DOCUMENT RESUME

ED 069 350 24 PS 005 938

AUTHOR Ehri, Linnea C.; Ammon, Paul R.
TITLE The Development of Antonym Adjective Structures in Children. Final Report.
INSTITUTION California Univ., Berkeley.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
BUREAU NO BR-0-I-045
PUB DATE Apr 72
GRANT OEG-9-70-0015(057)
NOTE 159p.

EDRS PRICE MF-$0.65 HC-$6.58
DESCRIPTORS *Comparative Analysis; *Early Childhood; *Language Development; *Listening Comprehension; Scoring Formulas; Statistical Data; Structural Linguistics; Task Analysis

ABSTRACT

The purpose of this project was to explore and more carefully design studies of adjective-related structures and processes as they emerge during development in children between the ages of 4 to 8, since the salient characteristics in speech at this age tend to compare and contrast objects encountered in their environments. A group of 40 black and white males and females between the ages of 4 to 8 were tested. The methods used were: 1. Negative Word Association Task, 2. One-Dimension Description, 3. Coordinated Language, 4. Hungry Pig, 5. Transformation, 6. Language and Seriation, 7. Seriated Picture Comprehension, and 8. Clay Manipulation Task. The greatest performance differences occurred between ages 4 and 5, and ages 6 and 8, but race was not found to be a factor, and sex emerged only twice as a significant variable. Comprehension appeared to precede and be a requisite for production of coordinated language during development. Results, though tentative, were thought to offer suggestions for future research. Summary Analysis and Journal citations are included. (RG)

FINAL REPORT
Project No. 0-I-045
Grant No. OEG-9-70-0015(057)

THE DEVELOPMENT OF ANTONYM ADJECTIVE STRUCTURES IN CHILDREN

Linnea C. Ehri
Paul R. Ammon
University of California
Berkeley, California

April 1972

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

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

Office of Education
Bureau of Research

ACKNOWLEDGEMENTS

The cooperation of the Childrens Centers, part of the Oakland Public School System, was a primary ingredient contributing to the success of this project. Mr. Sherman Skaggs and his staff at Laurel, Emerson, Arroyo Viejo, and Clawson centers were most helpful in making arrangements for our work with the children. Data was collected and analyzed with the extremely able assistance of Ronna Case and Janice Lohr, the two experimenters, and Ilana Dubose, the transcriber. The author is grateful to all concerned for their devotion to the project.

TABLE OF CONTENTS

Figures

SUMMARY

The present project was intended to explore processes involved in the child's acquisition and use of antonym adjective pairs and related linguistic and operational structures and to determine whether these capabilities could be organized into a developmental sequence. The project was divided into two phases, the first to explore the feasibility of various tasks, and the second to administer the tasks to a sample of 40 black and white males and females between the ages of 4 and 8. The following capabilities were selected for investigation: possession of an antonym adjective lexicon; use of antonym adjectives to describe object differences; comprehension and production of coordinated language; comprehension of conjunctive and disjunctive conjunctions; ability to perform mental transformations among relational linguistic structures; seriation of objects by size and weight; production and comprehension of comparative and equative constructions; comprehension of double adjective modifiers.

Analyses of results as a function of subject variables revealed a total absence of any effects as a function of race. Sex emerged only twice as a significant variable. In contrast, age differences predominated in most of the tasks, often with the greatest performance differences occurring between the younger Ss (ages 4 and 5) and older Ss (age 6 to 8).

Performances on measures of lexical-conceptual development indicated that the greatest gains in adjective growth occurred prior to age 6. However, not all basic antonyms emerged during this period. Some evidence was obtained confirming the findings of Donaldson and Wales (1970) that when marked or mini-adjectives enter the lexicon, they may be mistaken for the maxi-pole. However, this mini-to-maxi assimilation pattern was observed for only some, not for all antonym pairs. It was suggested that the occurrence of this phenomenon may depend upon the lexical histories of particular mini-terms, that is, the nature of their associations with other terms prior to their hookup with particular dimensions.

