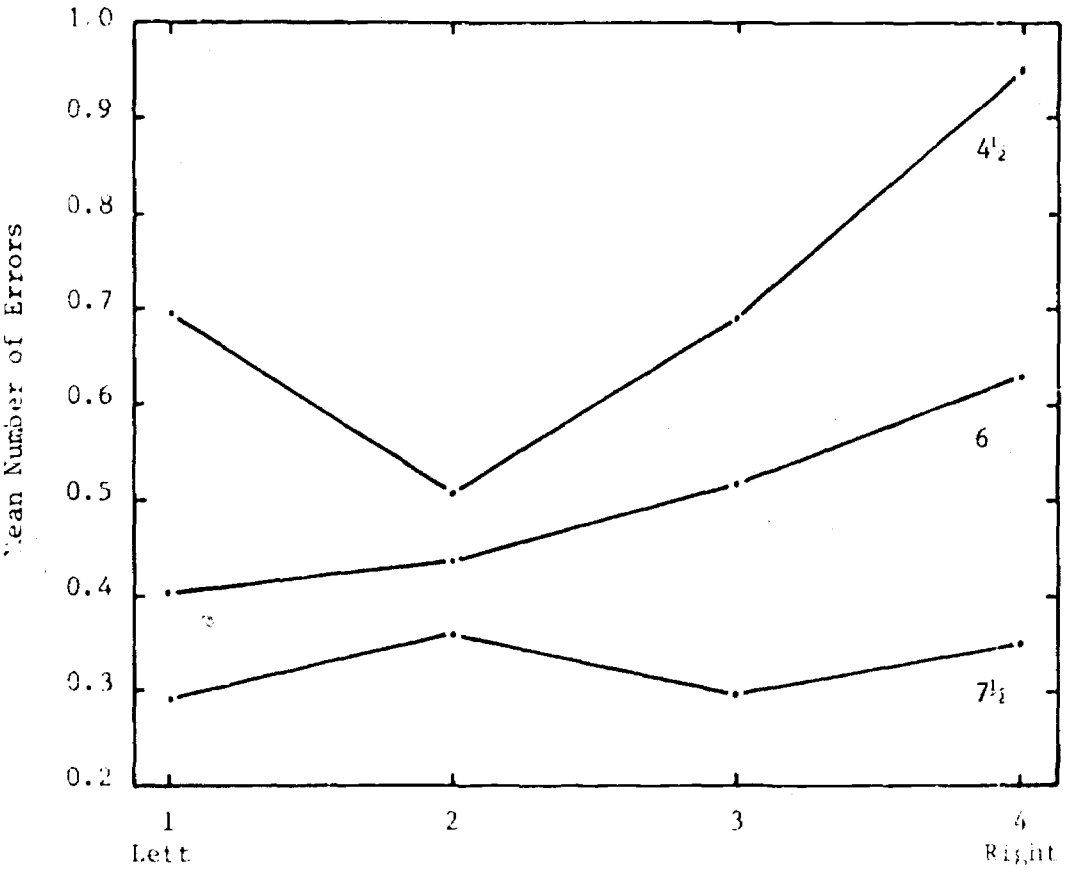


Fig. 6. Errors by target position at three age levels

Trials. The performance across the four trials is presented in Figure 7. There is a slight general tendency for number of errors to decrease across trials with a slight rise on the final trial which might reflect fatigue or boredom. Table 13 provides the mean number of errors by type of referent across trials.

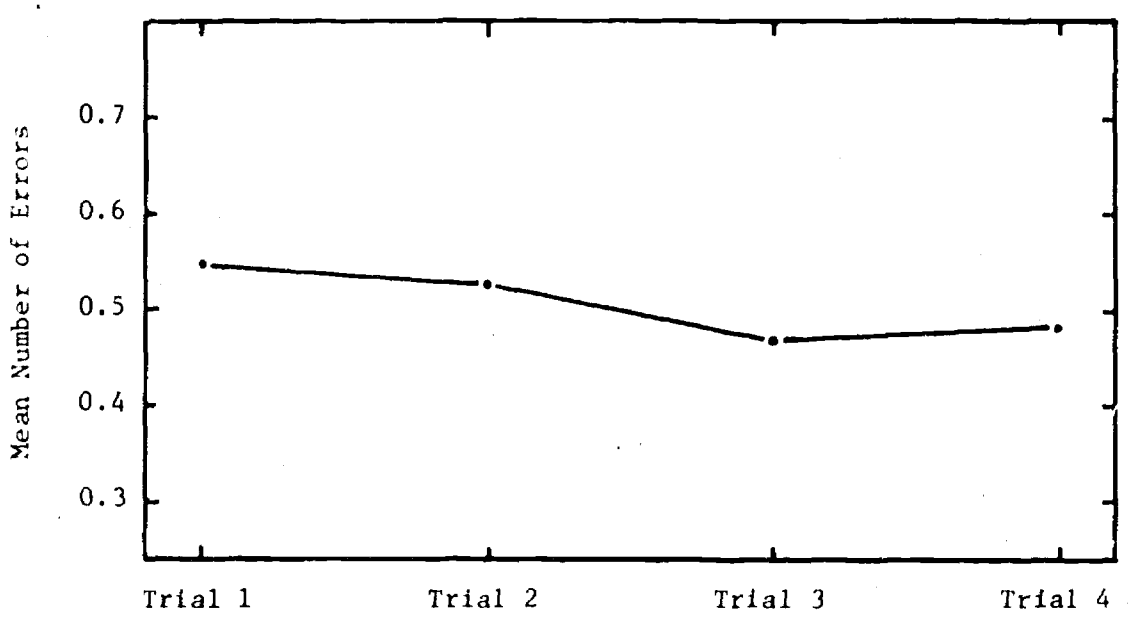


Fig. 7. Mean number of errors across trials of sixteen items.

TABLE 13

Mean Errors by Type of Referent by Trials

	Trials			
	1	2	3	4
Namable	0.057	0.031	0.057	0.130
(S.D.)	(0.293)	(0.202)	(0.327)	(0.479)
People	0.724	0.542	0.500	0.453
(S.D.)	(0.899)	(0.873)	(0.850)	(0.855)
Monkeys	0.682	0.526	0.500	0.615
(S.D.)	(0.920)	(0.843)	(0.773)	(0.959)
Abstract	0.729	1.010	0.823	0.766
(S.D.)	(1.038)	(1.121)	(1.049)	(1.065)

The change in performance between the first half and the second half of the task provides the best estimate of improvement in performance with practice. Each child performs as speaker and listener in each half which serves to average out differences in performances in these two roles. The training between the first half and the second half was intended to improve performance. Table 10 shows a nonsignificant tendency to improve between the first and second half of the task.

Trials for each type of referent. Given the large influence of referent type, separate analyses by type of referent seem appropriate. The namable referents were not analysed separately because of the essentially perfect performance of all children on them. Included in Table 10 are the results of separate analyses for the people, monkey, and abstract referents. There was a significant improvement in performance on the people referents but not on the monkey or abstract referents.

The change in mean number of errors by type of referent is shown in Figure 8. In addition to the significant improvement on the people referents, there was a substantial change in mean performance on the abstract referents which did not reach statistical significance. This change amounts to a 20% decrease in mean number of errors between the first and second half of the task. That this change is not statistically significant is another example of the large unexplained variance associated with individual differences. It is worth noting that the largest mean square for error occurred with the abstract figures, suggesting especially large individual differences in performance with them.

Trials by age. Children of all ages showed approximately the same change in performance between the first and second half of the task. Figure 9 shows the mean number of errors on the first half and second

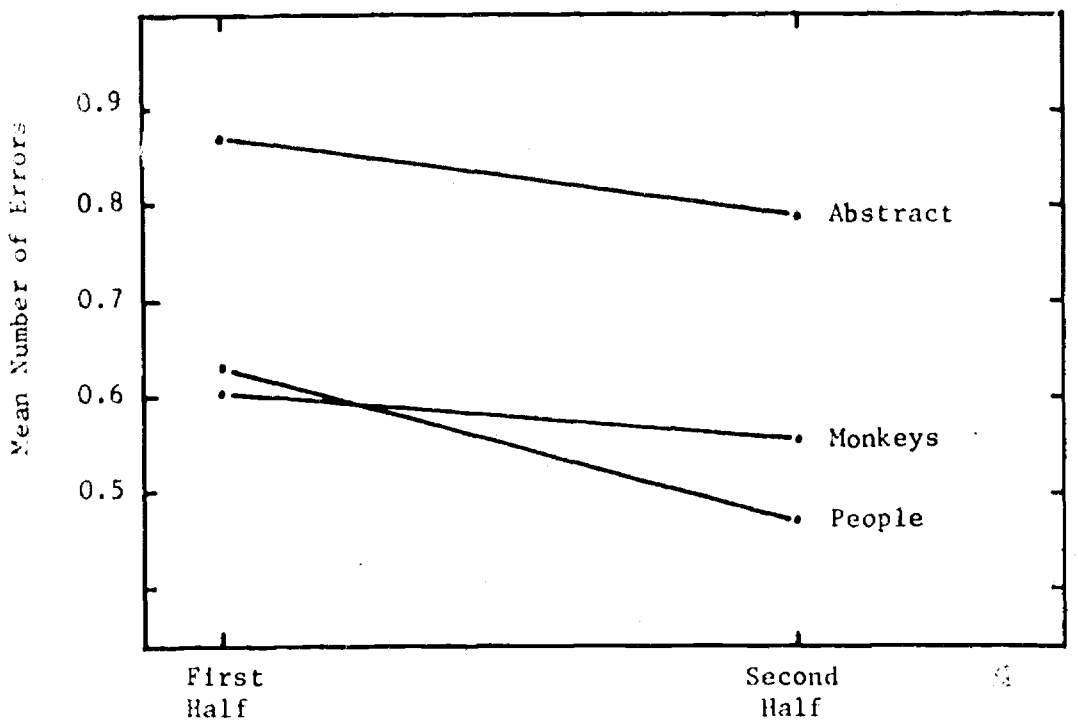


Fig. 8. Performance on first half versus second half by type of referent.

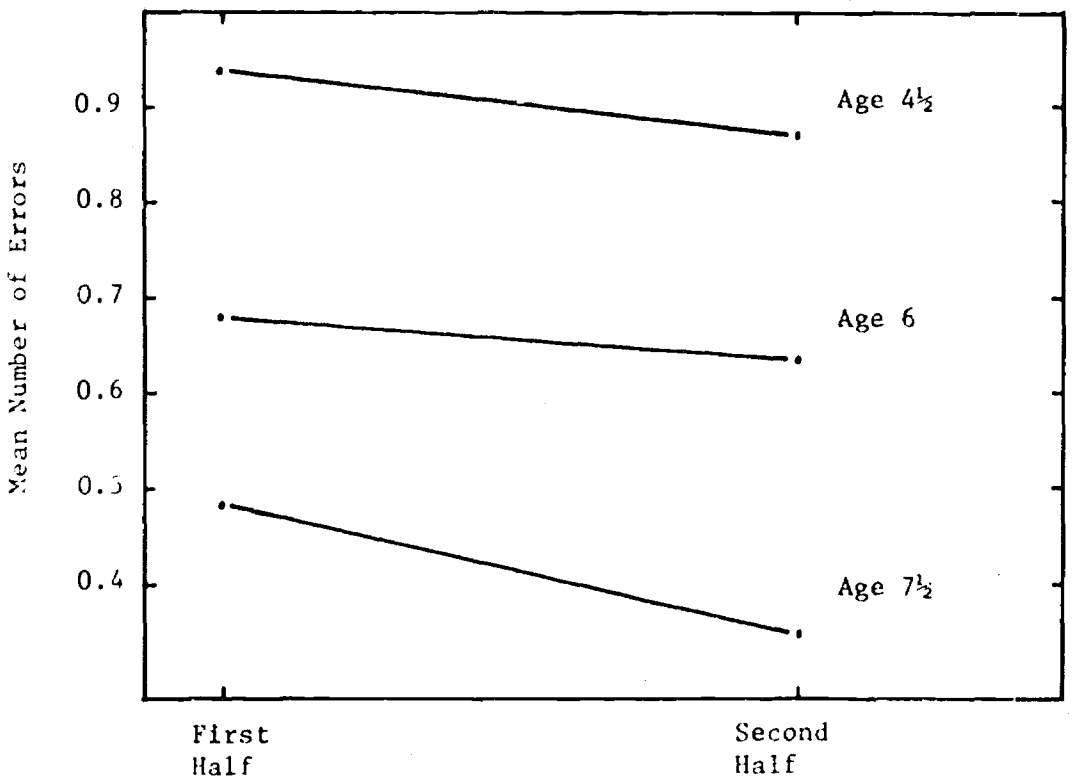


Fig. 9. Performance on first half versus second half by age.

half by age group. Although one might have expected a smaller improvement in the older group due to a ceiling effect, in fact the oldest age group showed the largest absolute improvement in performance.

Context. Table 10 shows no effect of context across all items. Although the main effect of context was not significant, analyses revealed an significant interaction of context with type of referent. The results of separate analyses by type of referent are included in Table 10.

Context by type of referent. The separate analyses of the effect of context by type of referent revealed that context exerted a large significant effect for the people referents and a marginally significant effect for the abstract referents. The interesting pattern of these results is shown in Figure 10. Note that the presence of context resulted

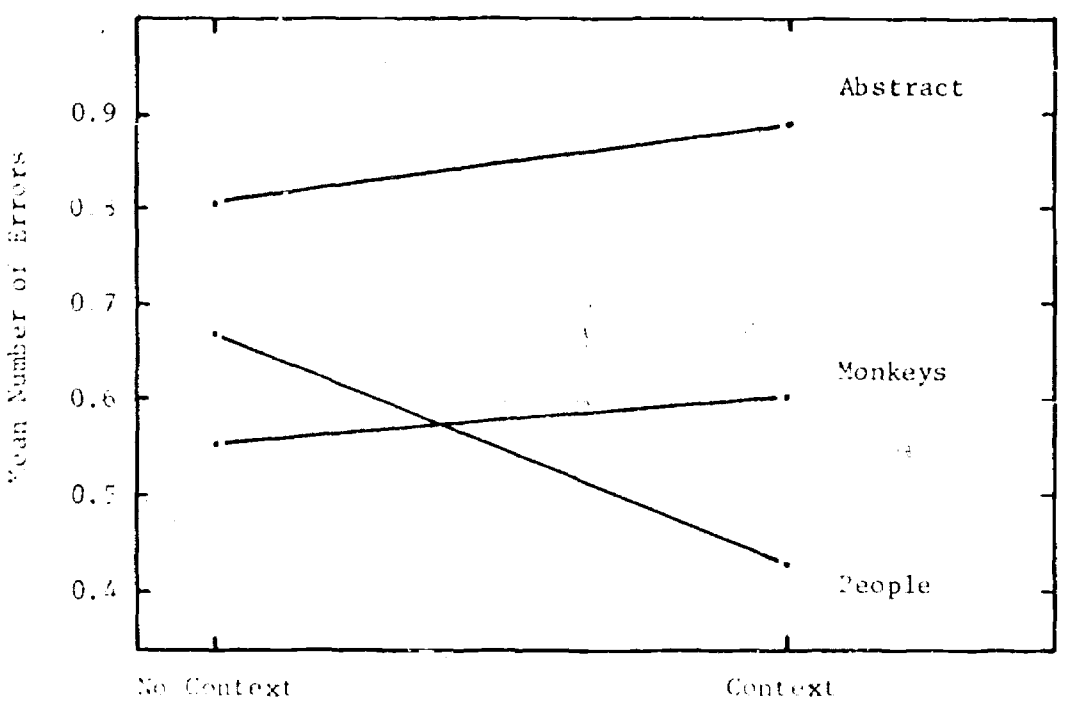


Fig. 10. Effects of context by type of referent.

in a substantially better performance on the people referents amounting to a 35% reduction in the mean number of errors. Quite surprisingly, the marginally significant effect of context on the abstract referents was in the opposite direction. The children actually made more errors on the abstract figures when the context was provided to the sender. This amounted to a 13% increase in the mean number of errors. There was no effect of context on performance with the monkey referents.

Context by trials. A significant interaction between context and halves is reported in Table 10. Figure 11 reveals the nature of this interaction. When context is absent, more errors are made in the first half than in the second half, whereas when the context is present, the number of errors is the same in the first and second halves. This interaction is quite easily interpreted as reflecting the importance of context when communication about a new set of referents is being established. After the nature of the referents is learned, however, it is reasonable that the importance of the context would decrease.

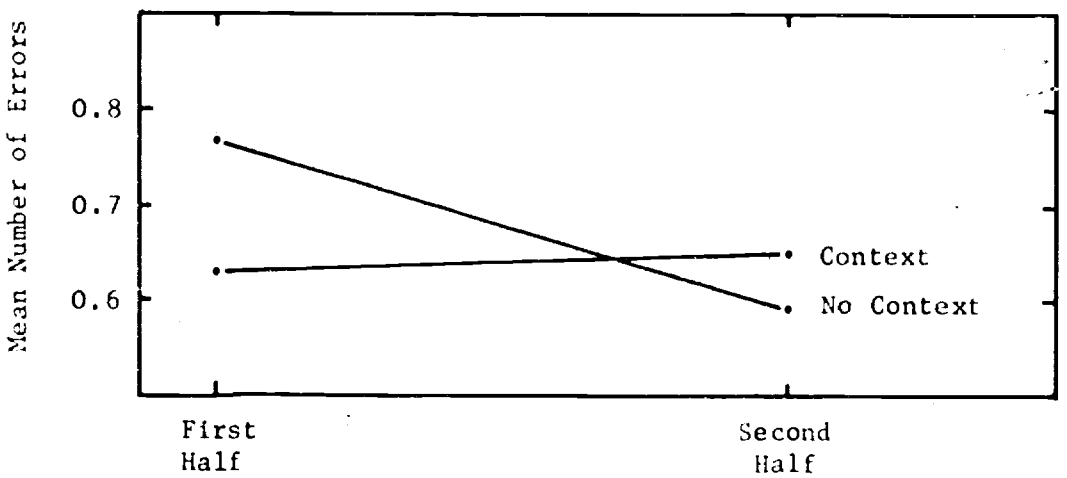


Fig. 11. Effects of context on first half versus second half performance.

Type of referent by age. The mean number of errors by age group for the people, monkey, and abstract referents are shown in Figure 12. The relative difficulty of the different types of referents among the three age groups is consistent with the exception of the greater number of errors by the youngest age group on the people referents. The anomalous error rate for the people referents by the youngest age group seems to have resulted from a greater difficulty in discriminating and communicating the attribute sex (or hair length).

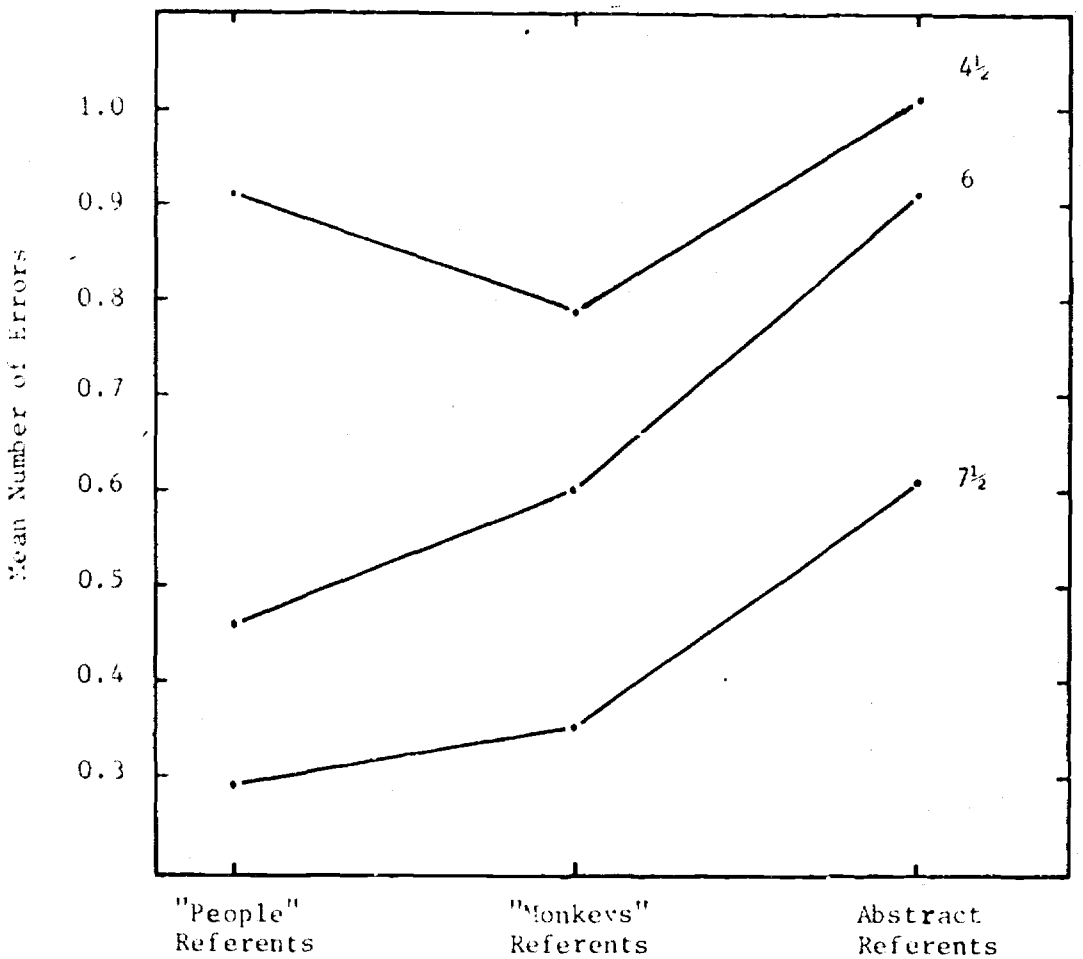


Fig. 12. Errors by type of referent by age.