One of the purposes of the project was to pursue some of the findings and conclusions drawn by Inhelder et al. (1966) and de Zwart (1969) regarding the relationships among lexical, linguistic-structural, and operational capabilities and their emergence during development. Some difficulty was encountered in adopting their definition of coordinated language because they did not clearly separate this form from the comparative form. However, findings confirmed their claim that comprehension appears to precede and to be a prerequisite for production of coordinated language during development. Also, production patterns suggested that coordinating physically similar dimensions was an easier process than coordinating physically dissimilar dimensions, but that coordinating maxi-maxi polar terms or mini-mini polar terms was not simpler than coordinating combinations of adjectives opposite in polarity. Furthermore, negating one of the adjectives did not appear to enhance comprehension difficulties.

In contrast to confirmation of the Piagetian researchers' findings regarding coordinated language, results involving the production and comprehension of comparative forms and the ability to seriate did not substantiate their conclusions. When age was minimized as a factor, the ability to produce full comparative forms did not distinguish between seriators and non-seriators. However, comparative-equative comprehension capabilities were found to be related to the ability to seriate. Furthermore, comparative forms were observed in the speech of Ss who lacked full comprehension capabilities. These results suggest that comparative comprehension rather than production constitutes the prerequisite capacity for operativity and that the emergence of comprehension may follow rather than precede the emergence of production for this class of syntactic constructions. It is possible that when mastery of an underlying system of linguistic-conceptual structures is involved, production of parts of the system may occur prior to full comprehension.

There were some additional results of interest in the seriation tasks. Inspection of the language of non-seriators revealed that they tended to confuse and to lack the ability to coordinate the operation of grouping and the operation of contrast in their descriptions and orderings. The observation of over-engineered descriptions for seriated object sets suggested the possibility that Ss were not fully aware of the meanings of components they were putting together. In the comprehension task, affirmative comparative constructions proved easier than negative comparatives, while negative equatives were easier than affirmative equatives. In the object ordering task, horizontal decalage was observed in the responses of Ss. Despite the fact that they noticed the relevant dimension, not all Ss who could order by size could also order by weight. However, all weight seriators were successful on the size task.

Most of the Ss were able to perform some mental transformations among relational statements. However, not all of the transformations were equally easy. Processing a mini-adjective combined with a negative marker proved to be harder than processing the corresponding maxi-form. This is consistent with evidence cited by Huttenlocher (1972) who identified the former as a double negative. The fact that such double negatives did not prove to be more difficult in other tasks suggests that this form imposes a special burden on Ss when its meaning cannot be read off the stimulus but must be determined by mental manipulations of the data.

Inspection of inter-task relationships revealed some evidence in support of the possibility that at least some of the capabilities emerge in sequence during development. In contrast to de Zwart's (1969) claims that lexical growth is less important to the emergence of operativity than linguistic-structural capabilities, measures of lexical-conceptual development used in the present study bore strong relationships to seriation ability as well as to measures of coordinated language comprehension and comprehension of the adjective modificational system. Also, both comprehension of coordinated language and comprehension of comparative language were identified as possible

prerequisites for seriation. In contrast to the Piagetian researchers' claim that production is critical, these results suggest that comprehension capabilities are the ones significantly related to other capabilities.

Results of the present study, though tentative, offer many methodological as well as substantive suggestions for future research. Most importantly, they point to the need for additional work to resolve the discrepancies between present and previous findings regarding comprehension-production lags and the developmental relationships among lexical-conceptual, linguistic-structural, and operational capacities. They hint at the possibility that a model conceptualizing emerging capabilities as sequential and additive may be oversimplified.

INTRODUCTION

One of the salient characteristics emerging in the speech of children between the ages of four and eight involves the use of antonym adjectives to describe, compare, and contrast objects encountered in their environments. As children develop, new descriptive terms are added to their vocabularies as they refine their knowledge of object and object relations. The present study is intended to investigate aspects of the emergence of adjectives. The need for this research arises from at least two sources:

(1) Psychologists, for the most part, have not been able to identify anything very interesting about the emergence of antonym adjectives in child language because they have been preoccupied with the study of surface phenomena, that is, vocabulary and speech. Recently attention has been drawn beneath the surface to deep structure syntactic and semantic levels of analysis. This orientation suggests the fruitfulness of exploring the underlying organizational features of antonym adjectives, that is, the knowledge involved in acquiring, comprehending and using appropriately those adjectives. This view of language which distinguishes deep from surface levels of analysis is suggested by various linguistic theories of transformational grammar (Chomsky, 1965; Langacker, 1968). Several characteristics of this approach to language make it useful for thinking about the acquisition of adjective structures: the distinction between competence and performance, the notion of an abstract underlying structure, rules of transformation for linking deep and surface structures, etc. This view is important because it identifies and describes complexities of language which have been overlooked by many developmental psychologists.