Summary of major results of the within-Ss analysis. Before moving into more detailed analyses it may be useful to summarize briefly the major results of the analysis of the within-Ss portion of the design.

The type of referent was the largest single source of variance in errors with the namable referents being the easiest and the abstract referents the most difficult. The systematic referents were intermediate in difficulty. Target position also influenced errors, with the number of errors increasing from left to right. This effect of target position varied with age. Although there was a tendency for errors to decrease from the first half to the second half, this tendency reached significance only for the people referents. The effects of the context condition varied according to type of referent. The presence of context resulted in improved performance with the people referents but not with the other referents. Finally, a context by half interaction revealed that the presence of context was most helpful in the first half of the task.

Overall, the results form a comprehensible, albeit complex, pattern, suggesting the sensitivity of the error rate on this communication task to a variety of influences.

Redundancy and Descriptive Salience

Hypotheses. As was discussed in Chapter Two, the systematic referent types (people and monkeys) were presented in sets which varied according to redundancy and descriptive salience. Three predictions were made regarding the effects of these conditions. High redundancy in the display was predicted to result in fewer errors compared with low redundancy. High descriptive salience was expected to result in fewer errors compared with low descriptive salience. And redundancy and descriptive salience were expected to interact such that the high

redundancy - high descriptive salience condition was expected to lead to an unusually small number of errors, while the low - low condition was expected to result in an unusually large number of errors.

The results of the analysis of the effects of redundancy and descriptive salience are presented in Table 14.

TABLE 14

Source Table for Analysis of Systematic Referents

	df	MS_{source}	df	MS_{error}	F
Redundancy (R)	1	6.253	45	0.763	8.20**
People only	1	0.630	45	0.476	1.32 ns
Monkeys only	1	7.521	45	0.905	8.31**
Salience (S)	1	0.586	45	0.507	1.16 ns
People only	1	0.750	45	0.527	1.34 ns
Monkeys only	1	3.797	45	0.620	6.12*
R x S	1	3.010	45	0.403	4.18*
People only	1	0.521	45	0.815	< 1
Monkeys only	1	3.000	45	0.391	7.67**

*p < .05
**p < .01

Redundancy. High redundancy in the referent display resulted in significantly fewer errors, as had been predicted. As shown in Table 14, the analysis of redundancy for the people and monkey referents taken separately revealed that this effect was most strongly associated with the monkey referents. These results are presented in Figure 13.

Descriptive salience. As shown in Table 14, the effect of descriptive salience in the referent display was not significant for the two types of referents taken together, but the analysis for the people and

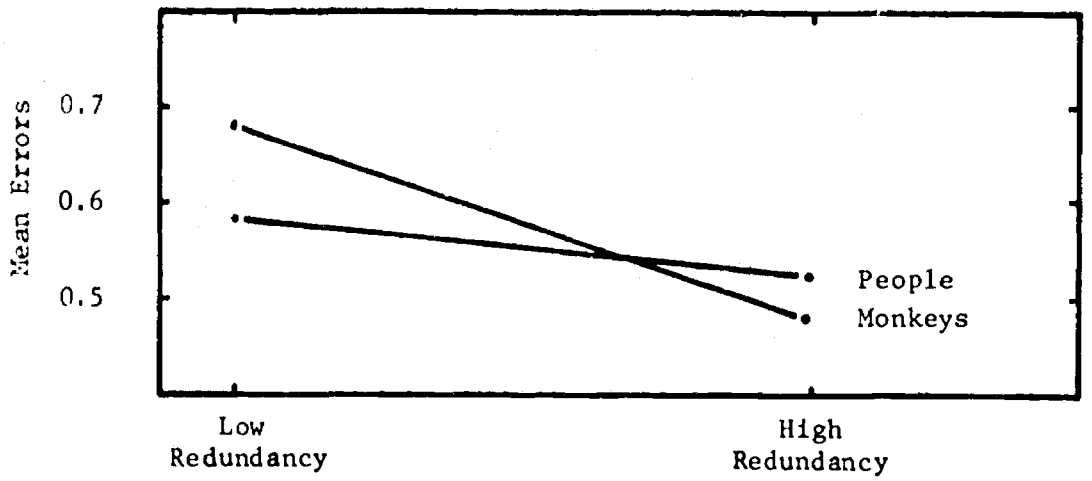


Fig. 13. Effects of redundancy by type of referent.

monkey referents taken separately revealed that descriptive salience did significantly affect errors on the monkey referents.

As can be seen in Figure 14, high descriptive salience did result in fewer errors for the monkey referents as predicted. Descriptive salience did not significantly affect the error rate for the people referents, and, in fact, the trend runs counter to the prediction. As mentioned in Chapter Two, the attributes of the people referents differed less than the attributes of the monkey referents in terms of descriptive salience. The larger effect of descriptive salience for the monkey referents might, therefore, have been expected.

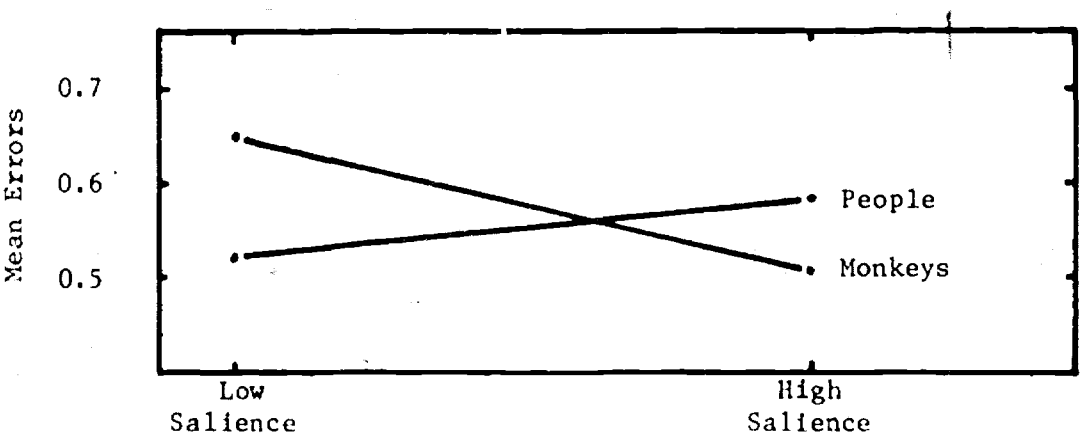


Fig. 14. Effects of descriptive salience by type of referent.

Redundancy by descriptive salience interaction. The significant redundancy by descriptive salience interaction in Table 14 supported the prediction. The interaction is presented in Figure 15.

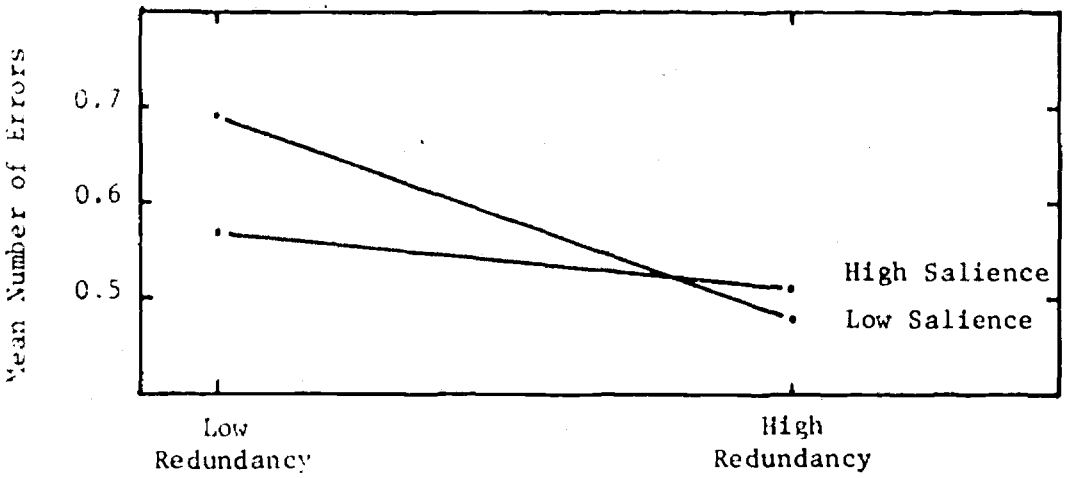


Fig. 15. Effects of redundancy by high and low salience.

Given the failure of the descriptive salience condition to affect errors on the people referents, one might expect that the redundancy by descriptive salience interaction would be most strongly associated with the monkey referents. As can be seen in Table 14, this is, in fact, the case. The interaction for the monkey referents alone is presented in Figure 16.

Summary of the effects of redundancy and descriptive salience. In general, redundancy and descriptive salience influenced the error rate in accordance with predictions. The fact that the effects of these conditions were more consistent for the monkey referents can be interpreted as resulting from the fact that the four attributes of the monkey referents were more strongly differentiated on descriptive salience. The pattern of results suggests that systematic variation in difficulty can be introduced when selecting sets of referents from a larger pool of referents.

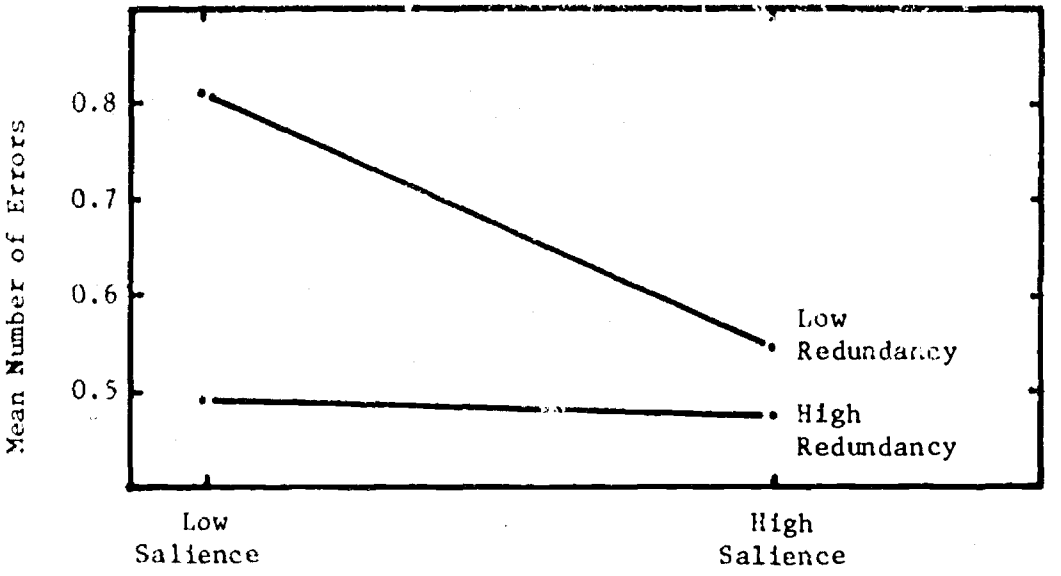


Fig. 16. Effects of salience and redundancy for monkey referents.

Effects of Training

Type of training and hypotheses. As described in Chapter Two, a short training session was held between the first and second halves of the game. This training was directed at three behaviors. The children were taught to look at all four pictures (when there were four), to say "at least two things about the picture" when in the knower role, and to ask questions when not sure in the doer role.

It had been predicted that these behaviors would result in fewer errors in the second half of the game. The effects of this training on performance cannot, in general, be distinguished from the results of practice. Nevertheless, one would predict that the effects of target position would decrease as a result of training to look at all four pictures. The number of adequate messages and the number of questions would be predicted to increase in the second half as a result of training.

Results of training. No clear evidence was found for the effectiveness of the training. The slight improvement in performance between the

first and second half might be attributed in part to the training. The number of adequate messages were coded for the people referents and did tend to increase in the second half. The effects of target position did tend to decrease in the second half, but the half by target position interaction did not reach significance. Finally, the number of questions was actually less in the second half of the game. Upon reflection this might have been expected. The need for questions is greater in the first half of the game when conventions are being established and messages are less adequate.

The brief didactic training conducted in this study must be regarded as a rather limited attempt at training. Furthermore the experimental design permitted only a limited assessment of the effects of training. Suggestions for alternative training procedures will be discussed in Chapter Five.

This completes the presentation of results based upon the total number of errors as the dependent measure. We will now turn our attention to the actual language used by the children during the game.

Transcript Analysis

Successful communication performance must be mediated through overt behavior. The foregoing analyses have dealt with the relationship between performance and the characteristics of the children and the game. The question remains as to how verbal behavior itself differed according to the characteristics of the children and the game. For this we must turn to the transcripts of the children's language.

Tape recordings of the children's communication were made with a Sony stereophonic tape recorder. The microphone was placed between the two children so that the stereophonic recording made it possible to eliminate any ambiguity as who was speaking. Typewritten transcripts were prepared which included all spoken words by the children and the experimenter. The game device made characteristic sounds which enabled the typist to indicate when a button was pushed or a new referent was presented. These transcripts were then checked for accuracy by a second person. The intelligibility of the tapes was quite good and few corrections resulted from this second review.

The analyses to be discussed in this section are based upon coding the typewritten transcripts. The content of the descriptions of the people referents will be discussed first. Then the descriptions of the abstract referents will be analyzed. Finally, the questioning behavior of the children will be described.

Content of descriptions of people referents. Language does not lend itself to simple analysis. Words have connotations and denotations which do not fit neatly as bits of information into the categories used in constructing the systematic referent sets used in this study. For example, "man" denotes male and connotes "big." But "big" connotes both "tall" or "fat" in some situations. The analysis is further complicated

by the ability of pairs of speakers to arrive at conventions of usage which gave connotations a specific meaning. In fact even denotations may be reversed, as in the case where children may speak of the "woman with short hair."

An attempt was made to analyze the children's language about the systematic referents according to the four binary attributes according to which the referent sets were constructed. Reliability in coding could only be achieved by establishing conventions for all commonly used words for each referent display taken individually. For example, if tall and male are the relevant attributes of a target referent, then by convention both "tall" and "male" were considered to have been encoded if the child said "man." For this same target, where "short" would be incorrect, only "male" was considered to have been encoded if the child said "boy." The specific conventions used for each item are shown on the coding form in Appendix E. These conventions, while somewhat arbitrary, seem to have a certain face validity from the perspective of an adult speaker of English. In addition, these conventions made coding rather simple and intercoder reliability quite high. One can quite easily make the judgement of whether or not the pair has spoken any set of words such as "man," "boy," "father," etc. The principal weakness of this coding system is that it does not take into account the adoption of "conventions" by a given pair of children. Fortunately, with the people referents the adoption of unique conventions seemed to be rare.

Upon completion of the coding of the occurrences of each attribute for each item, the adequacy of each encoding was then coded according to the number of bits of essential information communicated. In that two bits of information are required for successful discrimination of one

of a set of four referents, the adequacy score for each item for each pair was 0, 1, or 2.

The descriptions were also coded for the number of incorrect encodings ("red" for "white"), trivial details ("with arms and legs"), ambiguous word usage ("person" for "doll"), and redundancy. Redundancy scores could be 0, 1, or 2, according to the number of redundant bits of information encoded. A complete discussion of the coding conventions for these categories is also included in Appendix E.

The content analyses yielded rich and complex data. These results can best be grasped visually since the encodings of various attributes generally fell into consistent and meaningful patterns. The reader is cautioned that statistical tests of significance have not been applied to the data presented in the figures which follow. The figures are presented in order to give the reader a "feel" for the patterns in the children's spoken language.

The results are graphed in terms of the "proportion of occurrence," that is, the frequency of occurrence for a given behavior divided by the total number of possible instances of that behavior. The 48 pairs of children each described 16 people referents, yielding a total of 768 targets described. Therefore, the number of possible instances of a behavior in a figure where the data are broken down by age group, for example, will be 256.

There were 192 instances of irrelevant, 192 instances of relevant (but not redundant), and 384 instances of relevant-redundant attributes for each of the 4 binary attribute dimensions. The frequencies in some figures represent the total for the dimension (e.g., color), while in other figures the frequencies for the values (e.g., red and white) will

be shown separately. In most cases the general trends are consistent and meaningful so that the reader will usually find the visual impression sufficient to understand the pattern.

Adequacy of encoding the people referents. The analysis based upon the mean number of errors indicated that performance on the people referents improved with age, with practice, and with the presence of context. Examination of the children's language regarding the people referents clearly reveals that these influences upon performance were mediated through more adequate encodings of the essential information.

Changes in the adequacy of encoding are shown in Figure 17. The number of fully adequate descriptions increased with age, while the number of descriptions which were partially or completely inadequate decreased.

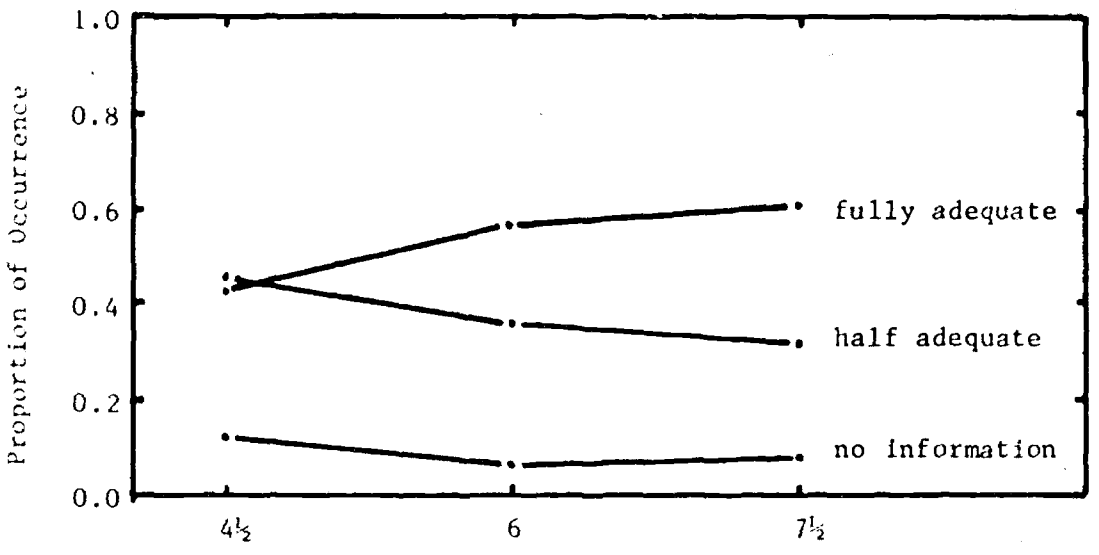


Fig. 17. Total frequency of adequate descriptions of people referents by age and adequacy (fully adequate = 2 bits).

The effects of context upon the adequacy of encoding the people referents are shown in Figure 18. The presence of context results in more adequate encodings at all age levels. Of particular interest is the evidence that even 4-year-old children were able to make use of the presence of context in formulating adeuqate descriptions of the people referents.

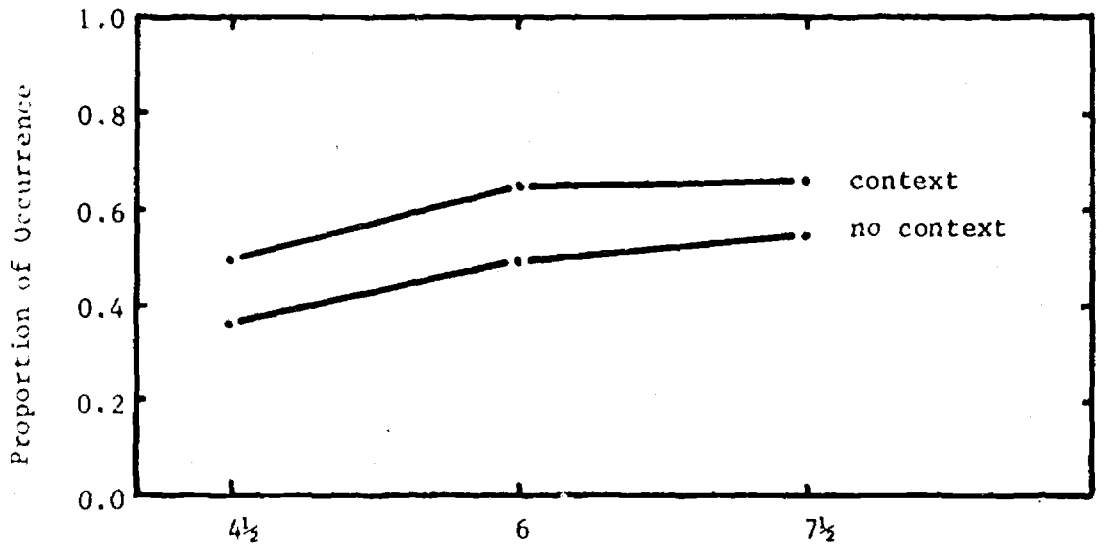


Fig. 18. Frequency of fully adequate encodings of people referents by age and context condition.

Redundancy in encoding the people referents. Redundancy in the children's descriptions was expected to increase with age and to result in improved performance. As can be seen in Figure 19, very few descriptions included redundant information. This lack of redundancy is all the more surprising in light of the coding conventions which, for example, coded "big" as meaning both "fat" and "tall" when these attributes were relevant.

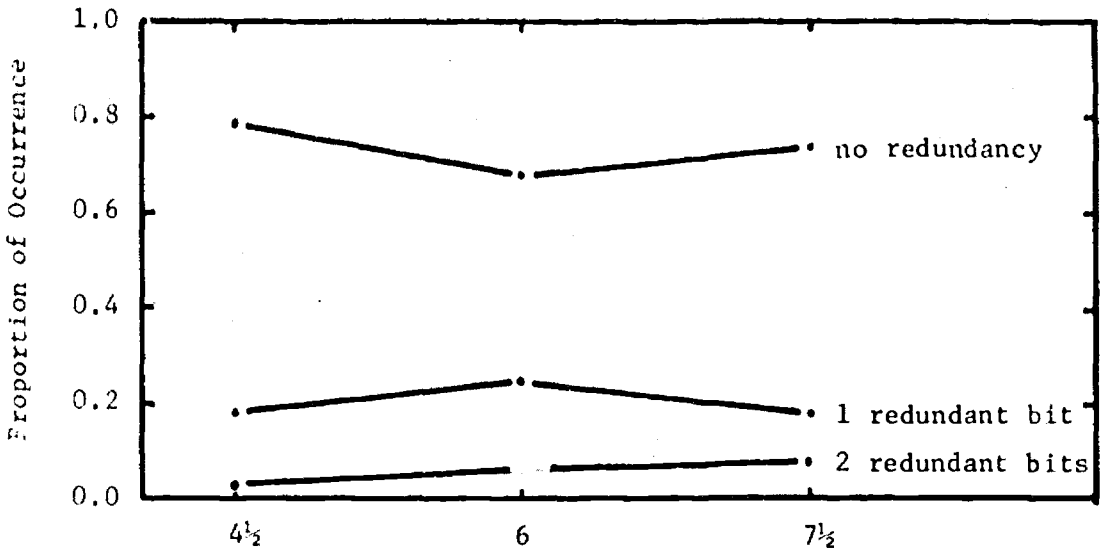


Fig. 19. Total frequency of redundant descriptions of people referents by age and redundancy.

Encoding incorrect descriptions, trivial details, and irrelevant attributes. As children grow older, their language would be expected to become more like adult language. Thus, older children might be expected to encode fewer incorrect descriptions, trivial details, and irrelevant attributes than younger children. As can be seen in Figure 20, incorrect descriptions occured on 24% of the items for the 4½-year-olds, decreasing to about 6% for the 6- and 7½-year-olds. Encoding of trivial details decreased only in the 7½-year-old group, going from 18% to 7%. The number of irrelevant attributes encoded did not show the expected decrease with age. In fact, the number of irrelevant attributes encoded was larger in the 6-year-old group.

Relative frequency of encoding of attributes of people referents. The ordering of the four attribute dimensions of the people referents by frequency of encoding across all conditions can be seen in Figure 21. The attribute dimension sex had the highest probability of being encoded, followed by height, girth, and color. The orderings of these dimensions

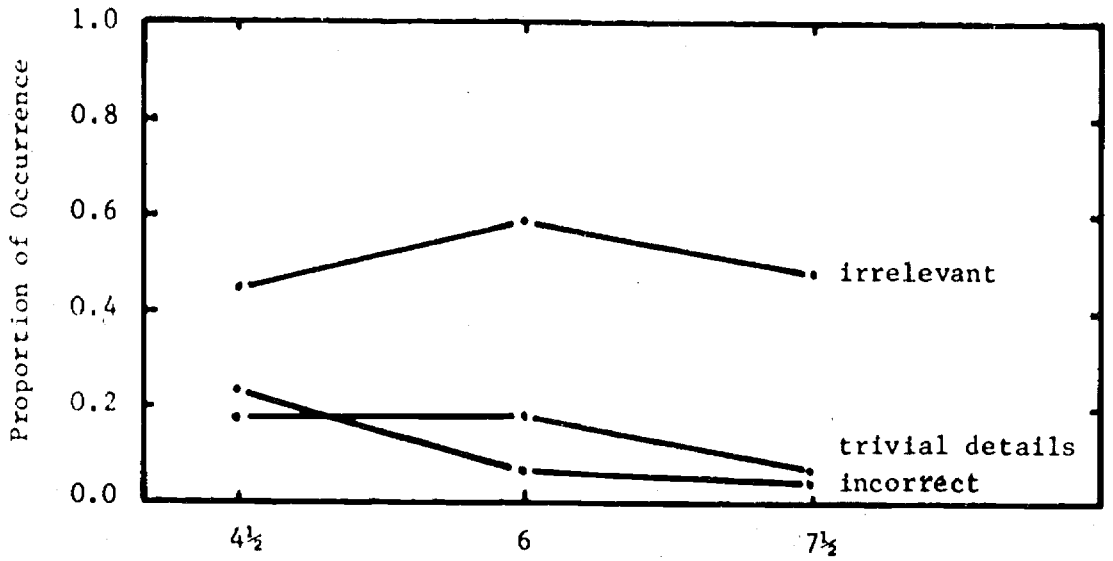


Fig. 20. Total frequency of encoding irrelevant attributes, trivial details, and incorrect attributes for people referents by age.

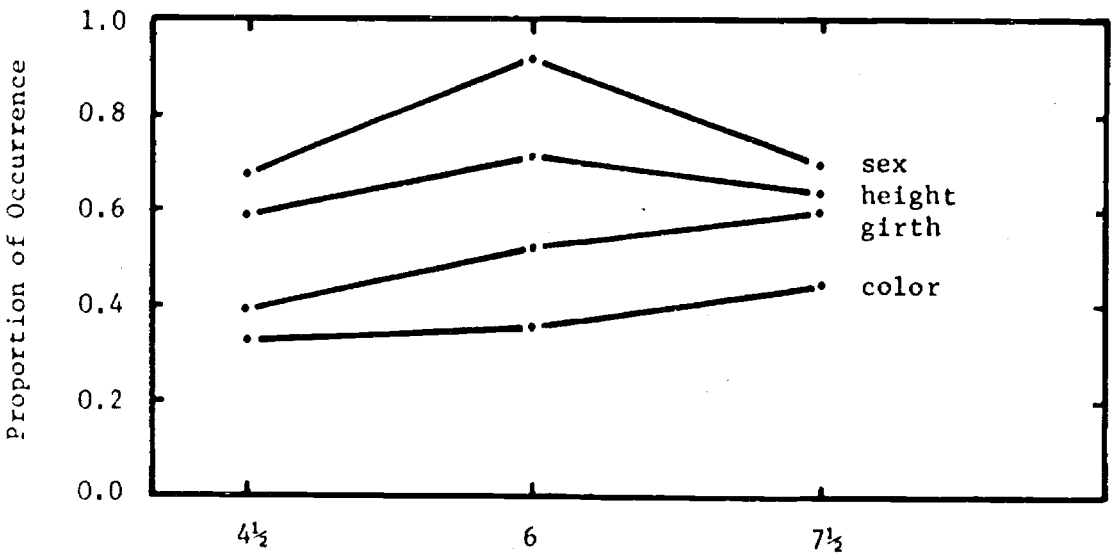


Fig. 21. Total frequency of encoding of attribute dimensions for people referents across all items by age and attribute.

when they were irrelevant, relevant-nonredundant, and relevant-redundant, are presented in Figures 22 - 24.

Figures 21 - 24, taken together, reveal three interesting results. First, the relative ordering of the four attribute dimensions is the same across all three age levels. Second, the absolute differences among the frequencies differ with age, being largest in the 6-year-old group. Finally, the general trends in the figures are similar for all three relevance-redundancy conditions.

The consistency of the relative orderings across the three age groups supports the rationale underlying the concept of "descriptive salience" discussed in Chapter One, but the actual ordering manifested does not correspond to the ordering determined by the procedures described in Chapter Two for ordering the attribute dimensions according to "descriptive salience" yielded the following relative ordering (from high to low frequency): height, color, sex, girth. Thus the attribute

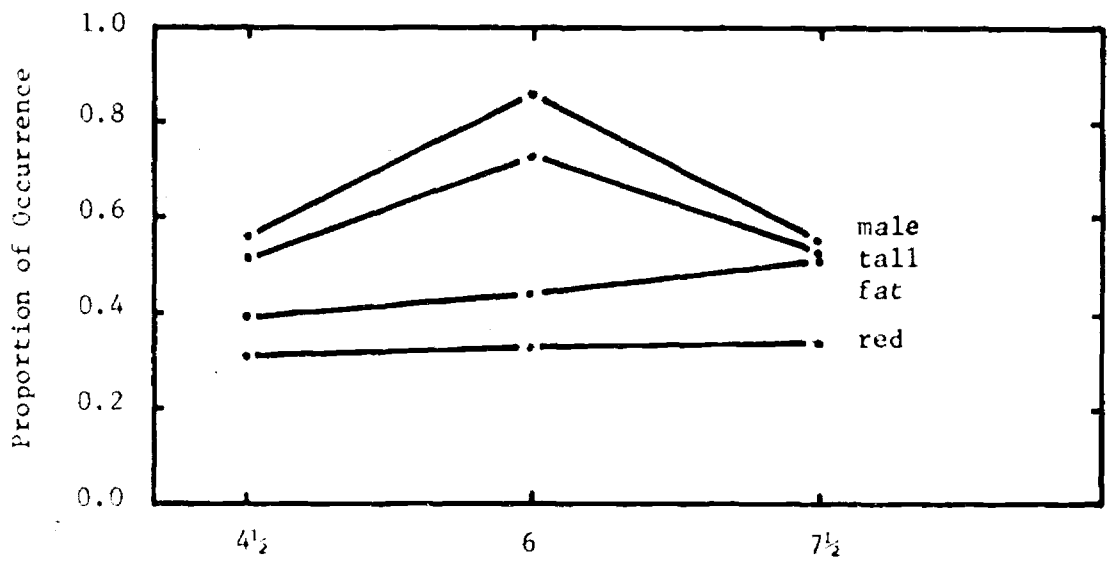


Fig. 22. Total frequency of encoding of irrelevant attribute values for people referents by age.

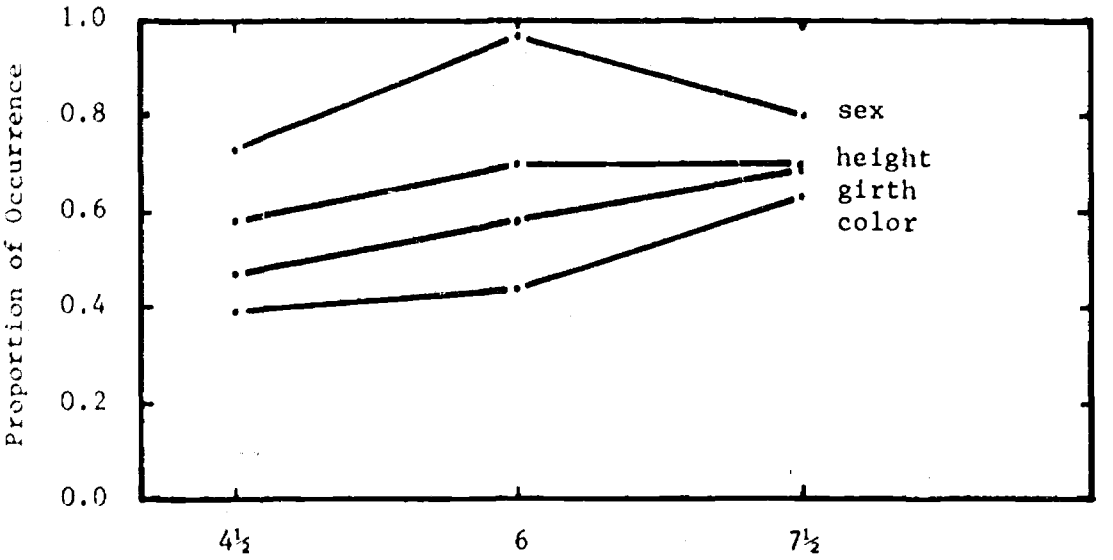


Fig. 23. Total frequency of encoding of relevant-nonredundant attribute dimensions for people referents by age and attribute.

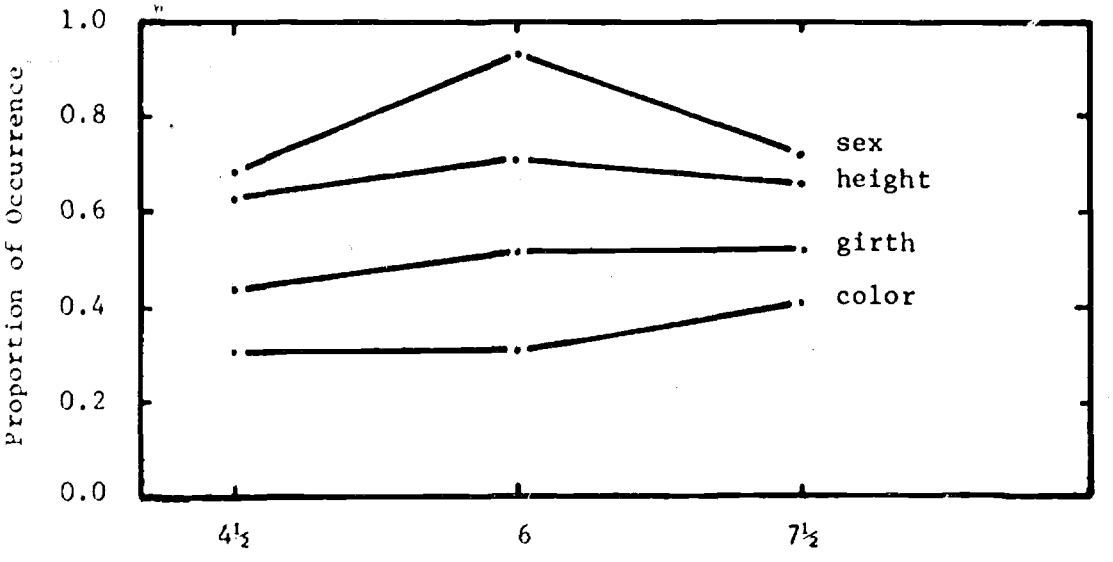


Fig. 24. Total frequency of encoding of relevant-redundant attribute dimensions for people referents by age and attribute.

sex, which was classified as low in descriptive salience when selecting the referent sets used in this study, turned out to be the most frequently encoded attribute. This discrepancy may account for the failure of descriptive salience to significantly affect the error rate on the people referents, in contrast to the monkey referents. This possibility will be discussed in more detail in the final chapter.

Relevant-nonredundant and relevant-redundant conditions. Figures 23 and 24 permit easy comparison of the frequency of encoding of the attribute dimensions under the relevant-nonredundant and relevant-redundant conditions. The notable aspect of this comparison is the similarity of the two figures. Perfectly adequate encodings of the relevant-nonredundant items would result in a proportion of occurrence of 1.0 for each attribute in Figure 23, whereas adequate (but nonredundant) encodings of the relevant-redundant items would result in a mean proportion of occurrence of 0.5 for the attributes in Figure 24. In other words, if perfectly adequate encodings without redundancy had been given, the attributes in Figure 23 all would have been at the top of the graph while the mean of the attributes in Figure 24 would have been in the middle of the graph. In fact, the two figures are almost identical. The grand means for the data in Figure 23 and 24, respectively, are 0.64 and 0.57. Overall, these data suggest that the children did not differentiate their encodings according to whether the attributes were essential or potentially only redundant.

Attribute dimensions and attribute values. Every binary attribute dimension has two "values." For example, sex may be either male or female. In the preceeding discussion, the orderings of the attributes according to the frequency with which they were encoded, was based upon

the sum of the frequencies of two values of each attribute, but one may wonder whether the two values of each attribute dimension occur with similar frequencies. This question is of particular interest with respect to the concept of descriptive salience. If the two values of an attribute dimension do not occur with similar frequencies, then descriptive salience should be defined in terms of individual values rather than in terms of dimensions.

Figures 25 and 26 show the proportions of occurrence for the attribute values by half for the two redundancy conditions, and Figures 27 and 28 show these proportions of occurrence by context condition. In general, the two values of an attribute dimension occur with similar frequencies, with the notable exception of the value "short" occurring more frequently than the value "tall." This exception may be the result of the coding system which accepted "little" as equivalent to "short." Many children seemed to use "little" as a diminutive (as in "the little person") without consciously attempting to communicate the attribute "short."

The general similarity of the two attribute values in frequency of encoding suggest that descriptive salience tends to be associated with attribute dimensions, although a finer gradation of descriptive salience could be made on the basis of attribute values taken individually.

Another question is whether children learned to communicate some values more easily than others. Inspection of Figures 25 and 26 shows a general tendency for most attributes to be encoded more frequently during the second half compared with the first half. Obviously, attributes such as "short" and "female" which were already occurring in a large proportion of instances in the first half could not show as large increases as those attributes which initially occurred infrequently.

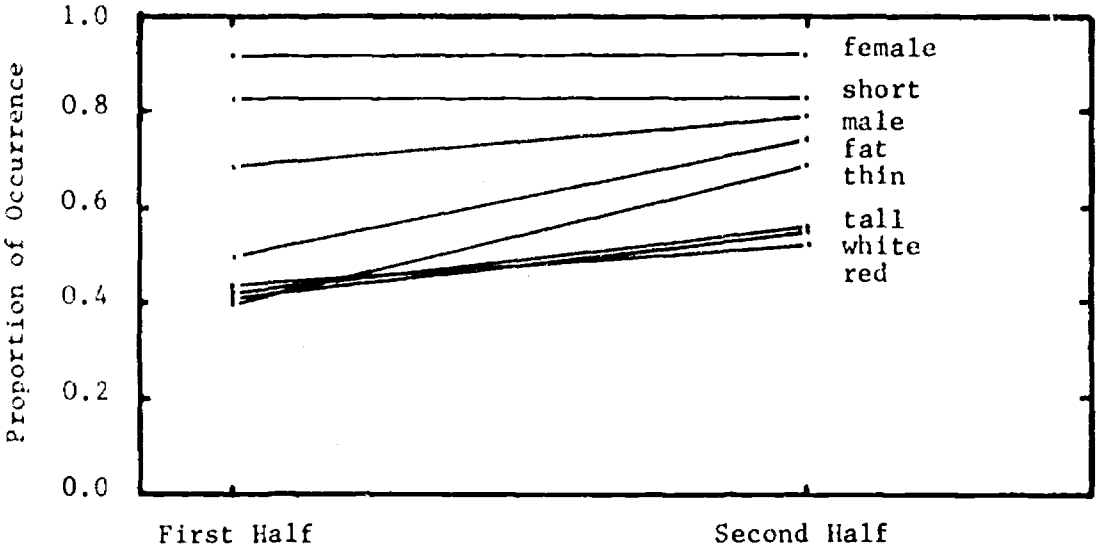


Fig. 25. Total frequency of encoding of relevant-nonredundant attribute values for people referents by half.

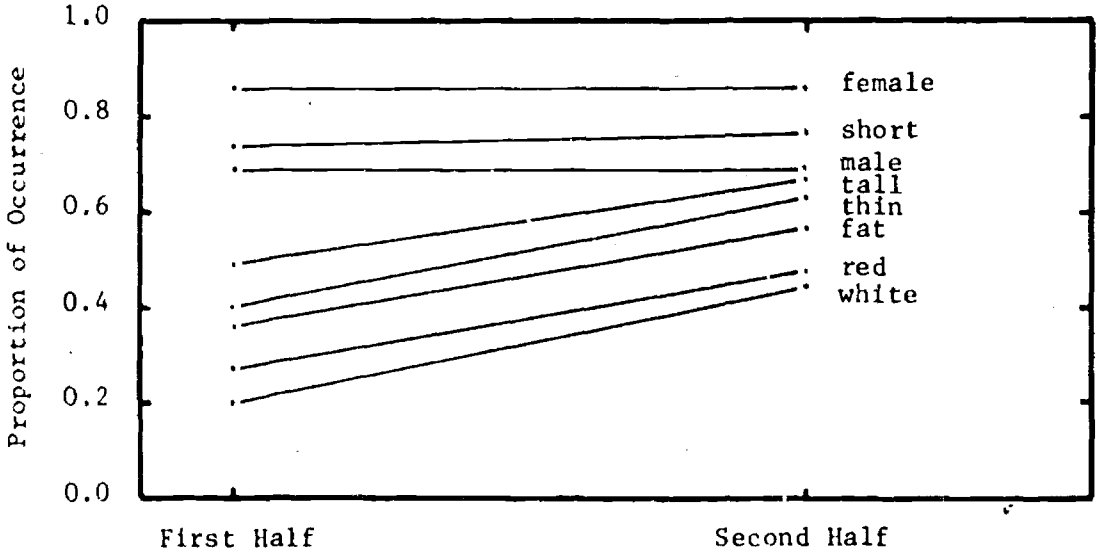


Fig. 26. Total frequency of encoding of relevant-redundant attribute values for people referents by half.

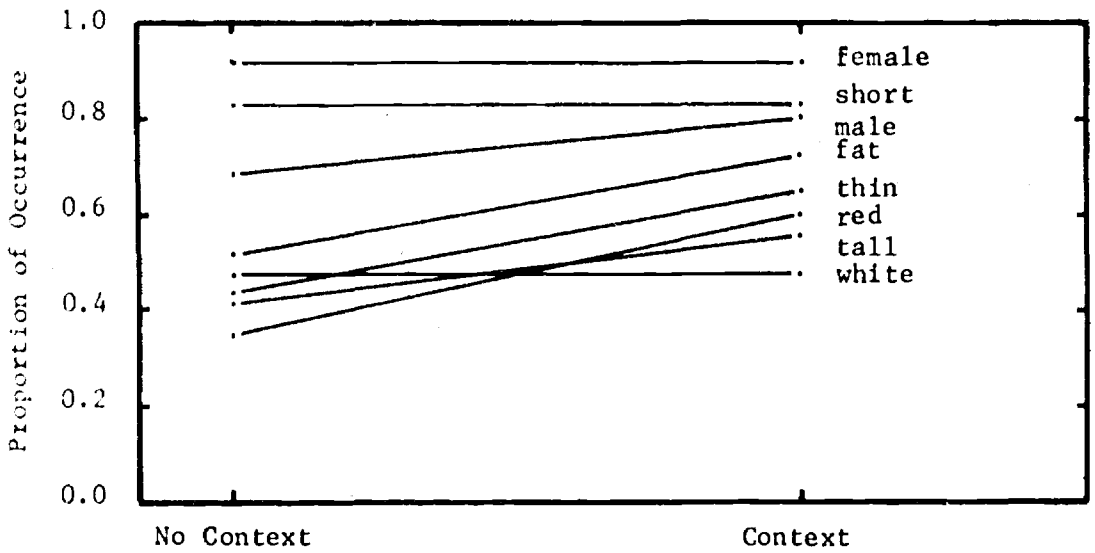


Fig. 27. Total frequency of encoding of relevant-nonredundant attribute values for people referents by context condition.