(2) One of the most active areas of research today involves the study of cognitive development. And one of the leading investigators is Jean Piaget, whose theory and research suggest that intellectual development proceeds by identifiable stages. Growth between the ages of six and eight is viewed as involving a transition between the pre-operational level and the concrete operational level of thinking. With the advent of the latter stage, the child becomes capable of performing logical mental operations which have such properties as reversibility and transitivity. Possession of such capabilities is inferred from the child's performance in various kinds of tasks. However, the child's ability to respond correctly in these tasks depends not only upon logical operational capabilities but also upon his ability to comprehend and to use antonym adjectives. For instance, in order for a child to perform successfully in traditional (i.e., verbal) conservation tasks, he must be able to comprehend the relational terms used by the experimenter. Several studies indicate that this is an important factor. Gruen (1968) found that when the meanings of terms "more" and "less" were distinguished and children were given practice in using these terms to refer to number of objects rather than to length of the line formed by the objects, more children were able to conserve number. Another line of evidence suggests that, when tasks are designed so that language comprehension is minimized as a prerequisite for success, then children display operational abilities at a much younger age. A study by Braine (1959) indicated that children around

the age of 4.5 could succeed in nonverbal tasks requiring transitivity and seriation of logical operations. These findings suggest the need to clarify the role of language in the transition from preoperational to concrete operational thinking and also the importance of determining just what children think these terms mean. Inhelder et al. (1966) have attempted to assess differences in the language habits of conserving and non-conserving children, but the tests used by these researchers are not completely adequate.

The present study was intended to chart some structural as well as lexical aspects involved in the emergence of antonym adjective pairs in the language of children in order to illuminate what is happening linguistically during the period of time in which the child ascends from the preoperational to the concrete operational stage of thinking.

The Nature of Adjective Structures

In order to investigate the development of adjective structures, an experimenter must have some notion about what it is that develops. Various suggestions regarding the structure underlying adjectives emerge from studies of word associations, from linguistic analyses, and from psycholinguistic investigations.

That anyonym adjectives can be regarded as linguistic structures is suggested by Deese (1964). Based on his analysis of the associative meanings of practically all common English adjectives in adult subjects, he concludes that a very considerable portion of the intraverbal meaning can be directly described by the contrast or polar-opposite scheme. That is, most of these adjectives elicit on a word association test their opposites and the relationship is reciprocal. In addition, he finds that such a reciprocal definition serves to identify all contrast pairs, with no false positives. This result is perhaps surprising in view of the tendency to regard synonyms as closer relatives than antonyms. However, Deese finds that the relationship of synonymity is nonreciprocal. Although synonyms for these terms may elicit the appropriate antonym pole, the reverse does not occur. Deese identifies the following set of fundamental contrast pairs. However, he does not suggest that this is an exhaustive list.

Alone-together	Dark-light	Hard-soft	Old-young
Active-passive	Deep-shallow	Heavy-light	Poor-rich
Alive-dead	Dry-wet	High-low	Pretty-ugly
Back-front	Easy-hard	Inside-outside	Right-wrong
Bad-good	Empty-full	Large-small	Rough-smooth
Big-little	Far-near	Left-right	Short-tall
Black-white	Fast-slow	Long-short	Sour-sweet
Bottom-top	Few-many	Married-single	Strong-weak
Clean-dirty	First-last	Narrow-wide	Thick-thin
Cold-hot	Happy-sad	New-old	

Upon examining intercorrelations among the vectors defined by the factor loadings of each antonym pair, Deese (1965) finds that they are surprisingly low. Only three exceed 0.10. This suggests that

intraverbal meanings for these antonym pairs are fairly independent. In other words, each pair is associated with a somewhat unique collection of words which perhaps serve to identify that pair and to keep it separate mentally from other pairs. Although the pairs are distinct conceptually, it should be noted that some of the polar terms serve as members of more than one antonym pair (e.g., heavy-light, light-dark). Such duplication no doubt produces greater discrimination problems for children yet the lexical load is lightened.