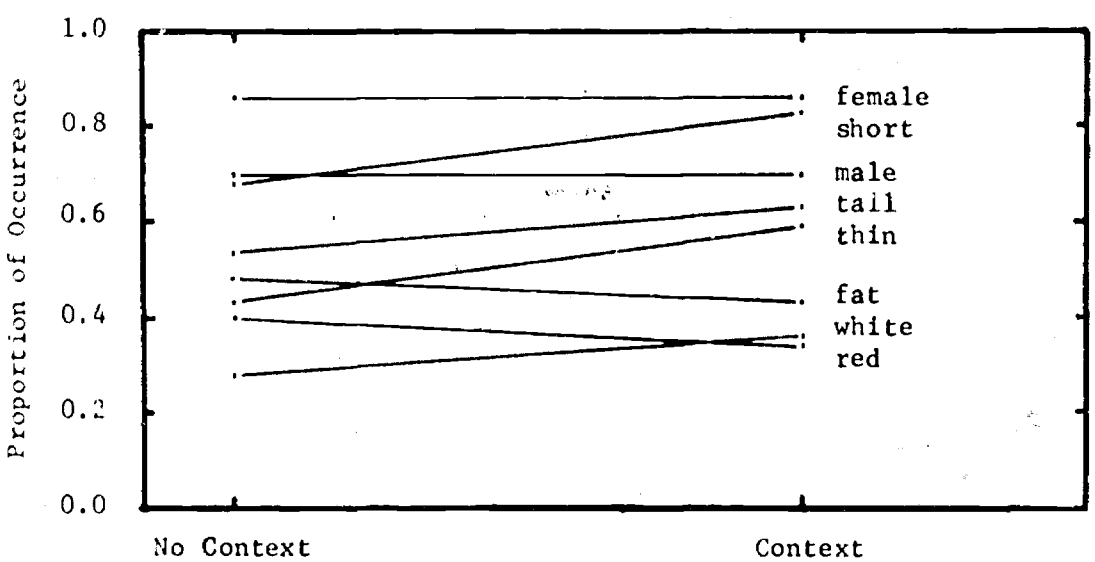


Fig. 28. Total frequency of encoding of relevant-redundant attribute values for people referents by context condition.

Recalling the discussion of the effects of the relevance-redundancy conditions presented in Figures 21 - 24, it is interesting to compare these conditions by half as presented in Figures 25 and 26. There is a general increase in the proportion of occurrence for the attributes under both conditions. The grand mean proportion of occurrence across all eight attribute values in Figure 25 rises from 0.58 in the first half to 0.70 in the second half, revealing the tendency toward more adequate messages. Similarly, the grand mean proportion of occurrence in Figure 26 rises from 0.50 in the first half to 0.64 in the second half, implying increased redundancy in the children's messages as the game progressed.

The effects of context upon proportion of occurrence for the eight attribute values as shown in Figures 27 and 28 present a less clear picture. The presence of context appears to generally result in a slightly higher frequency of encoding for most attributes, although there are exceptions. This effect of the presence of context is more evident under the nonredundant condition, as might be expected. In a nonredundant display the contrast between the two relevant-nonredundant attributes is perceptually more evident than in the redundant condition where all four attribute dimensions vary.

Content analysis of descriptions of the monkey referents. The descriptions of the monkey referents proved even more difficult to analyze than the descriptions of the people referents. The uses of language permit so many alternative ways of expressing location and orientation that coding which was both reliable and valid could not be achieved, at least with gain commensurate with the labor. Some children seemed to use "standing in the cage" to mean "right side up." Others seemed to arrive at this convention twoard the end of the game. Yet others seemed not to

use "standing" in any meaningful sense. The intractability of the problem of coding may suggest a reason why there was no improvement in performance with practice nor any effects of context on performance. What graduate students cannot code, perhaps children cannot rapidly learn to encode.

Summary of the content analysis. The coding procedures developed for the analysis of the content of children's language when communicating about referents with attributes which vary systematically revealed interesting and meaningful patterns when applied to the people referents. The adequacy of the children's descriptions increased with age. The presence of context resulted in more adequate descriptions at all age levels, suggesting that children as young as age 4½ were able to make use of the presence of context.

Children's descriptions contained rather limited redundancy, although message redundancy increased from the first half to the second half of the game. The number of messages containing incorrect and trivial encodings decreased with age, with incorrect encodings descreaing between ages 4½ and 6 and trivial encodings decreasing between ages 6 and 7½.

The pattern of results tended to support the concept of descriptive salience, though the procedure described in Chapter Two did not yield the same ordering of the attributes on frequency of occurrence as actually found in this task. Children seemed to encode approximately the same number of attributes, regardless of the relevance-redundancy conditions. Finally, the difficulty of applying the coding procedure due to the connotations of natural language for such common attributes as sex or location suggests that careful attention should be given to the selection of attributes of referent sets used in future studies where spoken language will be coded.

Questions

General. The questions and responses to questions are of interest for two reasons. The exchange of information by means of questioning might increase the performance of children in the communication game. In addition, skill in asking questions is important in its own right, independent of its relationship to performance in this particular communication game. In this section the frequency of several types of questions and responses as well as their relationship to the total errors made by the children will be analyzed.

Coding categories for questions and responses. The coding categories for questions and responses are discussed in detail in the coding manual in Appendix F. These categories will be described only briefly here. Every question asked by the child in the doer role was identified according to the referent displayed at the time of the question. The question and the response it received were each coded separately. Questions were coded in six categories.

"Specific question" explicitly calls for specific information: "Is it red?" A "general question" merely requests additional information: "What is it?" A "question in egocentric form" seems to assume that the hearer is looking at the same referent: "Do you mean this one?" A "statement functioning as a question" is similar to a specific question but lacks the grammatical characteristics of a question. This category was included to deal with the tendency of some children in the doer role who would make statements to which the knower would respond as if a question were asked: "It's the red man." "No." Statements receiving a response in this fashion occurred infrequently and were added together with specific questions in the discussion which follows. Two other

categories of questions, "questions with gesturing" and "miscellaneous questions," are not discussed here. The definitions and frequencies of these types of questions are included in the appendix.

Responses were coded in six categories. A question was said to receive "no response" if the child in the knower role failed to indicate any acknowledgement of the question whatever. An "informative, appropriate response" answered the question in a meaningful way: "Is it red?" "No." An "ambiguous response" would not aid the doer in selecting the correct referent: "Is it big?" "I don't know." A "refusal to respond" was a deliberate refusal to answer a question: "Is it red?" "I'm not going to tell you." "Question followed immediately by pushing a button" allowed no time for a response. "No response where button pushed immediately after a question" and "experimenter responds" are self-explanatory.

Every question and response was coded by two people. Disagreements were discussed and resolved. After considerable practice on 16 cases, 3 additional cases were selected and coded independently. The initial intercoder agreement on the 46 questions in these 3 cases was 89.9 percent. When the obvious errors of omitted questions were corrected, the percent agreement was 94.2 percent. Insofar as most careless errors of this type were detected in the process of comparing the two separate codings, this reliability seems acceptably high.

The complete frequency table for question and response types is included in Table 15. Several question and response types occurred so infrequently as to not warrant analysis. Questions involving gesturing and miscellaneous questions were not analyzed. Statements functioning as questions were summed with specific questions. Responses of refusal,

TABLE 15

Frequency of Question and Response Type by Age Group

Age Group	Question Type	Response Type: None	Informative	Ambiguous	Refusal	Button	Experimenter	Question Type Total
4½ Years	Specific	31	130	10	2	12	0	185
	General	31	57	16	3	5	0	112
	Egocentric	21	3	16	5	13	31	89
	Gesturing	1	1	0	0	1	0	3
	Miscellaneous	9	9	1	0	4	44	67
	Statement	0	5	1	0	0	0	6
Response Type Total		93	205	44	10	35	75	462
6 Years	1	29	164	9	3	11	0	216
	2	16	42	3	1	7	1	70
	3	1	2	0	0	2	13	18
	4	4	1	0	0	0	1	6
	5	7	13	0	0	2	21	43
	6	0	13	1	0	0	0	14
Response Type Total		57	235	13	4	22	36	367
7½ Years	1	14	274	18	0	25	0	331
	2	8	67	4	0	2	0	81
	3	2	1	0	0	1	0	4
	4	2	7	1	0	0	0	10
	5	7	6	0	0	1	15	29
	6	0	2	0	0	0	0	2
Response Type Total		33	357	23	0	29	15	457

non-responses due to button pushing, and experimenter responses receive comment but are not analyzed statistically. A total of 1286 questions and their responses were coded.

Analysis of variance was carried out on the total number of questions and responses of certain types. Between-Ss factors of age, sex, and verbal ability were entered into the analysis. No significant sources of variance were associated with sex and verbal ability was a significant source only for the "no response" category. All nonsignificant sources were pooled in the error term. The results of these analyses are presented in Table 16.

Question types by age. The frequencies of several types of questions changed with age in interesting and expected ways. These changes are shown in Figure 29 with the means and standard deviations provided in Table 17. A priori predictions were confirmed for two of three types of questions. Specific questions tended to increase in frequency with age, while questions in egocentric form tended to decrease with age. The frequency of general questions did not decrease with age as expected. Upon reflection it seems reasonable that general questions requesting clarification or elaboration continue to serve a prominent function in communication, even at older age levels.

A word of caution is in order regarding the validity of the "questions in egocentric form" category. In the test setting the experimenter sat between the two children and could see both screens. Consequently, a child could reasonably have been addressing a question such as "Is it this one?" to the experimenter. The experimenter always tried to ignore such questions and responded only when the interaction ceased. This discrimination cannot be reliably made from the transcripts.

TABLE 16

Summary Source Table for Types of Questions and Responses

Dependent Measure	Source	df	MS	F
Specific questions	Age			
	Linear	1	639.03	4.04+
	Residual	1	46.76	< 1
	Pooled error term	45	158.02	
General questions	Age			
	Linear	1	32.00	2.48 ns
	Residual	1	30.37	2.35 ns
	Pooled error term	45	12.92	
"Egocentric form" questions	Age			
	Linear	1	225.78	11.95**
	Residual	1	33.84	1.79 ns
	Pooled error term	45	18.90	
No response	Age			
	Linear	1	52.53	6.24*
	Residual	1	0.26	< 1
	Verbal ability	1	36.75	4.37*
	Pooled error term	44	8.42	
Meaningful response	Age			
	Linear	1	741.12	4.41*
	Residual	1	104.16	< 1
	Pooled error term	45	168.03	
Ambiguous response	Age			
	Linear	1	2.53	1.22 ns
	Residual	1	8.76	4.21
	Pooled error term	45	2.08	

*p < .05
**p < .01
+p < .10

Note: Pooled error term based on all between-Ss sources except age (age and PPVT for "no response" category).

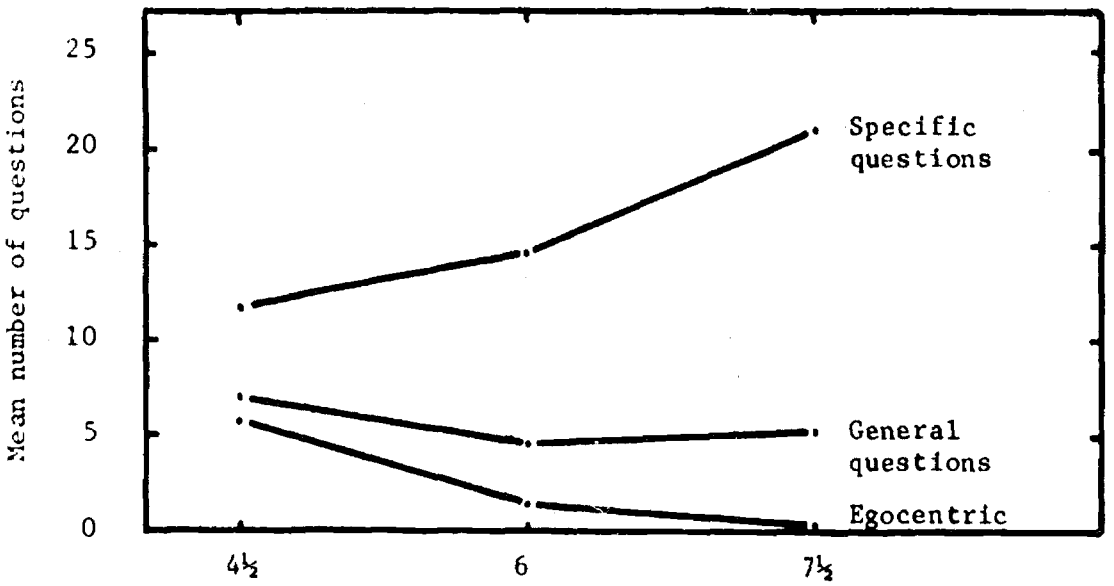


Fig. 29. Mean number of questions per subject-pair by type at each age level.

TABLE 17

Mean Question and Response Types by Age Level

	4	6	7
Specific Questions	11.9	14.3	20.8
S.D.	(7.9)	(9.1)	(18.1)
General Questions	7.1	4.4	5.1
S.D.	(4.4)	(2.9)	(3.3)
Egocentric Questions	5.6	1.1	0.3
S.D.	(7.3)	(1.7)	(0.4)
Informative Response	12.1	13.8	21.7
S.D.	(8.4)	(10.2)	(18.1)
Ambiguous Response	1.9	0.8	1.4
S.D.	(1.8)	(0.9)	(1.5)
No Response	3.9	2.8	1.4
S.D.	(3.8)	(3.3)	(1.5)

An examination of the complete frequency table for questions by response type in Table 15 shows that the decrease in questions in egocentric form is even more marked when those followed by an experimenter response are excluded. Keeping in mind that the "questions in egocentric form" category is contaminated to some degree with appeals for assistance, the conclusion that egocentric questions decrease with age seems justified.

Response types by age. The changes in response type with age are shown in Figure 30. Predictions were supported for two of the three types of responses. Informative responses increased with age, while the frequency of the "no response" category decreased. The frequency of ambiguous responses tended to decrease as predicted but this was not significant. Ambiguous responses occurred rather infrequently. The tendency of low verbal ability children to give "no response" was significant.

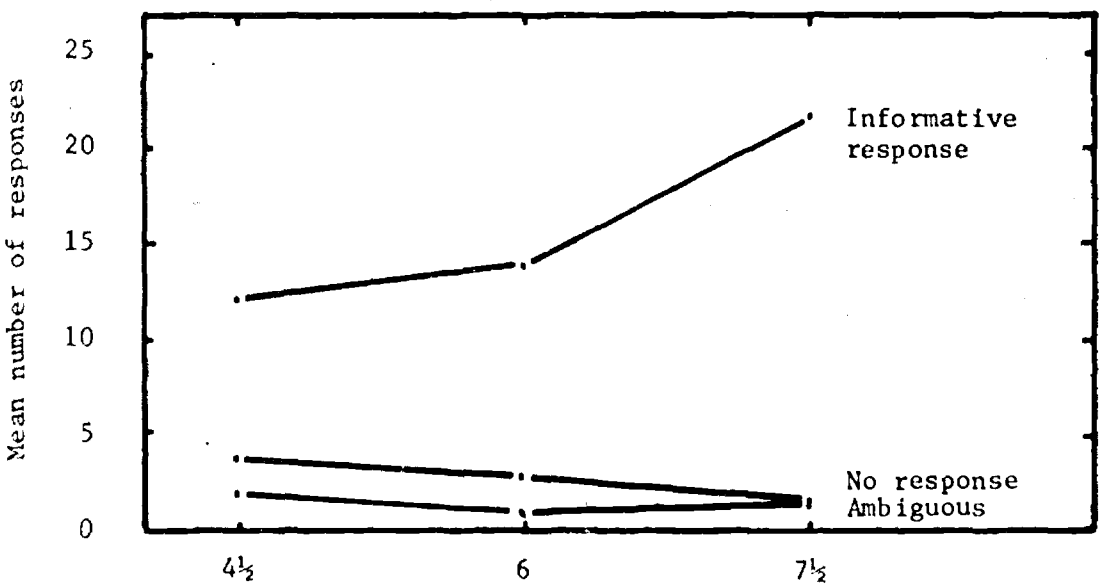


Fig. 30. Mean number of responses per subject-pair by type at each age level.

Other types of response. The frequencies of the remaining three response types deserve brief mention. Only 14 instances of refusal to respond occurred, with 10 of these in the youngest age group. Gesturing in response to questions occurred at all age levels and was rather infrequent. Responses by the experimenter decreased from 75 at age 4½ to 15 at age 7½.

Questioning and errors. Questioning increases with age and errors decrease with age. Questioning would seem to be one of the verbal skills which mediates this improvement in performance on the part of older children, but does the frequency of certain types of questions or responses by a given pair of children add to the prediction of errors by that pair? In order to answer this question a multiple regression analysis was performed.

The relationship of questioning behavior to performance can be thought of in two ways. One approach is to try to characterize the overall behavior of a pair of children and relate this to their total errors. The other approach would be to try to predict each error on each referent by some combination of variables.

Certain questioning behaviors such as egocentric questions, non-responses, and specific questions would seem to have predictive value extending beyond the immediate referent. Knowledge of the frequency of these behaviors provides some information regarding the quality and quantity of interaction between a pair of children. Based upon this rationale, multiple regression analyses were conducted on the total errors for a given pair, using the total number of questions and responses by type for that pair.

The regression analyses were done two ways. In one analysis the between-Ss factors found to be related to errors were forced into the equation first and then all of the question and response variables were allowed to enter freely in a stepwise fashion. This analysis indicated that only the "no response" measure added significantly to the prediction of total errors for a given pair, once the effects of age, verbal ability, and sex had been controlled. These results are shown in Table 18. (Nonsignificant question and response variables are not shown in the table.)

A second regression analysis was run in which the between-Ss factors and the question and response variables were allowed to enter freely in a stepwise fashion. The results of this analysis are shown in Table 19. In this analysis, the "no response" variable enters the regression analysis ahead of all other variables except age.

TABLE 18

Regression of Total Errors on Between-Ss Factors and Question and Response Types

Step Number		Variable Entered	b	R	R^2	F
1	Forced	Age	- .19	.61	.37	22.22***
2	Forced	Verbal Ability	.16	.68	.46	4.86*
3	Forced	Sex	- .10	.71	.50	1.49
4	Free	No Response	- .02	.74	.55	4.74*

***p < .005, df = 43
*p < .05

The failure of the knower in a referential communication task to respond to questions from the doer is, therefore, a useful predictor of errors on the task. The relationship between non-responses and errors

TABLE 19

Stepwise Regression of Total Errors on Age, Verbal Ability, Sex, and Question and Response Types

Step Number	Variable Entered	b	R	R^2	F
1 Free	Age	- .19	.61	.37	22.22***
2 Free	No Response	.03	.70	.49	4.74*
3 Free	Verbal Ability	.12	.73	.53	4.86*
4 Free	Sex	- .13	.74	.55	1.49

***p < .005, df = 43
*p < .05

likely results not only from the failure of the specific information to be transmitted but also from the implied competitive orientation on the part of the knower to the task. The failure to respond may also reflect inattention on the part of the knower or a lack of skill in responding to questions.

Summary of the analysis of questions and responses. The analysis of the questions asked by the doers and the responses given by the knowers in this referential communication task revealed a meaningful pattern in the development of interactional skills. Older children asked more specific questions and gave more meaningful responses than younger children. In contrast, younger children asked more questions in egocentric form and failed to respond to questions more often than older children.

CHAPTER IV

ANECDOTAL EVIDENCE FOR SOURCES OF ERRORS AND TYPES OF LEARNING

Overview of Chapter Four

The transcripts of the children's verbal interactions contain a richness which cannot be captured by numbers. Occasionally a child will verbalize his thoughts or strategies. What one child says, very likely other children have thought. Furthermore, the interactions between the children suggest various types of learning which may occur in such a communication game. Plausible explanations of errors sometimes seem evident in the transcripts. In this chapter, examples taken from the transcripts will be presented which suggest sources of errors in children's communication and types of interactions with educational potential.

The reader is cautioned that the anecdotes presented in this chapter are not organized within a precise theoretical framework. The anecdotes were selected, however, with a view to illustrating certain commonsense notions about what children might learn in such interactions and how communication between them can fail. Many phenomena illustrated could be tested more rigorously with appropriate experimental designs, and eventually they must be if the complex process of communication is to be more fully understood. Toward that end, these anecdotes are intended to provoke thought and perhaps suggest further experiments.

The discussion of sources of errors and types of learning will, of necessity, overlap. When an error is made or an imperfect description is given, learning may result. Many of the examples of interactions judged to be educational are based upon feedback after an error is made. Nevertheless these two general areas will be distinguished for purposes of discussion.

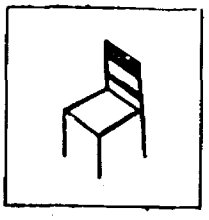
The examples will be presented single-spaced without quotation marks. The role of the person quoted will be indicated by a 'K' for the "Knower" and a 'D' for the "Doer". The referent will be described whenever this information is essential to the interpretation of the example. The age group of the pair will be given. When the doer pushed a button, this is indicated by "(Correct)" or "(Incorrect)".