Examination of the antonym pairs identified by Deese reveals that whereas some are dichotomous, others refer to scalable dimensions. However, regardless of the underlying meaning signaled, the polar terms themselves appear to function dichotomously. In order to express degrees along the scale and to make comparative statements, additional devices such as comparative or superlative inflections, intensifiers, or synonyms are needed. For example, to express extremes in size, a person might utilize terms such as "huge," rather than "big," or he might attach the modifier "very" to "big." To indicate relative size, he might add comparative or superlative inflections (i.e., bigger, biggest). That this involves a system applied to the basic contrast pairs is suggested by the fact that mature speakers employ this modificational system only with the basic contrast pairs, not with related synonyms. For example, adults are not likely to describe something as "very huge" or "huger," or the "hugest." Only polar terms such as "big" are appropriate in these contexts.

Linguistic analyses of these adjectives (Clark, 1970) reveal that many pairs can be shown to consist of an unmarked [+ Polar] and a marked [- Polar] term. The unmarked term differs from the marked adjective in that it can be used with neutral meaning, and it refers to both a region on a scale and the name of the scale itself. For example, asking "How long is the pencil?" implies nothing about the speaker's expectations, while inquiring "How short is the pencil?" involves a presupposition that the pencil is short. And replying "It is two inches long" is acceptable, while answering "It is two inches short" is not. Thus, "long" is considered unmarked and "short" marked.

Another way to describe this distinction is to note that when the comparative inflection is attached to the unmarked term (e.g., long + er), an increase in degree along the dimension is signaled, while adding the same inflection to the marked term (e.g., short + er) denotes a decrease along the dimension. For this reason, in the present study, the former is referred to as the maxi-adjective pole and the latter the mini-adjective pole.

Examination of the relationship between the polar terms and the underlying dimension reveals that the poles do not constitute mirror images. Wheras the region denoted by the mini-pole approaches a value of zero on the dimension, the region denoted by the maxi-pole appears to increase endlessly.

Evidence from various sources confirms the psychological relevance of this distinction between maxi-poles and mini-poles. In his word

association data, Deese (1965) found that response distributions of terms such as "speed" and "size" resembled the distributions of their maxi-adjectives (i.e., "fast" and "big," respectively), not their mini-adjectives. In her observations on developmental trends in the use of language, Inhelder (1969) reported that children employed the comparative form of the maxi-adjective term to describe lines before they used the comparative form of the mini-adjective pole (i.e., "longer" appeared in the child's speech at an earlier age than "shorter"). Clark & Card (1969) asked adults to learn sentences containing comparative adjectives and found that they remembered maxi-adjective sentences better than mini-adjective sentences, and that they tended to substitute maxi-terms for mini-terms much more frequently than they did the reverse.

The above analyses and findings suggest that at least some of the antonym pairs can be viewed as being related to an abstract underlying dimensional structure which is continuous, has a zero point, and extends from zero in a positive direction, in some cases approaching infinity. The contrast adjective pairs represent lexically the two poles of the dimension. The maxi-polar term, in addition to serving as the general label for the dimension, is used to denote increases along the dimension. The mini-pole term refers to decreases along the dimension approaching zero. This structure appears to describe the following maxi-mini pairs: big-little, deep-shallow, fast-slow, fat-skinny, full-empty, hard-soft (easy), heavy-light, high-low, large-small, light-dark, long-short, many-few (more-less), old-new (young), rich-poor, rough-smooth, strong-weak, tall-short, thick-thin, wide-narrow. There exist a few pairs which appear to constitute exceptions either because a zero-point is not identifiable (i.e., hot-cold, happy-sad, pretty-ugly) or because the extension from zero appears to run in a negative rather than a positive direction (i.e., clean-dirty, dry-wet).

Adjectives are used in speech to draw comparisons among objects. Depending on the relations being expressed, these constructions might assume various forms or form combinations: the comparative form (X is bigger than Y), or the equative form (X is as big as Y), or the negation of either of these forms. When more than two objects are involved, the form combinations can become quite complex (X is not as big as Y but X is bigger than Z). However, because relations which are part of an underlying system are being expressed by each of these forms, the use of one carries implications regarding the truth or falsity of the other forms. That is, the equivalence or non-equivalence among these forms is dictated by the underlying system. For example, if one asserts that X is as big as Y, it follows that Y is not bigger than X.