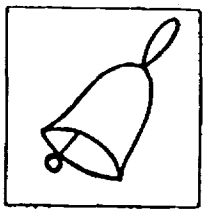
Commonsense model of the communication process. In order for communication to be successful, certain steps are essential. The knower must look at the target referent and encode a description containing sufficient information for the doer to discriminate the referent. This description must be spoken clearly and loudly so that the doer can hear it, and the words must have the same meaning for knower and doer. The doer must attend to the description, select the referent, monitor the adequacy of the information which is described by the information in the encoding, and push the appropriate button. Failure occurs at each of these steps with a certain probability, and failure at any one of them is likely to result in an error. The trancripts contain evidence of failure at all of these stages. This concatenation of steps, each liable to errors, makes the analysis of communication very difficult.

Sources of Communication Failure

Failure to look at the target referent. Although the target referent was marked with a bright spot beneath it, children occasionally forgot which one they were to describe. When the doer asked about a different picture, the knower might look at the one asked about and forget about the target.

Age: 7. Namable.





K: Bell.
D: Bell.
K: Oops! Don't push it. Chair.
D: Chair? (Correct)

Age: 6. Namable.

K: The broom - uh - uh - I mean the shoe.
D: The shoe. (Correct)

Age: 6. Namable.

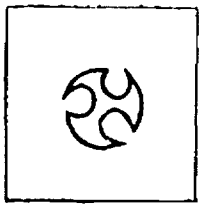
K: A train.
D: (Correct)
K: I almost said the wrong thing.

Possible explanations of the child's failure to keep the target in mind will be discussed later under "inattention."

Upon looking at the referent the child must select from his verbal repertoire a set of words sufficient to discriminate the target from the others. Rosenberg and Cohen (1966) have developed a probabilistic model to describe this process. The transcripts contain ample evidence of the substantial differences among children in the performance of this selection process.

Complete failure to encode. In the extreme case, a child might say nothing informative about the referent. This occurred most often with the abstract figures, although descriptions of the other referents frequently contained only attributes which were irrelevant to the task.

Age: 6. Abstract.



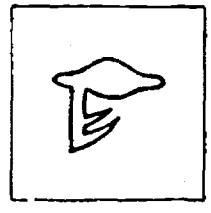
K: Uh - I don't know what that is.
D: Zig zag?
K: (pause) I don't know what that is.
D: I'm not sure either.
K: (pause) Just try any one.

Age: 7 . Monkeys.

K: Uh oh! What is it? Um - I really don't know how to do this. Sorry.
D: That's OK.

One of the intriguing differences among children would seem to be the speed of encoding as well as the adequacy of the encoding itself. Some children failed to produce any adequate encodings of the abstract figures, others were able to encode them quite rapidly, while others were successful in encoding them, but only after a very long time. The child below was consistently slow across the entire set of abstract referents, yet eventually succeeded with each.

Age: 7 . Two different abstract referents.



K: (pause)
D: Which one? (pause) Mary?
K: It sort of looks like an ash tray and it has something like a leaf.
D: (Incorrect) Oh. (Correct)

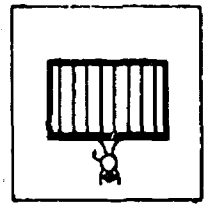
Another referent.

K: (pause)
D: Maaary?!
K: I know. You're getting impatient. (pause) It has two triangles together. With two lines there.
D: This had better be it. (Correct)

Within Rosenberg and Cohen's model, one might wonder whether the long delay is in the process of generating a potential encoding or in the process of evaluating its adequacy.

Egocentric descriptions with no information. Egocentric descriptions were sometimes given by younger children, although such descriptions were not very frequent. Interestingly, egocentric descriptions seemed most often to be elicited by the abstract figures. A child would struggle in an attempt to describe the referent and finally say, "It's this one." Egocentric descriptions were rare with the monkey and people referents and almost never occurred with namable referents.

Age: 4 . Target: monkey referent.



K: It's a monkey upside down in his cage. OK, Mary? OK?
D: (Incorrect)
K: Nooo! This one!
D: What one?
K: This one.
E: Tell her about it.
K: See, it's a monkey that has his arm - upside down with his feet touching the bottom of his cage.
D: (Incorrect)
K: No, Mary. This one! (Taps on screen.)
D: Which one?
K: This one. See where my finger is?

Ambiguous encodings. Often encodings were given which were ambiguous, using the judgement of an adult speaker of English as the criterion. With the abstract referents, a certain ambiguity remains in almost any encoding. Nonetheless, the ambiguity was most obvious where a pair would repeatedly apply the same description to different abstract referents.

Age: 4 . Four different abstract referents.

K: Push the one with the ice cream on it.
D: OK. (Incorrect) Oh. It didn't work.

Another referent.

K: You push the one with the ice cream cone on it.
D: (Correct)

Another referent.

K: Push the one like this.
D: The ice cream one?
K: Yeah.
D: (Incorrect)

Another referent.

K: Push the one that's a ice cream on it.
D: Ice cream?
K: Uh huh.
D: I haven't got no ice cream. (Incorrect)

This pattern of repeating a single description across many referents occurred with several pairs of children. Abstract referents were repeatedly described as, "It's a design," and then, "It's another design."

Other words used in this fashion were "shape," "lines," "zigzags," and "spider."

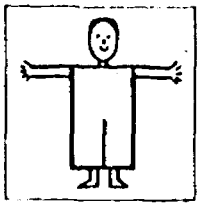
This pattern was not restricted to the abstract referents. With the people referents some children would perseverate in a pattern of "It's a doll," or "person." Similarly, the monkey referents might be described as "Monkey," "Another monkey."

A variation on this pattern occurred with some children who were successful in encoding the relevant information but who would also repeatedly encode irrelevant details: "It's a small red man with arms sticking out and two pointed feet." (All have arms sticking out and two pointed feet.)

Modeling and competition are two possible explanations for this phenomenon. If the first knower repeated several such ambiguous encodings, the other child would seem to model the behavior when it came to be his turn to describe. More will be said about this in a discussion of interference from competition below.

Ambiguities in words. Other ambiguities are inherent in the English language. "Man" carries a connotation of height as well as maleness. Similarly, "big" may mean "fat" or "tall" or both. Many errors seem to have resulted from the use of such misleading expressions.

Age: 4 . Target: tall, white, fat, male.



K: It's a boy, and he's fat.
D: It - I have a - which one is it again?
K: It's a boy - no, no - it's a man.

Age: 7 . Target: tall, white, skinny male.

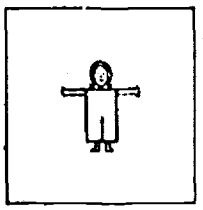
K: A thin person.
D: Is he big?
K: No.
D: (Incorrect)

Age: 6. Target: short, red, skinny, female.

K: A skinny lady.
D: You mean a skinny little girl?
K: Yes.
D: (Correct)

Ambiguous responses to questions. Ambiguity frequently entered into the communication process when the knower answered a question in an ambiguous or contradictory manner.

Age: 6. Target: short, fat, white, female.



K: It's a lady.
D: Skinny or fat?
K: No.

Age: 4 . Target: tall, fat, white, male.

K: It's a fat lady with flat hair like me...and you.
D: He has a red dress on?
K: No.
D: A white one?
K: No.

Sometimes the question itself was so disorganized that the answer was necessarily ambiguous.

Age: 6. Target: rightside up, inside, top, center.

K: The one holding on to the top.
D: Holding on like that? Holding on up here or there? Doing hand stands or -
K: No.
D: Oh, OK. (Incorrect) Oh! (Incorrect)
K: He's inside the cage, hanging on the top.
D: Oh. (Correct)

Inaccurate encoding. The knower sometimes gives a description which is clearly inaccurate by adult standards of word usage. Sometimes this inaccurate encoding seems to result from forgetting which referent is to be described. In the case of namable referents used in the examples above, this is quite evident. In the case of other referents it is not clear whether the child is looking at another referent or making a mistake when verbalizing about the correct referent. Inaccurate encoding occurred with all attributes but examples with the attribute

color should suffice.

Age: 6. Target: tall, red, skinny, female.

K: White lady.
D: White lady. There is none.
K: I mean red lady.

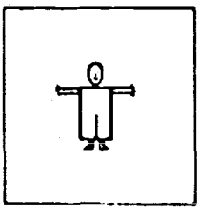
Age: 6. Target: tall, white, fat, female.

K: It's a fat lady.
D: Is she white or red?
K: Red.

The children certainly know the distinctions to be made but inaccurate encodings are communicated. Such inaccuracies occur both in descriptions initiated by the knower and in responses to questions from the doer. No doubt several effects contribute to inaccurate encoding, including inattention and competition.

Unconventional word usage. Another source of errors was the inability of some pairs to arrive at a consensus regarding the meaning of certain words with respect to the referents. The clearest examples of this occurred with the sex of the people referents. The people referents were deliberately drawn in a stylistic fashion such that the only difference between the male and female referents was the length and shape of the hair. Many children, especially at younger ages, seemed unable to arrive at an agreement on the distinction between males and females. Some children used "lady" for all referents. Others made the distinction between males and females but consistently referred to the long-haired figures as males and the short-haired figures as females. In several instances the two members of a pair argued about the sex of a referent without reaching agreement on a convention.

Age: 4 . Target: short, white, fat, male.



K: It's a small man.
D: You mean a lady.
K: No, a small man.
D: No, you mean a lady.
K: No. It's a man, not a lady.
D: (Incorrect) Uh huh.
K: No, it isn't.
D: Yes it is. (To E:) You tell him it is. It is.

Age: 6. Target: tall, red, fat, male.

K: She is fat and she has red pants...and it's a man. I mean it's a lady.
D: (Correct) Mine didn't have ladies on it, just had men.
K: Looks like a lady to me.

Age: 7. Target: short, white, fat, male.

D: A big daddy?
K: No. This is a little girl.
D: There's no girls.
K: A little boy?

Age: 4 . Target: tall, red, skinny, male.

K: It's a lady in a red dress and she's big. ....And she doesn't have any hair on.

Age: 4 . Target: tall, white, fat, male.

K: It's a fat lady with flat hair like me....and he's fat and he -
D: He has a red dress on?
K: No.

Self-contradictions. Contradictory descriptions also occurred frequently with adjectives describing size.

Age: 7. Target: tall, red, fat, male.

K: A boy that's big and kind of small.

Age: 7. Target: short, red, fat, male.

K: It's a real shrimpy, - it's real shrimpy and it's fat.

Age: 7. Target: short, red, fat, male.

K: Wide people with a -
D: What?
K: Wide people.
D: What? Wide people?
K: I mean small people.
D: (Correct)

Unusual words or associations. Words mediate meaning only to the extent that the speaker and hearer share similar associations with the words. Children often seem to assume that all meanings are shared.

Age: 7. Abstract.

K: Um - it's kind of a star looking thing.
D: Like holly?
K: What does that mean?
D: Like that Christmas stuff you have.
K: Yeah.
D: That you buy. It's like holly.
K: I don't know what it is.

Even peripheral comments might inject uncertainty into the communication process.

Age: 4 . Target: bird.

D: This is going to be a cinch.
K: A cinch? It's a bird.

Insufficient descriptions. In order to perfectly discriminate one of the monkey or people referents, at least two relevant attributes had to be encoded. Children often encoded only one of the two relevant attributes.

Age: 7. Target: short, white, fat, male.

K: Can you see a little fat boy?
D: But there are two little fat boys. Red or white?
K: Little fat.
D: Hmm?

Age: 7. Target: fat, male; all are tall, red.

K: Big. Big.
D: Big. They're both all big!

Age: 4 . Target: top, side; all rightside up, inside.

K: Monkey with - kind of hanging onto the top of his cage.
D: I don't know which one to push, that one or that one.

Age: 6. Target: short, white; all male, fat.

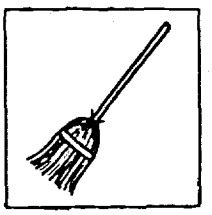
K: A fat little boy....
D: (Incorrect) That doesn't help....Hmm...it's a little boy, but I've got two little boys and I don't know if it is red or white.
K: It's white.

Insufficient descriptions were often remedied by questions from the doer, although many children seemed reluctant or unable to ask questions. Some appeared to enjoy guessing.

Failures of enunciation and pronunciation. Although the necessity of speaking loudly and clearly in a communication task is obvious, it is worth noting that communication failures did occur with surprising frequency due to children speaking too quietly or unintelligibly. Some children tended to whisper, especially when uncertain how to describe abstract figures. Doers frequently had to ask for repetition of descriptions.

As might be expected, problems with enunciation and pronunciation seemed to occur more often with younger children. The namable referent depicting a "broom" provided the most frequent examples. Several of the younger children were unable to pronounce "broom" clearly. The results were sometimes amusing.

Age: 4 . Target: broom.



K: It's a 'bawoom.'
D: (to E) Does he got one?
E: Tell him again.
K: It's a 'bawoom.'
D: A balloon?
K: Yeah.
D: There's no balloon here.
K: (pause) You don't have a 'bawcom?'
E: Tell him again.
K: It's a 'bawoom!'
D: A balloon? There's no balloon. Do you mean drum?
K: No. One of those. (Egocentric point.)
D: One of what?
K: A 'bawoom.'....
D: (to E) You tell him what it is if he's wrong.
E: You can ask him about it.
D: Let me press all of them. (Two incorrect, then correct) A 'broom,' you mean?
K: Yeah.
D: I didn't hear you. I thought you said a 'balloon,' because it sounded like you were saying 'balloon,' right?

Age: 4 . Target: broom.

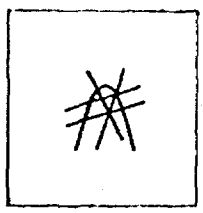
K: A 'bwoom.'
D: What?
K: 'Bwoom.'
D: What's that?
K: A 'bwoom.'
D: A broom?
K: Yeah.
D: (Correct)

Age: 4 . Target: broom.

K: 'Bwoom.'
D: Brown?
K: 'Bwoom.'
D: Brown?
K: 'Bwoom.'
D: Ball?
K: 'Bwoom.'

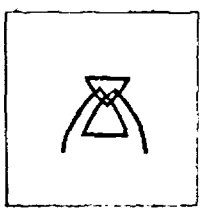
Problems with enunciation or "baby talk" were often circumvented by rephrasings or questions.

Age: 4 . Target: Abstract.



K: Uh - assident.
D: What is 'ass-ident?'
K: Crass.
D: What's crass?
K: Crass cars - like smash up derby.
D: (Two incorrect, then correct) Ah!

Age: 4 . Target: abstract.



K: 'Skuwut.' (Skirt.)
D: What?
K: 'Skuwut.'
D: (Incorrect)
K: Nope. 'Skuwut!'
D: (Correct)
K: Right.

Older children had recourse to other strategies for dealing with this problem.

Age: 7 . Target: people referent.

K: Tall.
D: Doll?
K: Tall.
D: Doll?
K: Uh huh.
D: Doll. D...o...l (pause) d...o...l...l?
K: No, tall.
D: Oh, I got it.

Failure to monitor adequacy of information or question inadequate information. The doer must monitor the information communicated to him by the knower. Children often seemed quite adept at this, verbalizing about their information processing and requesting more information when needed. In other instances children seemed unable or unwilling to seek more information.

Age: 4 . Target: abstract.

K: Um - that looks like a piece of cheese to me.
D: (pause) Two ones do. (Incorrect, Correct)

Age: 6. Target: upside down, outside, bottom, center.

K: It's a monkey hanging on his cage on the outside.
D: On the outside....
K: On the bottom.
D: Oh, I just saw him.

Age: 6. Target: abstract.

K: It has two points on the end of it and there's a little bit of circles on the end and it's crooked.
D: I'm not sure about this one (Incorrect). Sigh!

Age: 6. Target: top, side; all rightside up, inside.

K: It's the monkey inside of his cage and he's on top. (Insufficient information)
D: Is it - OK - it probably - I'll try. (Correct) That was really hard.

Age: 6. Target: top, side; all rightside up, inside.

K: Holding on to its cage.
D: On top of his cage?
K: Yeah.
D: So it's that one or that one. (Incorrect)
K: No.
D: (Correct)

In the last two examples the doers were aware of having insufficient information, but failed to ask whether the monkey was in the center or at the side of the cage.

Children frequently repeat the information as they search the display.

Age: 7. Target: abstract.

K: It has two points sticking out of the sides and two on the bottom.
D: Two on the sides and two on the bottom...(Correct).

Age: 4 . Target: people referent.

K: It is a girl...with long hair and it's a red body - a big, red, fat body.
D: Fat one. Long hair. (Correct)

Repeating the relevant information while searching the display may increase accuracy.

Age: 4 . Target: abstract.

K: Something is upside down. (An ambiguous description)
D: I know that one....I know it's upside down. Can't find it. Can't find it! I know that one.

In this last example the child seemed puzzled by the failure of his "knowing" the target was "upside down" to result in his knowing which button to push.

A large source of errors in the game seemed to result from the failure to ask for additional information, even when it was clear that the knower had not given enough information. This frequently occurred with the abstract figures where the knower would give only an empty label such as "design."

Age: 6. Target: abstract.

K: Design.
D: (Incorrect)
K: You got it wrong.
D: (Incorrect)
K: You got it wrong.
D: (Incorrect)
K: You got it wrong.
D: (Correct)

Competition, enjoyment of guessing, as well as an inability to frame appropriate questions would seem to lie behind this pattern.

Choosing the referent described and pushing the appropriate button. Even when sufficient information was communicated and apparently understood by the doer, errors were still made in the final step of the process. Some of these errors probably resulted from the difficulty of keeping several attributes in mind at the same time. In other instances, children's hands seem not to have gone where they intended them to go.

Age: 6. Target: abstract.

K: Do you see one little point?
D: (Incorrect) Oops! (correct) I pushed the wrong one accidently.

Age: 7. Target: abstract.

K: Hmm...two straight lines.
D: Two straight...oh, OK. What? Oops! Don't push that one! (talking to himself) I want to push this one. (Correct)

Age: 7. Target: abstract.

K: A circle thing. It's like a circle.
D: (Correct) I was about to push that one (an incorrect one) and I made a mistake in pushing.

Such unintentional errors could occur at each step of the communication process. Examples were given above in discussing other steps. Many of them can be attributed to a failure of the child's attention at a critical moment.

Inattention and boredom. A substantial number of the errors in communication seem to have resulted from inattention on the part of the knower or doer. While this source of errors is only "noise" in the data in the present experiment, it represents a phenomenon worthy of study in its own right. Children seemed to vary considerably in their distractability and attention span while playing this communication game.

Boredom contributed to inattention in some children. Older children were bored by the repetition and lack of challenge, whereas the difficulty

of the game produced boredom in some of the younger children when they had to wait for their partner to give a description. The time required to complete the set of 64 referents ranged from about 15 minutes to about 40 minutes. By the end of this period several of the 48 pairs were quite tired of the game.

Age: 4 . After 34 referents.
D: I'm getting tired of this game.

Age: 7 . After 32 referents; namable referent.
D: Why do you give us such easy ones?

Age: 4 . After 8 referents.
D: Why is this game a long game?

The child in the doer role seemed most subject to boredom and inattention. The rapid growth in children's communication skills during this 4 year period is evident in the fact that some younger children were bored due to the difficulty of the game and some older children due to its simplicity.

Many children seemed to enjoy the game to the point of wanting to continue past the 64 referents.

Age: 4 .
D: Why do you let us play this game?
E: Because I wanted to see how you liked it.
D: I love it.

Curiosity about the game and the equipment contributed to the inattention of the children. The children asked many questions about how the machine worked and why they were doing the game. This source of distraction could be reduced in a long term study with a given group of children. Some of the questions on the children's minds are exemplified below.

How does that machine know when you're right?

Do you always have to push the button?

Does that have pictures in it?

Is this a test?

When are we going to change places?

Inattention was not merely a result of boredom. Children, not unlike adults, enjoy talking. Frequently, associations from their streams of consciousness intruded into the communication game.

Age: 7. Abstract.

D: It's like holly.
K: I don't know what that is.
D: It has a green leaf and then it has red things on it, and it's called holly. We were going to name my sister "Holly." She was born on -
K: Christmas?
D: Not Christmas, not Christmas, but New Year's Eve, so we were going to call her "Holly."
K: Did you?
D: No. Her name's Mary.

The attribute "fatness" seemed to elicit numerous expressions of disgust or reference to individuals who were fat. As such, this turned out to be a rather distracting attribute.

Age: 4 . People referents.

K: Do you see a fat lady with - um - a fat....fat like you?

Age: 7. People referent.

K: Can you see a fat boy?
D: Of course! (Giggles) He's ugly!

Age: 6. People referents.

K: Fat little boy...like my little brother. He's really fat!

Competitive set resulting in errors. Many children had difficulty grasping that the task called for cooperation rather than competition. Despite the initial instructions which emphasized cooperation and reminders by the experimenter during the task, interference with performance

did occur as children took the game as a sort of competition between the two players. Some of the large individual differences, particularly with the oldest group, seem to be explained by this tendency. Deliberate withholding of information is not easily distinguished from oversight in the transcripts, but certain clear examples of competition appeared.

Age: 6. Target: top, center; all inside, rightside up.

K: A monkey that's in his cage.
D: Holding on like this?
K: I'm not going to tell you, friend.

Age: 7. Target: fat, male; all tall, red.

K: Do you see a big fat girl?
D: Big fat girl. (Incorrect) Big fat girl?
K: Yeah. (laughs)
D: You're tricking me.
K: In red.
D: They're all red.
K: I know.

Age: 6. Target: upside down, top, outside, center.

K: He's not holding up his cage....it's like the one you saw.
D: Holding up - he's holding up his cage?
K: No.
D: Um - he's hanging upside down?
K: You have to guess.
E: No. You tell him so you're sure he'll get it right.

The competitive orientation toward the game was also evident in the comments of some children after the doer made a choice.

Age: 6. Target: outside, center, top, upside down.

K: A monkey on top of his cage. (adequate encoding)
D: (Correct)
K: Hey, you always get it right!

Age: 6. Target: abstract referent.

K: Design.
D: (Incorrect)
K: You got it wrong.
D: (Second incorrect)
K: You got it wrong.
D: (Third incorrect)
K: You got it wrong.
D: (Correct)
K: (No comment)

Age: 6.

D: (Correct) Who's winning? I am!

Age: 7.

D: (Two incorrect)
K: Two wrong! You got two wrong!

Not all children were competitive and some worked together in a very cooperative manner.

Age: 6.

D: (Correct
K: Yeah. You got it right! You got it right!

Age: 7.

D: (Correct)
K: Good, you got it right!

Age: 7. Target: abstract referent.

K: Fifteen lines.
D: Fifteen lines. (Correct)
K: You got it!

Virtually no children chose the phrasing, "We got it right," although some did show considerable enthusiasm and "team spirit" in performing the task. This communication setting might prove to be a useful means for studying such social behavior as cooperation or competition. This phenomenon is worthy of further study in its own right.

Summary comments on sources of errors in children's communication. Communication can fail in many ways and at any point in the communication process. As the foregoing examples make clear, where communication could go wrong, it usually did in at least a few instances. These manifold sources of error suggest the difficulty of studying relatively free communication between two children. The amount of noise in the data is very large. More will be said about this in the final chapter when discussing directions for further research.

Having detailed the many types of errors committed in this task, it should be emphasized that all children at all age levels performed considerably better than chance. More examples of successful and imaginative communication exist in the transcripts than of unsuccessful communication. Overall, the children were quite skillful in their ability to communicate with each other.

Interactions with Educational Potential

General. Educators have a special responsiblity for structuring situations which are rich in possibilities for children to learn. Children cannot be made to learn, nor can learning be guaranteed. Nonetheless situations can be examined to see whether they seem potentially educational.

The examples below have been selected to suggest some of the types of educational interactions which occurred during the communication games. The examples were selected on the basis of a commonsense view of learning. People generally learn a skill by practicing it, receiving feedback regarding their performance, and trying it again.

Performance in the game provided practice on several communication subskills. Both encoding and decoding skills required considerable information processing by the children. The doer had to monitor the adequacy of the information received and consider asking questions when this information was inadequate. Feedback was given by the game device and by the verbal comments, responses, or questions from the other child. Finally, interaction between children offered an opportunity for learning important, if subtle, social skills. The examples below make no claims that learning did occur, only that the potential for learning existed.

Encoding. The encoding of the systematic referents required the child to examine the target referent (and the other referents when they were in view), decide what attributes were important, and then select words which would describe those attributes. Some descriptions were quite succinct.

Age: 6. Target: tall, fat, white, female.
K: OK. Fat lady in the white.

Age: 7. Target: short, fat, white, female.
K: A little lady - white. It's not red, it's white.

Age: 7. Target: short, red; all fat, male.
K: It's small and red.

Age: 7. Target: upside down, inside; all top, center.
K: Upside down and inside.

Other descriptions were not so efficient.

Age: 6. Target: top, center; all inside, rightside up.
K: It's a monkey that's hanging on top. It's hanging on - oh, how do I describe it? It's a monkey on the top of the thing. Not the regular top, you know, on the roof. Not on the roof, but he's hanging on the top. Not the roof. OK, try that.

Large individual differences seemed to manifest themselves in the ease with which children were able to encode descriptions.

Feedback on inadequate encoding. The transcripts contain many examples of feedback regarding inadequate descriptions. In some cases the feedback merely took the form of a request for additional information, while in other cases the doer was quite explicit about the inadequacy of the message.

Age: 6. Target: short, white; all fat, male.

K: A fat little boy.
D: (Incorrect) That doesn't help....
K: OK. He's fat and little.
D: That still doesn't help.... It's a little boy, but I've got two little boys and I don't know if it's red or white.
K: It's white.
D: (Correct)

Age: 6. Target: top, side; all inside, rightside up.

K: It's a monkey hanging in his cage.
D: I see two monkeys in his cage. Is he near the side or away from the side?
K: Near the side.

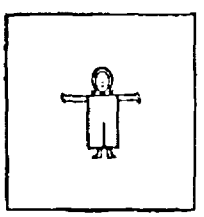
Age: 6. Target: short, red; all fat, male.

K: It's a boy, he's sticking his hands out and he's fat.
D: (Incorrect)
K: No. Got that one wrong....
D: Did you say a big boy?
K: No, small. But he's fat.
D: I thought you said a big one.
K: Oh. That's why you got it wrong. It's not a white one. It's red - it's a red suit and it's small and he's sticking his arms out.
D: (Correct)
K: Got that one.

This last example points up an interesting problem which occurred frequently in the communication game: mistakes due to ambiguities in the words denoting size. Children made many mistakes because of confusions among words such as "big," "fat," "small," "man," and so on. These difficulties suggest that the communication game might provide a useful medium for developing precision in expression in young children.

Age: 7.

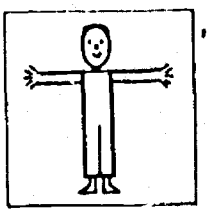
K: Small girl - lady - girl.
D: Well, make up your mind.
K: Girl.



Age: 6. Target: short, fat, white, female.

K: Fat little lady - fat little girl.

Age: 7. Target: short, thin, red, male.



K: It's - his body is long and red.
D: Is it skinny?
K: Yeah.

Age: 6. Target: short, skinny, red, female.

K: A skinny lady.
D: You mean a skinny little girl?
K: Yes.

Age: 7. Target: fat, female; all red, tall.

K: A girl - big with red clothing.
D: Fat?
K: Yeah.

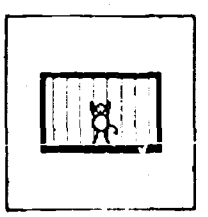
Age: 4 . Target: short, red; all fat, male.

K: A fat person except it's small.

One can imagine constructing a set of referents especially designed to teach children to make fine distinctions in word usage on a variety of dimensions such as color or facial expressions.

Inadequate enunciation and pronunciation also elicited feedback. The small but important distinction between "on" and "in" is emphasized in the following example.

Age: 6.



K: A monkey standing up in his cage.
D: On it?
K: In it.

Monitoring adequacy of information and asking questions. The topics already discussed contain sufficient examples of questioning on the part of the doer. It is clear that at least some children do monitor the adequacy of information quite well and question inadequate information. Older children asked more questions than the younger children, however, despite the fact that the information which they received was generally more complete.

It might be educationally sound to pair older children with younger children in communication game settings. The older children would gain

from the practice in questioning and the younger children would receive more ample feedback on the types of information which were relevant in the task.

Processing negative information. Understanding negative sentences is one particular form of information processing which might have educational potential. Although children in the knower role did not often initially encode the attributes in negative statements, negative replies to questions from the doer were quite common. In some instances the doer acted only on two negated attributes.

Age: 7. Target: bottom, side; all inside, rightside up.

K: It's a cage.
D: Does it have a monkey on top?
K: No.
D: Does it have a monkey in the middle?
K: Nope.
D: (Correct)

Age: 7. Target: short, fat, white, female.

K: It's a small woman, but it's not colored in.
D: (Correct)

Negated attributes probably are more often misunderstood.

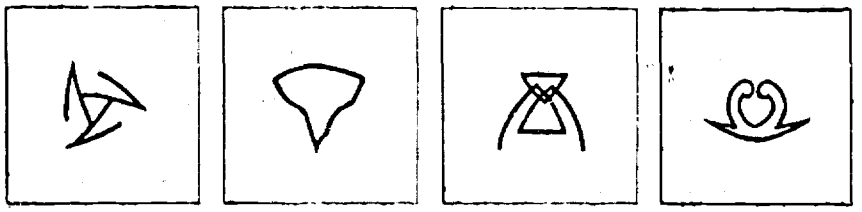
Age: 6.

K: It's a fat boy and it doesn't have red in it.
D: (Incorrect) You said it had red.
K: I said it doesn't have red.
D: Oh. (Correct)

It might be productive to have children play the communication game with a rule that they could only describe the target in negated terms.

Creative encoding. Encoding abstract figures called for creativity in encoding which went beyond the information processing required by the systematic referents. Performance on the abstract referents showed large individual differences. Encoding abstract figures may have educational potential for developing ideational and verbal fluency.

Consider the varied descriptions given by the 48 pairs of children in this study of the figures on the right in this display.



*

Age: 4 .

1. A ring.
2. A ring.
3. It is - it looks like a ring.
4. It's the one that has pointy - two pointed things and it has a little - sort of a harp inside and - it looks like a ring. (Incorrect) It's the one that has - um - sort of - it has two points and it has a closing and sort of looks like a ring.
5. A wing. (Possibly baby talk for "ring.")
6. Push - push the one that - push the one that - the wing - the wing.
7. Cow horns.
8. Hook.
9. It's kind of a sword.
10. It's an ash tray. Different.
11. Kind of a house with a curve in it and it has a line that's upside down.
12. It's something like two things coming up and almost touching together.
13. It looks like a - it's like a cone. (Possibly describing an incorrect referent.)
14. Because my daddy has one of those. It's - uh - that's all. Do you have that one?
15. It's a - a - something on the back of one - on the back of one - one picture on there - there - one picture on there.
16. (No description. Doer guesses.)

Age: 6.

1. Um - it's a ring.
2. Um - the thing - the thing that is like a ring.
3. Hanger with a ring on it.
4. John, do you see - I don't know what it is. (pause) Oh, I know what it is. Do you see a ring?
5. Um - anchor - or whatever it is.
6. Um - kind of a - anchor - an anchor.
7. The crab.
8. A hat - kind of like.
9. Do you see something that looks like a rocking chair?
10. Something that's sharp.
11. It has two points on the end of it and there's - um - a little bit circles on the end and it's crooked.
12. Now, it goes this way - it goes that way (gestures).
13. Do you see a thing like this (gestures)?

14. There's a curvy thing like this (gestures).
15. It's a design.
16. Another design.

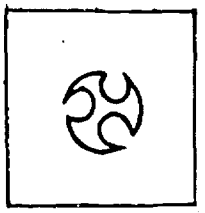
Age: 7 .
1. Something that looks like a - like a ring.
2. It looks like it has a tree inside of it upside down. (Incorrect) It has two sharp points on the bottom. D: Is it like an upside down ring? K: Yes.
3. It has two points at each end. (Incorrect) It has - some are two fists.
4. It gots like - um - two arms coming out of something.
5. Kind of a grabbing thing.
6. Oh - that kind of - it's sort of like one of those things when - that you hang belts and things up.
7. It looks like an upside-down handle.
8. Oh - a little hat.
9. Do you see a kind of a heart shape - like a ball?
10. Upside-down man.
11. Anchor - it looks like a anchor - at least.
12. It's like moustache - it's like - it goes like this (gestures) - like a moustache - and it goes on and like that (gestures).
13. It has two points and two curves.
14. It's a shape - it has two round and then half over - and then - and then half way around - and then it goes in and then it comes in the other side.
15. Picture. D: What of? K: A design. D: Does it have any points in it? Triangle? K: The top of it has - um - is shaped like a doughnut and - uh - the bottom of it has points sticking out.
16. Um - (long pause) - design.

The richness in imagery and language in these descriptions is obvious. Many of the descriptions are quite creative in the sense of being infrequent or unusual. Artistic insight is seen in the child who saw "a tree inside of it upside down." Such original descriptions frequently give one the feeling of "Oh, yes! It does look like that." The same can be said of descriptions such as "rocking chair," "two fists," and "harp inside."

Successful performance on the communication task requires a certain tension between creative encoding and the need for the other child to understand. The encodings most often given such as "ring" or "anchor" are perhaps most likely to lead to success, at least to the degree that they lead to a shared concept.

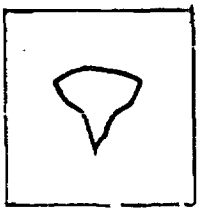
Highly divergent encodings are likely to be misunderstood: "An upside down man," for example, can be seen in the figure if one thinks about it for a while. Consider the three creative (that is, infrequent) descriptions below.

Age: 7 .



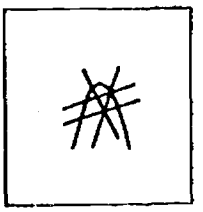
K: It looks - it looks sideways. It looks like a person with his mouth - like - cut off and his two eyes cut off.
D: (Three errors)

Age: 7 .



K: Brazil.
D: Brazil?
K: Like Brazil.
D: That looks like - (Correct) Ahh!

Age: 4 .

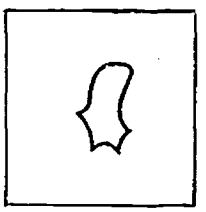


K: It is - it looks like an old-fashion clock, but it has lines across it - in the middle.
D: Ah ha! (Incorrect) This one? (Correct)

The "artist" runs the risk of being misunderstood when educating our eyes to see something in a new light.

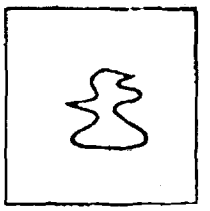
Sensitivity to different perspectives. The struggle to encode abstract figures, coupled with the errors and verbal feedback from the other child, would seem to offer learnings beyond simple imagery and verbal fluency. The potential for learning to be sensitive to the perspective of others exists. The children in the following examples are encountering alternative perceptions of the figures.

Age: 4 . Target: abstract.



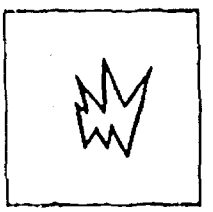
K: It's - uh - sort of looks like - um - a frog's feet.
D: (Incorrect)
K: It's the one that first looks like frog's feet, but doesn't look like frog's - but doesn't look like frog's feet, really.

Age: 6. Target: abstract.



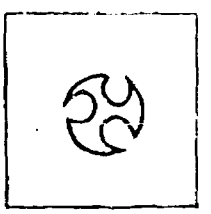
K: Bird.
D: A bird. I don't see no bird in there.
K: Well, it doesn't look like - very good like a bird.

Age: 6. Target: abstract.



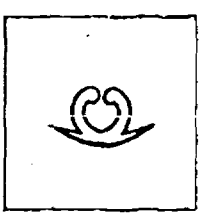
K: I don't know what it is. (pause) Mountains.
D: What?
K: Mountains.
D: I don't see any. Oh, I guess you mean this one here.

Age: 7. Target: abstract.



K: It's kind of like -
D: Shape that goes like this - like Swiss Cheese?
K: What do you mean?
D: Holes in it.
K: No. Do you have Swiss cheese on your picture?
D: Yes, I have Swiss cheese....

Age: 6. Target: abstract



K: Do you see something that looks like a rocking chair?
D: Rocking chair?
K: Yeah.
D: I don't see it.

Age: 7. Target: abstract.

K: Um - it has two straight lines.
D: Is it like a leaf?
K: Um - I'd say no.
D: Is it - um - kind of like a mushroom?
K: Yes.
D: (Incorrect, Correct)

Age: 4 . Target: abstract.

K: Um - that looks like a piece of cheese to me.
D: (pause) Two ones do. (Incorrect)

Summary of potentially educational interactions. The relatively small improvement in performance across trials in this game permits only cautious optimism regarding the educational benefits of participating in this game. Nevertheless, given that communication makes use of a complex set of highly practiced patterns, one should not expect rapid modification of communication performance. The examples given in this chapter suggest some of the types of interactions between children in the game which seem likely to contribute to improvement in communication skills.

Specifically, the communication game gives children considerable practice with immediate feedback in encoding and decoding descriptions. The interactions between the two children also provide practice in questioning, processing information in positive and negative sentences, monitoring the adequacy of information, and exposure to different uses of words and images. These types of experiences would seem to offer children an opportunity to broaden their repertoire of communication skills.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Overview of Chapter Five

This discussion will be organized into four parts. First, the factors related to children's performance on the communication task will be discussed. Second, the results of the analyses of the children's language will be described. Third, impressions of the educational potential of the children's interactions in this communication game will be given. This chapter will end with a discussion of future directions for research on children's referential communication.

Review of study. This study sought to examine the development of referential communication skills in young children. To this end a game device was designed with a view to both research and educational applications. Performance was analyzed in terms of the characteristics of the children and the experimental conditions. Finally, the children's language and interactions were analyzed in an attempt to better understand the nature of their relationships with communication skill and success.

Summary and discussion of between-Ss factors. Age was by far the largest of the between-Ss sources of variance. There was a linear decrease in the number of errors between the ages of 4 and 8. The very youngest children in this study (below the age of 4.0) made a particularly large number of errors, suggesting a minimum level of language maturity for performance in this referential communication task around this age. Nevertheless, even the youngest children were performing at better than chance level with the most difficult referents, the abstract figures.

Verbal ability based upon the PPVT raw score showed up as a significant source, although supplemental analyses suggested that this variance could be more parsimoniously explained as an effect of age confounded with raw score. The correlation of the mean IQ of the pair with total number of errors was nonsignificant ($r = -.22$). The percent of variance in errors explained by this source is certainly quite small in any interpretation.

Girls tended to make fewer errors than boys although this tendency had only marginal statistical significance. Overall, boys had a mean error rate which was 23% higher than girls. The difference was greatest in the youngest age group. Both because of the marginal statistical significance and because of possible effects resulting from a male experimenter, this difference can only be noted as suggesting further study.

Birth order showed no relationship whatever to errors on the communication game. The studies discussed in Chapter One showing effects of birth order on verbal ability were based upon samples of hundreds of thousands of people. Although statistically significant differences appeared, these differences were quite small. Upon reflection, it would seem unrealistic to expect to detect effects of birth order on communication performance in this study.

No differences in performance existed between the two communities used in this study despite a significant difference in IQ in favor of the children from the university community. The range of socioeconomic status was not large, however, and the lack of difference between the two communities might be best seen as extending the generalizability of the results beyond children from an exclusively academic community.

Large individual differences in performance existed which were not explained by the between-Ss factors included in this study. The magnitude of these differences was seen in the degree of overlap between the youngest and the oldest pairs in number of errors. These differences were even more obvious in the transcripts of the children's language. These large and intriguing individual differences suggest one of the most important areas for further study.

Summary and discussion of within-Ss factors. The type of referent produced the largest amount of variance in the performance on the communication game. As expected, the namable items were communicated with almost no errors, whereas the abstract referents produced significantly more errors than the other types. The two types of systematically varied referents, the people and the monkey referents, were intermediate in difficulty.

The very large effect of referent type on performance suggests the need for unusually careful attention to the design and pilot testing of referents in future studies of this type. An example of the unexpected ways in which referent type can affect performance was seen in this study. The youngest children made distinctly more errors on the people referents. Examination of the transcripts revealed that the attribute "sex" signified by long hair in the people referents caused a large number of errors. The youngest children had great difficulty in arriving at agreement on a convention for describing this attribute.

The second largest source of within-Ss variance was associated with target position. Averaging across all age levels, errors increased from left to right. The effects of target position varied with age. The 4½-year-olds made more errors at both the left and right ends of the display.

Errors for the 6-year-olds increased linearly from left to right. Target position showed little relationship to errors for the 7½-year-olds. The change in the error pattern from age 4½ to 6 may reflect the influence of reading instruction on the 6-year-olds.

The decrease in the effects of target position with age suggests that older children are more thorough in considering all of the referents before responding. Two explanations for the effects of target position come to mind, only one of which is easily observable. A few instances were observed where children manifestly guessed from left to right when given completely inadequate descriptions. Obviously, such behavior would account for part of the effect of target position.

Incomplete information processing is a less observable but potentially more interesting source of the effects of target position. The work of Vurpillot (1968) provides support for this interpretation. She found that young children did not completely scan all aspects of sets of pictures before selecting one which matched a target. Memory may also be involved here. For example, if a child hears, "It's a tall, red man," he must remember these attributes while matching them across the entire display. He might forget the attributes described or he might forget to check all of these attributes against all of the pictures, or both.

It is not enough merely to compare the description with the referent to ensure that it matches. Performance on the game also requires the listener to scan the display to be sure that the description applies to only one of the referents. If younger children fail to carry out this process, this also would result in an effect of target position.

Research such as that conducted by Vurpillot has usually examined search strategies in visual-visual matching. The extension of such

research to verbal-visual matching in this communication game certainly warrants consideration in future studies. For example, the effects of a failure of memory compared to the effects of a failure to analyze the display could be tested in an experimental design where children were given systematically varied descriptions. At the very least, future studies of referential communication must carefully control for the effects of target position.

Performance showed a modest tendency to improve between the first and second half of the game, although this improvement reached significance only for the people referents. The mean number of errors across all Ss decreased by 11% from the first half to the second half. Errors tended to increase slightly toward the end of the game, perhaps reflecting boredom and desire for novelty.

The improvement between the first and second half could have resulted from either the practice in playing the game or the brief training session halfway through the game. The training was directed at having the children look carefully at all of the pictures, say more about them, and ask questions when necessary. The experimental design used in this study does not allow the effects of training to be unambiguously distinguished from the effects of practice. What evidence is available in the study, however, suggests that the effects of practice contributed more to the improvement than the effects of the training session.

The rather small improvement with practice suggests that communication skills may prove resistant to rapid modification. Of course, the habitual patterns of communication which a person brings to any communication task necessarily consist of some of the most thoroughly practiced behaviors in the human repertoire, so large improvement in performance

should not be expected in a few minutes of practice. Nevertheless, the consistent tendency toward fewer errors with practice may be taken with some caution as suggesting that communication skills can be improved.