It is important to note that in speech the nature of this abstract dimensional structure is not directly represented. For example, the same comparative inflection is added to both maxi-terms and mini-terms. However, in one case an increase along the dimension is denoted while in the other case a decrease is signaled. (Parenthetically, it might be noted that this aspect of adjective structures does involve a mirror image.) In interpreting such utterances, a listener must have organized

the adjectives into maxi- and mini-poles in order to know which direction is signaled. The importance of this underlying knowledge is most striking in the interpretation of adjective combinations such as "a little bigger." The listener must possess and coordinate quite a bit of structural knowledge in order to distinguish which region along the dimension is being denoted and to determine whether and how much of an increase or a decrease is signaled. The listener cannot extract the appropriate interpretation by processing the meaning of each morpheme separately and then adding them together. Furthermore, there exists nothing in the surface structure to indicate which forms are equivalent in meaning and which are not, or which forms are implicated by others and which are not. One must possess the underlying dimensional structure to make such judgments.

One other structural feature of adjectives might be mentioned, the feature which distinguishes adjectives from nouns in terms of their relation to referent objects. Whereas nouns involve the use of labels to identify and classify similar objects, adjectives are used to group and to contrast both similar and different objects. In doing this, the appropriateness of the specific adjective label is relative and varies depending upon the context. For instance, the same pencil can be called "long" when compared to a toothpick but "short" when compared to a flagpole. However, the noun "pencil" does not change and in fact is viewed as a sort of permanent feature of the object.

The foregoing describes some of the characteristics of adjective structures discoverable when one examines what is required to comprehend the meaning of and to use adjectives. The functional value of an underlying dimensional representation is that it reduces drastically the amount of information needed in the stimulus to convey a message. Listeners who possess such structures can rapidly interpret dimensional utterances. Furthermore, they can organize and represent simultaneously in thought phenomena which are changing temporally and/or spatially along a dimension. Although such a system is most efficient for mature speakers of a language, the problems encountered by young children, who have not yet acquired these structures must be overwhelming. Thus, it is of interest to examine the emergence of these linguistic-cognitive capabilities. Can any evidence be obtained to indicate whether the child's acquisition of knowledge involves the construction of such an abstract dimensional structure with its linguistic correlates, a structure which he uses to organize reality and to make sense of speech containing adjectives?

Adjectives, Language Development, and Cognitive Development

There exist some studies which suggest aspects of the emergence of adjectives. Entwisle (1966) examined word associations in young children and found that contrast adjectives rapidly emerged as responses between the ages of 6 and 8 years. Prior to that age, noun responses constituted the most common associate of all stimuli. Also, she found IQ to be associated with a child's tendency to emit antonyms. That is, prior to the third grade, children with higher IQs were more likely to give opposites as responses. Furthermore, her data revealed that

as age increased, children were less likely to respond to a given antonym with opposites from other similar antonym pairs (e.g., in first grade, "tall" elicited "small" and "little" as often as it elicited "short," while in fifth grade "short" was given by six times as many children as "small"). This suggests the gradual emergence of separate identities among similar dimensions. Ervin-Tripp and Foster (1967), using another task more directly aimed at determining the relationship between age and confusion among similar dimensions, provided supporting evidence for Entwisle's data. They found that sixth graders had much less trouble differentiating dimensions in their descriptions of objects than first graders. These studies combine to suggest that adjective emergence is an important part of development between kindergarten and third grade, and that part of this development involves learning to distinguish among dimensions which are similar.

One of the issues arising in research on cognitive development involves the relationship between language and thinking: does language lead to the development of thought? or does thought develop first and prepare the way for the acquisition of language? This issue has arisen specifically in connection with attempts to distinguish between pre-operational and concrete operational levels of thinking in children. Whereas Bruner (1964) claims that symbolic representation is the factor underlying the transition from one level to the next, Inhelder et al. (1966) argue that linguistic facility is necessary but not sufficient for operational thinking. As a consequence of their attempts to explore the relationship between a child's ability to comprehend and produce language and his performance in various cognitive tasks, both Genevan and Harvard research camps have uncovered some interesting features involved in the emergence of contrast adjectives structures in child speech and thinking.