The presence or absence of context affected performance in complex ways. The presence of context resulted in a large and significant improvement in performance with the people referents but not with the monkey referents. The presence of context resulted in a marginally significant decrease in performance for the abstract referents.

Why the presence of context improved performance with the people but not the monkey referents is not readily apparent. An intuitive impression suggests that it is somehow easier to perceive at a glance the distinctions among the attributes in a display of the people referents than those in a display of the monkey referents. This difference would correspond to the definition of "salience" as used by Trabasso and Bower (1968).

The tendency for abstract referents to be more difficult in the presence of context is quite unexpected. Indeed, the work of Krauss and Glucksberg (1968) was criticized in Chapter One on the grounds that the young children were not allowed to see the context from which their partners had to select the appropriate abstract figure. The impression gained from reviewing the transcripts is that the presence of context may have hindered the children's performance in several ways. For example, if the knower delayed in describing the target, the doer would offer a description in question form, usually a description of the referent in the display easiest to describe: "Is it the leaf?" The knower might then look for a leaf and forget the target. Context may have also served to elicit perseveration on a previously used description. Finally,

it is possible that display of four abstract figures may have intimidated the knower and inhibited encoding. Whatever the explanation, the decreased performance on abstract figures in the presence of context is an unexpected and intriguing phenomenon.

Children at all ages performed better in the presence of context on the people referents (but not the monkey or abstract referents). Contrary to expectations, the performance of older children was not more sensitive than the performance of younger children to the presence of context, at least with the people referents. This effect of context on performance suggests that children, even as young as 4½ years old, were able to make use of the information available in the display when encoding descriptions of the people referents.

Context and trials showed a significant and interpretable interaction. More errors were made under the no context condition on the first half as compared with the second half of the game, whereas performance was the same in both the first and second half under the context present condition. This interaction gives some insight into the use of context. The presence of context is seen to be most important in the initial encounters with a referent set when a pair of children is learning which attributes are relevant and what conventions are going to be used to describe them. Once these conventions are established the presence of context is no longer as helpful.

Redundancy in the display of referents was found to lead to fewer errors, as was predicted. The presence of relevant and redundant attributes increases the likelihood that a child verbalizing a set of attributes will give the two bits of relevant information. The careful use of redundancy would permit a finer gradation of difficulty levels in preparing

referent sets in future studies.

The attempt at defining and employing the concept of descriptive salience was not totally successful. Descriptive salience as defined did lead to significant effects in performance in the directions expected for the monkey referents but not for the people referents. Content analysis of the children's language for the people referents revealed that the frequencies with which the attributes were mentioned did not correspond to the frequencies generated by the procedure described in Appendix C. On the other hand, the ordering of these frequencies did correspond to the ordering initially found in pilot testing the referent sets.

The procedure in Appendix C was used in an attempt to achieve a less tautological definition of descriptive salience than simply pilot testing the referents. Apparently, at least for the people referents, the frequency with which children mention attributes under the instruction to say how two referents differ is not the same as the frequency with which they mention these attributes in the communication task. In part this may be explained by the conventions of language usage. A child may not report that two figures differ on sex, but when the child is formulating a description, it is natural to say "the red boy."

The existence of variation on the relative probability that attributes will be verbalized is clear. Equally clear is the necessary effect of these probabilities on the likelihood that a referent will be communicated without error. Some knowledge of these relative probabilities is essential for good control over the systematic variation built into any set of referents for use in referential communication studies. For the practical demands of constructing referent sets in communication tasks,

it may be sufficient to pilot test the referents and then make final pairings of attributes according to the results of the pilot testing. A more adequate understanding of the factors influencing the probability of mention in a communication task must await further study.

Summary and discussion of children's language. The analysis of the transcripts of children's language with regard to the people referents revealed changes which mediated the improvement in performance with age. Older children tended to give more adequate descriptions of the target and fewer descriptions which were incorrect. The adequacy of the message was greater in the presence of context. The different attributes showed consistent increases across trials in the frequency with which they were spoken. Overall, the children's language showed changes in the direction of better communication quality.

Questioning was found to be one of the changes in verbal behavior which mediates improvements in communication performance with age. Older children asked more specific questions and gave more informative responses. Questions in egocentric form decreased with age. The failure to respond to a question was found to predict performance even after the effects of age were removed.

Summary of anecdotal evidence. The transcripts revealed manifold ways in which communication can fail. The examples presented in Chapter Four contain many suggestions for experimental studies of discrete sources of errors. The examples presented in Chapter Four also show many interactions between children which seem rich in the potential for learning communication skills. Specifically, the interactions between children seemed to provide feedback on the quality of the descriptions, practice in information processing, and practice in asking questions.

Educational technology as a structuring intermediary. The communication game device represents a use of technology which is fundamentally different from many present applications. The most common use of educational technology has been essentially for training skills which can be specified and taught by drill. Recent advances have made the drill more flexible and responsive to individual states of knowledge in the learner. Nevertheless, for all its sophistication, such uses of educational technology have remained restricted to training which might be characterized as drill. (This is not to downplay the importance of such applications.)

In addition, most applications of educational technology to date could be characterized as putting a person in front of a computer. The focus has been upon the person interacting with the computer. Unfortunately, computers capable of comprehending natural language are unlikely to be available in the foreseeable future, yet communication between people is a natural language phenomenon.

The approach used in this study placed the technology between two people rather than in front of one person. The game device used electronic circuitry to structure the interaction between two children while permitting the children to comprehend and respond creatively to their natural language. As the examples presented in Chapter Four indicate, even young children are capable of providing each other with a rich variety of feedback on natural language performance, a capability exceeding that of any presently existing computer. At the same time the technology permits the educator to structure these interactions so as to create opportunities for educationally important outcomes.

Many applications and variations of this use of technology as a structuring intermediary can be imagined. A brief vision of some such applications may suggest directions for future study. Within the structure provided by the present communication game device many variations in stimulus type are possible. For older children written words might be presented to one child and pictures of the referents described by the words presented to the other child. One child might have to read "a red hat" and the other child select the appropriate picture. Training on enunciation could present confusable words to each child: "hat," "hit," "hut," and "hot," for example. Similar approaches with arithmetic symbols can easily be imagined. Other applications might include more complex matrices of referents varying on different dimensions as a means of developing concept formation or analytic skills.

The application of technology to structure interactions between people would seem to offer many possibilities. The vision outlined above must be considered only tentative and suggesting directions for future research. The game device developed for this study represents only a first step in the direction of placing a computer between two people for educational purposes.

Directions for future research on referential communication. Referential communication is a complex process in which many factors can influence performance. The strong effect of the age of the Ss on performance suggests that the use of more narrow age ranges in future research with young children would provide better control over the variance associated with age. In addition, given the very large variance associated with the type of referent, careful attention should be given to

the selection of referent sets in future studies.

The question which would seem to deserve the highest priority for future research concerns the stability of individual differences in performance on referential communication tasks. If individuals do differ widely, as the results of this study would indicate, and if these differences are stable, then referential communication tasks may be measuring something of considerable importance. If, on the other hand, the differences in performance are not stable, then the importance of these differences is questionable.

Stability in performance on referential communication tasks could take several forms. Research is needed to indicate whether individual performance is stable across time and across various referential communication tasks. The stability across different tasks should be studied by using variations on referent types as well as variations in the instructions to the Ss. If individual performance is found to be somewhat stable, then it is of interest to know more about the relationships of this performance to other characteristics and abilities of the individuals.

Finally, further research is needed on the effects of different training procedures on performance. (Needless to say, the research on the effects of training will shed additional light on the question of intraindividual stability of performance.) The results of this study suggest that didactic training with young children may not be the most effective way to train communication skills. For example, the overall impression gained from observing the children participating in the game suggests that the use of modeling might be more effective as a training procedure.

Despite the attention which is given to "communication skills" in the popular press and educational literature, the fact remains that no objective measure of spoken communication performance in a face-to-face situation exists. Referential communication tasks may provide a step toward both the assessment and teaching of interpersonal communication skills.

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APPENDIX A

TECHNICAL DESCRIPTION OF GAME DEVICE

1. General. The game device consists of two rear projection screens mounted in cabinets which are hinged and placed at a right angle to each other. Directly beneath each screen is a row of evenly spaced red lights. Another row of four lights is 5 cm below this row of lights. A row of four push buttons is directly below the bottom row of lights. The device is shown in Figure 31. The lights are represented by a small dot and the buttons by a large dot in Figure 31. All dimensions are in centimeters.

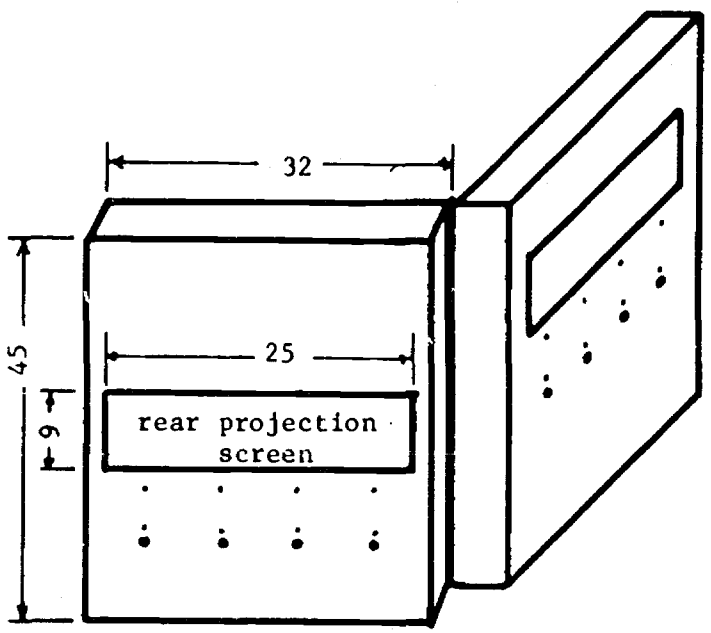

Fig. 31. Dimensions of the communication game device.

The cabinet contains integrated circuits which are connected to a slide projector with zoom lens. The slide projector is approximately 1.5 meters away from the screen. A plate glass mirror at a 45 degree angle to the beam of the projector is used to send the bottom half of

the image to the lower projection screen.

Each slide is prepared with each referent appearing twice, once in each of two rows. One row is reversed with respect to the other in order to compensate for the mirror. The referent to be the target is designated by a pinhole which appears as a bright spot under it. The zoom lens is used to adjust the size of the referent to 5 cm by 5 cm.

A stereophonic tape recorder is used with the microphone placed between the two Ss, making it easier for the typist to determine the identity of each speaker.

2. Logic Circuits. Integrated circuits were used to perform the following operations:

a. The first button pressed is set as the "correct" button. The red light next to the button comes on to remind the speaker that this is the "correct" button.

b. If the button pressed on the other side corresponds to the "correct" button, the circuit to the slide projector is closed, automatically advancing the projector to the next slide.

c. If the button pressed on the other side is not the "correct" button, the red light directly below the "incorrect" referent is lighted on each side and remains lighted until the "correct" choice is made.

3. Costs. The cost of materials (including the projector) was approximately $100.00. The cost of wiring the integrated circuits and the construction of the cabinet cannot be estimated because this depends upon the cost of labor and the availability of skilled personnel.

APPENDIX B

INSTRUCTIONS FOR PRACTICE SET

Seat the children in front of the device. Say, THIS IS A PICTURE GAME AND I'M GOING TO SHOW YOU HOW TO PLAY. To N_1_____ say, SEE THESE PICTURES (Point). THIS ONE HAS A LITTLE DOT UNDER IT. I PUSH THE BUTTON UNDER THAT PICTURE (Push button) AND TELL N_2_____ WHICH ONE I PUSHED. To N_2_____ say, DO YOU SEE A SAILBOAT ON YOUR SIDE? OKAY, PUSH THE BUTTON UNDER THE SAILBOAT. THAT'S RIGHT. YOU PUSHED THE RIGHT BUTTON AND SO THE NEXT PICTURE CAME ON.

LET'S DO ANOTHER ONE. N_1_____, PUSH THE BUTTON UNDER THE ONE WITH THE DOT. THAT'S RIGHT. NOW, N_2_____, PUSH THE BUTTON UNDER THE EYE. SEE. HE GOT IT RIGHT AND THE NEXT PICTURE CAME ON. To N_1_____, SO THAT'S HOW THIS GAME WORKS. YOU TRY TO TELL HIM ABOUT THE ONE YOU PUSHED SO YOU ARE SURE HE WILL GET IT RIGHT.

LOOK AT THIS ONE (Airplane). SOMETIMES YOU ONLY HAVE ONE PICTURE ON THIS SIDE, BUT THERE ARE ALWAYS FOUR PICTURES ON THE OTHER SIDE. YOU HAVE TO PUSH THE BUTTON UNDER THE PICTURE AND TELL HIM ABOUT IT SO YOU ARE SURE HE WILL GET IT RIGHT. DO THIS ONE.

GOOD. SEE HE KNEW WHICH ONE YOU PUSHED AND THE NEXT PICTURE CAME ON (Feet). DO THE NEXT ONE. RIGHT.

DO THE NEXT ONE (Duck). Before N_2_____ can push the button, stop him and say, HE KNOWS WHICH ONE YOU MEAN, BUT LET'S SUPPOSE HE DID NOT. SUPPOSE HE GOT IT WRONG. I'LL PUSH A BUTTON TO SHOW WHAT HAPPENS. SEE. THE RED LIGHT COMES ON BENEATH THE ONE HE PUSHED SO YOU CAN TELL WHICH ONE HE PUSHED. THEN YOU CAN TELL HIM AGAIN UNTIL HE GETS IT RIGHT. TELL HIM AGAIN. RIGHT. To N_2_____, IF YOU ARE NOT SURE WHICH ONE HE MEANS, YOU CAN ASK HIM QUESTIONS.

YOU CAN ASK HIM ANYTHING YOU WANT. YOU SHOULD ALWAYS ASK IF YOU ARE NOT SURE. THAT WAY YOU WILL GET IT RIGHT THE FIRST TIME. REMEMBER IN THIS GAME YOU HAVE TO COOPERATE WITH EACH OTHER TO BE SURE YOU GET IT RIGHT THE FIRST TIME. AFTER N_1_____ HAS DONE SOME, THEN YOU WILL GET A CHANCE TO GO FIRST AND TELL HIM ABOUT THE ONE YOU PUSHED. DO YOU HAVE ANY QUESTIONS? OKAY, I'LL START THE NEXT PICTURE.

APPENDIX C

SELECTION AND PREPARATION OF SETS OF REFERENTS

Introduction. This Appendix will describe the specific referents used in this study and the rationale and procedures underlying the selections. The discussion will necessarily be succinct, but enough detail will be included both to permit a complete understanding of the referents used in this study and to serve as a guide to anyone attempting to construct similar sets of referents with systematic variations.

Types of Referents. Four types of referents were used in this study. There were 16 pictures each of namable objects, abstract figures, people figures, and monkeys in different positions in cages. The complete set of referents is pictured in Figures 2a and b. The namable and abstract referents are easily discussed.

Namable. The namable referents were rather arbitrary selections from children's books and flash cards. They were intended to be easy for all children 4 years of age and older. These referents were hand drawn in simple form. The namable referents were always presented in the same sets of 4 as they appear in Figure 2a.

Abstract. The abstract referents include 8 items from the work of Krauss and Glucksberg[1] (1967) and 8 original items developed for this study (Sets 5 and 6). They were intended to be difficult to describe, although there is wide variation in difficulty among the referents. These figures were always presented in the same sets of 4 as they appear in Figure 2a.

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[1]Dr. R. M. Krauss most kindly provided these figures for use in this study.

Referents Varying on Binary Attributes. In referential communication tasks there are many reasons for using referents which have been constructed so as to vary systematically on a certain number of attributes. The discussion in this section relates to stimulus sets which vary on four binary attributes which are presented in combinations of four referents at a time. Certain terms require definition.

1. Binary attribute. A binary attribute is a feature of a stimulus which can take two values.

   Example: The binary attribute height can take a value of tall or short.

2. Irrelevant attribute. An attribute is irrelevant whenever this attribute has the same value for all four items in a combination.

   Example: The attribute color is irrelevant if all four items in a set are red.

3. Relevant attribute. An attribute is relevant whenever this attribute assumes different values within the set of four items. There are two types of relevant attributes: redundant and non-redundant.

   a. Redundant attributes. Two or more attributes are completely redundant if a particular value of one attribute always occurs with, and only with, a particular value of another attribute.

      Example: The attributes color and height are redundant if all tall stimuli are red and all short stimuli are white.

b. Non-redundant attribute. An attribute is non-redundant if no value of that attribute always occurs with, and only with, a particular value of another dimension.

Example: Height and sex are non-redundant whenever male stimuli occur with both tall and short values and female stimuli occur with both tall and short values.

4. Symmetric and asymmetric attributes. Within a display of four stimuli, an attribute may be symmetric or asymmetric.

a. Symmetric attribute. An attribute is symmetric if it has one of its values for two stimuli and its other value for the two remaining stimuli.

Example: Color is a symmetric attribute if two stimuli are white and other two are red.

b. Asymmetric attribute. An attribute is asymmetric if it has one value for three stimuli and a different value for the fourth stimulus in a set of four.

Example: Color is asymmetric in a set of four stimuli with three white stimuli and one red stimulus.

Combination of Referents. There are sixteen items in a set of items which vary on four binary attributes: $2^4 = 16$. There are 1820 combinations of 16 things taken four at a time:

$$C\binom{16}{4} = \frac{16!}{4!\,(16-4)!} = 1820.$$

Out of the various possible combinations of the sixteen items, two types of combinations have been selected for study:

1. Combinations of four stimuli with two irrelevant attributes and two symmetric non-redundant attributes.
2. Combinations of four stimuli with two pairs of symmetric redundant attributes.

Descriptive salience. "Descriptive salience" refers to the likelihood of an attribute being verbalized when a referent is being described. Attributes differ in the relative likelihood verbalization. Some of the factors affecting this probability are discussed in the main body of this report. For purposes of preparing sets of referents a simple procedure was used to estimate the relative ordering of the four binary attributes of the people and monkey referents.

Pairs of referents which differed on two dimensions were presented and the S was asked, "How are these two pictures different?" As soon as the S reported one of the attribute, the next pair was presented. Where the S reported both attributes, the item was not scored. Twelve pairs of each referent type were presented in two subsets of 6 pairs. A 6 x 6 Latin square was used to control for order effects. Each attribute dimension appeared 6 times. Six preschool children between the ages of 4 and 5 served as Ss.

The percentage of the time an attribute was verbalized when it was present is shown in Table 20. The difference between the most frequently mentioned and the least frequently mentioned attributes is quite large, especially for the monkey referents. Whereas the "upside down/rightside up" attribute was mentioned in 78% of the cases where it appeared, the "side/center" attribute was never mentioned. The ordering is less

marked in the people referents. Although the differences between the intermediate attributes are not large, the difference between the two most frequently and two least frequently mentioned attributes is considered large enough for the purposes of this study. These orderings must be considered tentative.

TABLE 20

Relative Probability of Verbalization of Attribute

Referent	Attribute	Percent of Verbalization
People	Tall/short	78%
	Red/white	42%
	Fat/thin	36%
	Male/Female	28%
Monkeys	Upside down/rightside up	83%
	Inside/outside	47%
	Top/bottom	38%
	Side/center	0%

Redundancy. There were two redundancy conditions in this study. In the low (or "no") redundancy condition two attributes were relevant and the other two attributes were irrelevant. In the high redundancy condition two pairs of attributes were perfectly redundant with each other.

Redundancy and Salience Combinations. Crossing of two redundancy conditions with two salience conditions led to four combinations on these two factors. There were several possible ways in which these combinations could have been made. The actual choices made will be discussed briefly. The assignments discussed below appear in Table 21.

In Table 21, attributes joined by a hyphen ("-") are mutually redundant. Attributes or attribute pairs separated by an 'x' are crossed with each other in a 2 x 2 set of referents. Two pairs of attribute values separated by a slash mark ('/') are the specific assignments within one half of a 2 x 2 set of referents.

For the low redundancy conditions the assignments to high and low salience conditions are straightforward. With the people referents the high salience condition was that in which the two most frequently verbalized attributes (height, color) were relevant. In the low salience condition sex and girth were relevant. The conditions for the monkey referents are similarly determined.

The high redundancy conditions permit several assignments. For the "high salience, high redundancy" condition each high salience attribute was paired with a low salience attribute, then attribute values were paired within these two attribute pairs.

The "low salience, high redundancy" condition might best be characterized as a "one-half high salience and one-half low salience" condition. The two high salience attributes were made redundant as were the two low salience attributes.

Order of Display. The order of the referents from left to right in the display as seen by the Ss permitted several possibilities. In all of the displays in this study the attribute or attribute pairs with lower salience were placed side by side. For example, in the low salience, low redundancy condition where girth was the least salient attribute the two fat referents were placed side by side as were the two skinny referents. The male and female referents therefore alternated. The result of this display placement may have made the communication task

TABLE 21

Assignments to Salience and Redundancy Conditions

Salience/ Redundancy	Assignments
High/Low	Tall/short x red/white; all fat, male Rightside/upside x outside/inside; all center, top
Low/Low	Male/female x fat/thin; all tall, red top/bottom x side/center; all inside, rightside up
High/High	Tall-male/short-female x red-skinny/white-fat Rightside-bottom/upside-top x inside-side/outside-center
Low/High	Red-short/white-tall x male-skinny/female-fat Rightside-inside/upside-outside x bottom-center/top-side

slightly easier at the cost of some reduction in the degree of difference between the high and low salience conditions.