The Genevan group reported that conservers differed from non-conservers in terms of the adjective structures used. Inhelder et al. (1966) found that conservers but not non-conservers produced language patterns consisting of comparatives, differentiated parts, and coordinated terms. That is, conservers used the terms "more" and "less" to compare amounts whereas non-conservers tended to describe amounts in absolute terms such as "big" and "small," or "a lot" and "a little." Also, conservers used two pairs of opposites to describe objects differing on two dimensions whereas non-conservers used one term to refer successively to two different dimensions (e.g., "big-small" and "tall-small"). Furthermore, conservers, unlike non-conservers, could coordinate two dimensions. For example, they were able to notice simultaneously that one set of marbles was both more numerous yet also smaller that another set, whereas non-conservers, if they distinguished the two dimensions at all, only focused on each one successively.

Although conservers and non-conservers differed in their production of adjective structures, Inhelder et al. (1966) found that these groups did not differ in their ability to comprehend these structures. This is suggested by the finding that both groups were able to follow instructions comprised of these structures.

In addition to examining the production and comprehension capabilities of subjects, these researchers attempted to teach non-conservers the language used by conservers and then to determine whether this training enabled them to perform successfully on a conservation task. De Zwart (1969) reported that it was easiest to teach non-conservers to use differentiated terms, less easy to teach the comparatives "more" and "less," and most difficult to teach coordinated structures. However, only 10 percent of the children who were able to learn these expressions acquired the ability to conserve. The other subjects just became better able to utilize their newly acquired language to justify their non-conservation responses.

From this series of experiments, de Zwart (1970) drew the following conclusions:

(a) A distinction must be made between lexical acquisition and the acquisition of syntactical structures, the latter being more closely linked to operational level than the former. The operator-like words (e.g., more, less, as much as, none) form a class apart whose correct use is also very closely linked to operational progress. The other lexical items (e.g., long, short, thin, thick, high, low) are far less closely linked to operativity.

(b) Operational structuring and linguistic structuring or rather linguistic restructuring thus parallel each other. The lexical items are already being used or at least easily learned at a pre-operational level; the coordinated structures and operator-like words are correctly "understood" in simple situations; but the latter are only precisely and regularly used with the advent of the first operational structures. Moreover, the difficulties encountered by the child in the use of these expressions seem to be the same as those he encounters in the development of the operations themselves: lack of decentration and incapacity to coordinate.

(c) Verbal training leads subjects without conservation to direct their attention to pertinent aspects of the problem (covariance of the dimensions), but it does not ipso facto bring about the acquisition of operations (pp. 324-325).

These results are most useful in suggesting some of the steps and sequence of steps involved in the emergence of adjective structures.

One other investigator has also focused upon that part of adjective use involving the production of coordinated language. In examining children's descriptions of a 3 x 3 matrix of beakers organized in terms of increases in height and width, Bruner (1964) distinguished three types of productions: global, confounded and dimensional. The younger children tended to use global descriptions in which the two dimensions were given the same polar labels (big and little). Confounded language consisted of the use of dimensional terms (tall and fat) for one pole of each dimension and global terms (little) for the other pole. In contrast to these two types, dimensional language involved mentioning the specific polar terms for both poles of the dimension

and thus clearly distinguishing the two dimensions in speech. Furthermore, Bruner found that the children who produced confounded descriptions had the most difficulty when asked to set up a transformed version of the matrix, and children using dimensional descriptions performed best. However, not all but only about 40 percent of these latter subjects (the ones producing dimensional descriptions) were successful on the transposition task. Bruner concluded that 'having' vocabulary, even organized in dimensional pairs, is not necessarily the same as using it to organize experience or to order one's intellectual operations. This is similar to the conclusion reached by Inhelder et al. (1966) in their examination of linguistic productions and performance in seriation tasks, that possession of the linguistic structures necessary to represent an ordered array in speech does not constitute the complete equipment needed to arrange the objects in order. This evidence appears to provide more support for Piaget's than for Bruner's position regarding the relationship between language and thought.

The Present Study

From the foregoing analyses and investigations of adjective structures, it is possible to identify various developmental steps describing the emergence of these adjective-related structures in the language and thinking of children. Lexical aspects appear to precede linguistic-structural aspects which in turn appear to precede operational capabilities during development. It is the purpose of the present study to examine further these steps and their interrelationships in order to verify and make explicit the nature and sequence of these emerging capabilities. For each of the capabilities, measures of both comprehension and production are attempted in order to assess the lag between these two classes of performance. Also, these capabilities are examined in two different populations of subjects in order to more firmly establish the generality of any results obtained.