APPENDIX D

TRAINING PROCEDURES

General. After the Ss had completed 32 slides with each child taking each role for 16 of them, the training was conducted. The two children were seated side by side with the experimenter next to them. The experimenter led them through the 10 training slides in the sequence described below. The training lasted about 5 minutes. There were three objectives of the training: Ss were to look at all four referents (when four were present), say "at least two things" about the target referent, and ask questions when uncertain.

Although the experimenter adhered as closely as practical to the wording given below, flexibility was necessary due to the different responses given by each child. Ample praise, repetition of correct responses, and correction of inaccurate or irrelevant responses. Every effort was made to elicit the desired behaviors from the Ss, repeat all correct responses, and praise them ("One red ant. Good! You said two things about it.") When a child failed to respond, the experimenter gave the desired response and commented upon it ("Well, we might say, 'The big red square.' See, I said two things about it and now you know which one I mean.")

Training Sequence.

YOU PLAYED THAT VERY WELL. DID YOU LIKE PLAYING THAT GAME? GOOD. I WANT TO TELL YOU HOW YOU CAN DO IT EVEN BETTER AND THEN YOU CAN DO SOME MORE. WOULD BOTH OF YOU SIT RIGHT OVER HERE?

Item 1: Blue namables.

LOOK AT THESE PICTURES. SUPPOSE I TOLD YOU TO PICK THE BLUE ONE? WHICH ONE WOULD YOU PICK? [Pause for Ss to reply.]

YES (BUT YOU SEE), THEY ARE ALL BLUE. IF I JUST TELL YOU IT IS THE BLUE ONE, THAT DOES NOT HELP YOU FIND IT, DOES IT?

Item 2: Four colored squares.

LOOK AT THESE PICTURES. SUPPOSE I TOLD YOU TO PICK THE SQUARE ONE, WOULD THAT HELP YOU FIND IT? [Pause.]

NO, IT WOULD NOT. THEY ARE ALL SQUARE SO THAT DOES NOT HELP. THIS IS THE FIRST THING I WANT YOU TO REMEMBER: ALWAYS LOOK AT ALL FOUR PICTURES BEFORE YOU CHOOSE ONE. SEE, IF YOU LOOK AT ALL FOUR, THEN YOU WILL KNOW IF THEY ARE ALL SQUARE.

Item 3: Ants - big/little x orange/blue.

NOW LOOK AT THESE PICTURES. LOOK AT ALL FOUR OF THEM. [Pause.] DID YOU LOOK AT ALL FOUR PICTURES? GOOD. SUPPOSE I TOLD YOU TO PICK THE ORANGE ONE. WHICH ONE WOULD YOU PICK? [Pause.]

YES (YES, BUT...) SEE THERE ARE TWO ORANGE ONES. YOU KNOW IT HAS TO BE EITHER THIS ONE OR THIS ONE, RIGHT?

WHAT ELSE DO YOU NEED TO KNOW ABOUT IT?

("BIG OR LITTLE")

YES. THERE IS ONE BIG ORANGE BUG AND ONE LITTLE ORANGE BUG. NOW IF I SAY, "CHOOSE THE BIG ORANGE BUG," WHICH ONE WOULD YOU PICK? RIGHT. I TOLD YOU TWO THINGS ABOUT IT. I SAID IT IS THE BIG ORANGE ONE AND YOU CAN TELL WHICH ONE I MEAN. SO THAT'S WHAT I WANT YOU TO DO: ALWAYS TRY TO SAY AT LEAST TWO THINGS ABOUT THE ONE YOU MEAN.

N_1_____, CAN YOU SAY TWO THINGS ABOUT THIS ONE?

GOOD. (or prompt)

N_2_____, CAN YOU SAY TWO THINGS ABOUT THAT ONE?

GOOD.

Item 4: Squares: big/little x red/green.

LET'S TRY ANOTHER ONE. FIRST, LOOK AT ALL FOUR. DID YOU LOOK AT ALL FOUR? GOOD. NOW SUPPOSE I SAY, "PICK THE LITTLE RED ONE....THE LITTLE RED ONE." (Slowly.) WHICH ONE IS IT?

GOOD! (or repeat)

SEE. I SAID TWO THINGS ABOUT IT. I SAID THE LITTLE RED ONE. N_1_____, CAN YOU SAY TWO THINGS ABOUT THIS ONE?

GOOD.

N_2_____, CAN YOU SAY TWO THINGS ABOUT THAT ONE?

Item 5: Ants: red/blue x one/two.

LET'S TRY ANOTHER ONE.

WHAT"S THE FIRST THING YOU SHOULD DO?

LOOK AT ALL FOUR PICTURES. RIGHT.

NOW, N_1_____, SAY TWO THINGS ABOUT THIS ONE.

GOOD, YOU SAID "_____ AND _____."

N_2_____, SAY TWO THINGS ABOUT THIS ONE.

GOOD, YOU SAID, "_____ AND _____."

SO THOSE ARE TWO THINGS I WANT YOU TO DO.

ALWAYS LOOK AT ALL OF THE PICTURES.

ANS ALWAYS TRY TO SAY AT LEAST TWO THINGS ABOUT THE ONE YOU MEAN. YOU CAN SAY MORE IF YOU WANT TO, BUT ALWAYS TRY TO SAY AT LEAST TWO THINGS.

THERE IS ONE MORE THING WHICH WILL HELP YOU PLAY THIS GAME BETTER.

Item 6: Square/ball x on/beside table.

YOU CAN ASK EACH OTHER QUESTIONS, IF YOU ARE NOT SURE HOW TO DESCRIBE IT. SUPPOSE I LOOKED AT THESE AND SAID, "I DON'T KNOW HOW TO TELL WHICH ONE." YOU CAN ASK ME QUESTIONS. YOU MIGHT ASK ME, "IS THERE

A BALL IN THE PICTURE?" CAN YOU THINK OF ANY OTHER QUESTIONS TO ASK ME?

N_1_____, ASK ME SOMETHING ABOUT IT. (Prompt if necessary.)

YES, IT HAS A _____. GOOD. CAN YOU ASK ME ANYTHING ELSE?

Item 7: Triangle/ball x on/under table.

LOOK AT ALL FOUR OF THESE PICTURES. SUPPOSE I SAID, "IT HAS A TRIANGLE."

N_2_____, DOES THAT TELL YOU ENOUGH ABOUT IT? (No) CAN YOU ASK ME A QUESTION ABOUT IT? (Prompt, if necessary.)

GOOD. SEE. IF YOU AREN'T SURE YOU KNOW WHICH ONE YOUR PARTNER MEANS, ASK A QUESTION. WHEN THE PICTURES ARE HARD TO DESCRIBE, IT IS IMPORTANT FOR YOU TO ASK EACH OTHER QUESTIONS.

Item 8: Abstract figures.

LOOK AT THESE PICTURES. THEY ARE PRETTY HARD.

SUPPOSE I SAY, "I CAN'T DESCRIBE IT."

N_2_____, CAN YOU ASK ME A QUESTION ABOUT THE ONE I AM LOOKING AT? (Prompt) GOOD.

N_1_____, CAN YOU ASK ME A QUESTION ABOUT THE ONE I AM LOOKING AT? (Prompt) GOOD.

Item 9: Abstract figures.

LOOK AT THESE PICTURES. THEY ARE PRETTY HARD.

SUPPOSE I SAY, "I CAN'T DESCRIBE IT."

N_2_____, CAN YOU ASK ME A QUESTION ABOUT THE ONE I AM LOOKING AT? (Prompt) GOOD.

N_1_____, CAN YOU ASK ME A QUESTION ABOUT THE ONE I AM LOOKING AT? (Prompt) GOOD.

SO CAN YOU REMEMBER ALL THESE IDEAS? ALWAYS LOOK AT ALL THE PICTURES. TRY TO SAY AT LEAST TWO THINGS ABOUT THE ONE YOU CHOOSE.

ASK QUESTIONS IF YOU ARE NOT SURE YOU UNDERSTAND.

LET'S DO ONE MORE.

Item 10: Cup/glass x full/half-full.

WHAT'S THE FIRST THING YOU DO? (Look at all four pictures.) NOW, N_1_____, CAN YOU TELL ME TWO THINGS ABOUT THIS ONE? GOOD.

N_2_____, CAN YOU TELL ME TWO THINGS ABOUT THIS ONE? GOOD.

IF I TOLD YOU IT WAS THE GLASS, WOULD THAT TELL YOU ENOUGH? (No.)

N_2_____, IF I TELL YOU IT IS THE GLASS, WHAT QUESTION WOULD YOU ASK ME? GOOD.

N_1_____, SUPPOSE I TELL YOU IT IS THE CUP, CAN YOU ASK ME A QUESTION? GOOD.

SO, LET'S PLAY THE GAME AGAIN. LET'S START JUST LIKE WE DID BEFORE. REMEMBER:

ALWAYS LOOK AT ALL OF THE PICTURES.

ALWAYS TRY TO SAY AT LEAST TWO THINGS ABOUT IT.

ALWAYS ASK QUESTIONS IF YOU NEED TO.

APPENDIX E

CODING MANUAL FOR DIALOGUE ABOUT SYSTEMATIC REFERENTS

1. General. This manual provides a detailed coding system for analyzing communication about referents which vary systematically on four binary attributes. (Details of these referents are included in Appendix .) The complete dialog for each subject pair regarding each referent was first transcribed. Each "descriptor" was then circled in these transcripts. Finally the entire exchange regarding the referent was then examined and all attributes of the referent which were successfully communicated were coded according to the rules discussed below.

2. Summary of coding. The successfully communicated attributes were coded according to referent number, attribute value communicated, the relevance of that attribute who initially verbalized that attribute, and the number of errors prior to its verbalization.

Referent	Attribute Value	Relevance	Person Initiating	Prior Errors
01-16	1 = tall 2 = short 3 = red 4 = white 5 = male 6 = female 7 = fat 8 = thin	0 = not communicated 1 = relevant 2 = 1st relevant redundant 3 = 2nd relevant redundant 4 = irrelevant	1 = knower 2 = doer	0-3

3. Identification of descriptors. Any word which referred to one of the systematically varied attributes was circled in the transcript. The specific words which were considered acceptable for each attribute value are discussed below.

4. Person initiating description. An attribute can be successfully communicated in two ways. The knower can initiate description in statement form: "It is a red man." Any such statement by the knower

is considered a successful communication. On the other hand the doer can initiate a description by asking a specific question such as, "Is it red?" or "What color is it?" If this doer initiated description is responded to in a meaningful way ("Yes," "No," "It's white," etc.), the communication of that attribute is considered successful and the doer is given credit for initiating it. If no response is given to the question, it is not counted as successful. General questions by the doer are not considered to have initiated any description which follows: "Which one?" "The red one."

5. Definitions of acceptable descriptions by attribute. Human language does not follow neat logical categories. Any coding system for analyzing communication must, therefore, be a mixture of common sense rules for achieving validity and arbitrary rules for purposes of reliability. These definitions include both types of rules.

The greatest difficulty is a result of the fact that certain words may communicate two attributes. For example, "man" means both male and large. Some pairs of children seem to have recognized this and used "man" and "boy" in this fashion. Others seem not to have used these words systematically, but the distinction among pairs cannot be made easily and reliably. In order to ensure adequate reliability, therefore, the coding gave all Ss the benefit of the doubt where such ambiguous usages occurred. Such words were coded as if equivalent to the two attributes which they imply. Any attribute may be described as the negation of the other possibility: "not tall," etc.

Words which were coded as acceptable equivalents for the attribute values were determined on the basis of adult usage. Denotative equivalents consisted of words with similar definitions: "little" for "short," for

example. Connotative equivalents consist of words which suggest meaning: "man" connotes "tall," for example. The acceptable equivalents in the coding of the people referents in this study are presented in Table 22.

TABLE 22

Acceptable Equivalents for the Attributes of People Referents

Attribute	Acceptable equivalents
tall	big, large, man, woman, daddy, mommy
short	little, tiny, small, boy, girl, baby
red	colored, with pants, clothes on, brown
white	plain, not colored in
male	man, boy, he, daddy, short hair, "cap," flat hair, black hair
female	woman, lady, girl, she, mommy, long hair, with hair
fat	big, large, rectangle body, biggest (tall and fat)
thin	skinny, little, small, smallest (thin and short)

Thus, the word "boy" was coded as communicating both male and short, when "short" was a relevant attribute of the target, but "boy" was coded as only communicating "male" when "short" was not a relevant attribute of the target. The general rule was to give the children the benefit of the doubt when such conotations were coded. Therefore, if the target was tall, the word "boy" was not considered to encode the attribute of height incorrectly. Encodings were coded as incorrect only if explicitly incorrect: "short" for a figure which was tall.

6. Administrative details of coding. In order to facilitate coding and increase reliability, coding forms were prepared which indicated the

specific attribute values of the target, identified these values in terms of the codes in paragraph 2, and specified the connotative equivalents which would be acceptable for the attributes. For example, for item 3, the target is a short, red, thin female. Short is redundant with female and red is redundant with thin. "Girl" is therefore credited as meaning both female and short. "Small" is credited as meaning both short and thin. The coding form for item 3 contains the following information:

Item 03 shor22__ red33__ thin83__
"girl" = short + female; "small" = short + thin

The provision of this information on the coding form made it relatively easy for the coder to enter either a 1 or a 2 in the first blank for each attribute designating whether the knower or the doer initiated the encoding of the attribute, and a 0 - 3 in the second blank designating the number of errors which had occurred prior to the encoding attribute. For example, the code '6210' means 'female' was relevant and redundant, and the knower initiated this attribute prior to any errors. These completed codes were then punched into computer cards in fixed fields. Each item for each pair was placed on a single card. This arrangement permits considerable flexibility in data analysis. Insofar as the first two digits specify precisely the attribute and the redundancy condition, a crosstabulation of codes in the complete 4 digit field permits a detailed analysis of the nature of the encoding of each attribute value. Similarly, because the encoding of each attribute dimension such as height (both tall and short) is entered in a fixed field, data analysis on the third or fourth digit alone is possible. The simultaneous use of specific codes to designate the attribute involved and the use of fixed fields to designate who encoded the attribute (if anyone) and when it was encoded allows many options in data analysis.

7. Adequacy, incorrectness, and trivial details.

a. Adequacy for each item for each pair was coded as follows:

0 = no relevant attributes communicated.
1 = one bit of information, half adequate.
2 = two bits of information, fully adequate

If two attributes about a target referent which are redundant are communicated, only a half adequate description has been given.

b. Incorrectness. For each item for each pair a 0 or 1 was coded, indicating whether any incorrect attribute had been communicated. Only explicitly incorrect encodings were considered to be incorrect: "red" when the target was "white," for example.

c. Trivial details. If the knower included any description of certain features of the people referents which were common to all of them, a '1' was coded for that item. The features considered as trivial details were: arms, legs, fingers, feet, eyes, mouth, or nose.

APPENDIX F

CODING MANUAL FOR LISTENER QUESTIONS

1. General. All questions by the doer in the communication game were coded according to the type of question and the type of response received. The questions were identified by referent type and trial.

2. Summary of coding. Each question was coded in three fields.

Referent	Question Type	Response Type
01-64 (Block one) 65-128 (Block two)	1 = Specific 2 = General 3 = Egocentric 4 = Gesturing 5 = Miscellaneous 6 = Statement Form	0 = No response 1 = Informative, appropriate 2 = Ambiguous, "Don't know." 3 = Refusal, "Just push," etc. 4 = No response where question followed immediately by pushing a button. 5 = Experimenter response

3. Definitions of question types.

a. Specific question. A specific question seeks a response to content related to the characteristics of the target provided by the question itself. Specific questions can usually be responded to with a "yes" or "no" or with a single word or phrase. The content of the question need not be relevant, but it must deal with the target. For example, "Is it red?" where all are red is still a specific question. A specific question could also refer to the attribute dimension rather than a particular value of the attribute: "What color is it?" Specific questions relieve the knower of the burden of deciding what to describe.

Examples: Did you say "fat?"
Does it look like a jar?
Woman?
How many points?
Is it sticky?
Upside down?
Where is the monkey in the cage?

b. General question. A general question is a request for additional information where neither the specific value nor the dimension of the attribute is provided by the question. General questions place the

burden of analyzing what to describe upon the knower.

Examples: What?
Huh?
What is it?
What did you say?
Where? (in the sense of "Where is the target?")
What kind of woman? (not questioning "woman.")
What is the monkey doing? (semi-specific, but still general.)
What's a snowflake? (equivalent to "Tell me more.")

c. Egocentric question. An egocentric question appears to assume that the other person is seeing through the same eyes as the questioner. The question, "Is it this one here?", is egocentric where the knower cannot see what the doer is pointing at. In this study the experimenter was sitting between the two Ss, so questions which appear in the transcript to be egocentric may have been reasonable questions addressed to E. As a result, this category must be thought of as "egocentric plus questions addressed to E about the target."

Examples: This one?
Do you mean this one here?

d. Gesturing question. Ss were permitted to describe the referent with gestures, although only a few actually used gestures to any real extent. A question which seems to have been accompanied by gesturing is a gesturing question unless the question also contained specific verbal content in which case it is a specific question. If there is any indication of gesturing the question is coded as gesturing despite the fact some gesturing was egocentric in that the knower may not have watched the gestures.

Examples: Does it go like this?
Is it shaped like this?
Does it go like this and like this and like this?

but: Is it a leaf like this? (specific question)
Does it have an X like this? (specific question)

e. Miscellaneous question. A miscellaneous question does not deal with the communication act itself. Any question addressed to E is miscellaneous, such as questions about the rules of the game, the machine, and so on. Any illegal question regarding the location of the target in the display is coded as miscellaneous: "Is it the picture on the end?" Questions regarding correctness after a button is pushed are coded as miscellaneous because the correctness is indicated by the machine. Such questions do not communicate information.

Examples: May I show him which one?
What's that microphone for?
How many more pictures?
Did I get it right?

f. Statement question. Statements by the doer with specific content which were responded to as if they were questions were coded as statement questions. The distinction between statements and questions is often difficult to draw, especially in the language of young children. Questions may be signalled by either sentence structure or intonation. Message units ending with a rising intonation were marked with a question mark, whatever the sentence structure: "In the middle?" and "It is a fat man?" Judgements of intonation, however, are not perfectly reliable.

Some statements, apparently unmarked by a rising intonation, were responded to as if they were questions. Insofar as information is elicited by the doer in this fashion, these statements are functionally equivalent to questions. These exchanges usually involve repetition of a description by the doer with a confirmation by the knower. Sometimes the doer offers a series of guesses in statement form.

Examples: It's a red fat man.
It's a red fat man....
Yes.

It's a bird.
No.
It's an elephant.
No.

g. Interrupted message units. Self-interrupted questions which are not complete and are followed by rephrasing are treated as one question: "Is it a fat - a fat man?" Incomplete questions which were interrupted by a response from the knower are treated as bona fide questions:

"Is it the - " "Fat boy."
"Is it the fat - " "Boy."

These may also occur in statement form.

"It's in the - " "Middle."
"It has two - " "Yes." (Inferred "2 points.")

h. Repetitions. Completed repetitions are coded as two questions because of the difficulty of measuring pauses:

"Is it the fat man? - The fat man?"

4. Definitions of response types.

a. No response. The "no response" category is used when a question is not followed by a message unit by another person indicating at least a minimal reaction to the question. A question followed by another message unit by the questioner is usually considered to have received no response: "Is it red? Tell me what it is." Sometimes after a long pause, E would prompt a response. If E had to prompt, the question is considered to have received no response: "Is it red?" (Pause.) E. "Can you tell him about it?" "It's red." Although wide latitude was allowed in admitting messages as responses, clearly unresponsive messages were not coded as responses: "Is it red?" "I see a microphone."

(See paragraph 4e for questions followed immediately by pushing the button.)

b. Informative or appropriate response. A response which communicates meaningful information is an informative, or "good," response. It may include explicit descriptive words or implicit description by responding with a "yes" or "no."

Examples:	What color is it?	Red.
	Is it red?	Yes.
	What?	The red one.

An appropriate response to an egocentric question reminds the questioner that the knower cannot see the referent.

Do you mean this one? I can't see yours.

c. Ambiguous or non-informative response. An ambiguous or non-informative response contains no information content, content which is ambiguous, or a statement equivalent to "I don't know."

Examples:	Is it red?	It's a people.
	Does it look like a jar?	What?
	Is it a leaf?	I don't know what it is?
	Is it a leaf?	I guess so.

d. Refusal to respond. If a Ss responds with an explicit refusal to answer a question or with suggestion to guess, this is coded as a refusal. This type of response provides an indication of a competitive attitude on the part of the knower.

Examples:	Is it red?	I'm not telling you, Buster.
	Is it red?	Push it and see.
	Is it red?	If I tell you, it will be easy.
	Is it red?	Do it.

e. Question followed immediately by pushing a button. Many Ss adopted a pattern of repeating a description in question form then immediately pushing the button. In some sense this behavior gives the knower a brief opportunity to interrupt if the description is incorrect,

although it may merely be a mannerism in most instances. It is difficult to judge the length of pauses which would help discriminate these two patterns. Therefore, patterns of this type were placed in this unique category. Any intervening message unit or an indication of a long pause by the typist implies no response.

Examples: The fat lady? (Push - Correct)
Upside-down monkey? (Push - Correct)

but: The fat lady? Oh, I see it. (Push - Correct)
(Coded as question receiving no response.)

f. Experimenter responds. E responded to miscellaneous questions and questions in egocentric form when the speaker clearly turned and addressed him. These responses were all coded in this category. If an egocentric question was not addressed to E, E attempted to say nothing, but after a long pause E would prompt the knower to speak or the doer to try one when no further description was given.

Examples: How many more pictures? E: Four more.
Is it this one? E: Ask him.

but: Is it this one? (Pause) Tell him something about it.
Is it this one? (Pause) Just try one.