To accomplish the above objectives, it is essential to take a close look at the tasks used to reflect underlying processes. This is necessary to enhance the likelihood that performance is indeed a reflection of competence. Although Inhelder's results are extremely useful in suggesting some aspects of the emergence of adjective structures, some of the tasks provide inadequate indices of the abilities being inferred. The comparative comprehension test is one of these. In this, the child is presented with only <u>two</u> groups of objects differing in amount and is told to give more to the girl doll than to the boy doll. In order to perform successfully, the child has only to note a dichotomous contrast between the two groups. If he interprets "more" and "less" to mean "big" and "little," or "many" and "few," then he can carry out the instructions. He needs no notion of relative amounts. Thus, the ability to "follow instructions" in this instance does not constitute an adequate criterion of comparative comprehension. Also in their investigation of a child's ability to

produce coordinated language, Inhelder et al. (1966) fail to distinguish between the general ability to coordinate and the specific ability to coordinate two particular dimensions. Their task examines only whether the child can coordinate similar, experientially correlated dimensions yet they infer that nonconservers lack the general ability. Perhaps the problem of the nonconserver is not that he lacks this structure but that he has trouble using it with certain dimensions.

The possibility of committing these oversights in research on language development is recognized by Chomsky (1964) who reminds investigators of the need to distinguish between competence and performance. Inferences about what the child knows must be based on observations of what he does or is able to do, yet knowledge of underlying structures is not always clearly reflected in one particular performance or another. The latter may be affected by setting, mood, or particular task characteristics which combine to obscure one's view of underlying competence. As Chomsky (1964) points out,

> "The deeper question concerns the kinds of structures the person has succeeded in mastering and internalizing, whether or not he utilizes them, in practice, without interference from the many other factors that play a role in actual behavior. For anyone concerned with intellectual processes, ... it is the question of competence that is fundamental....
>
> ...if anything far-reaching and real is to be discovered about the actual grammar of the child, then rather devious kinds of observations of his performance, his abilities, and his comprehension in many different kinds of circumstances will have to be obtained, so that a variety of evidence may be brought to bear on the attempt to determine what is in fact his underlying linguistic competence at each stage of development." (p. 36)

Testing for competence regarding adjective structures is not at all straightforward. Not only are many tasks necessary but also care is required to insure that inferences from performance to competence are valid. The danger of an experimenter's inadvertently providing nonlinguistic support in his tasks is substantial. Also, there is the danger of attributing more competence to the child than successful performance at a task warrants. In the present study, this problem was considered for each of the tasks used. In all cases, results must be regarded as tentative since it has been found impossible to surmount all of the problems resulting from the competence-performance dilemma.

METHODS

Previous studies suggest that the emergence of contrast adjectives is a salient feature of development between the ages of 4 and 8 and that this process needs to be examined in more detail. The present study was intended to do this. The project was divided into two phases. The first involved constructing and administering a preliminary set of tasks to a small sample of children. Based upon analyses of these performances, the tasks were modified and given to a larger sample of children in the second phase of the study. The aim was to arrive at a series of tasks which would reflect aspects of the child's growing ability to comprehend and use relational terms in various ways.

Subjects. Equal numbers of black and white males and females between the ages of four and eight were included in the sample. These children were obtained from several day care centers operated by the Oakland Public Schools. The majority of the children enrolled in this program come from lower-middle income, single-headed families. Parental permission was obtained for each child. Twenty-four children were tested during Phase I and forty children were included in the Phase II sample. No child was included in both samples.

Testing Procedures. Subjects were tested individually by a white female adult. Whereas a single experimenter handled Phase I testing, two women were used to complete Phase II. Each tested half of the children in each age, sex, and ethnic group. All test sessions were recorded on tape for transcription and analysis. Two to four separate test sessions (total of approximately two hours) were required to administer all the tasks to each child. These were conducted on separate days. During Phase I, a shortened version of each task was given to subjects unable or unwilling to respond. During Phase II, tasks were constructed so as to eliminate the need for shortened versions of tasks.

Design. Phase I testing was conducted for the purpose of pilot testing the various tasks. Performances within and between tasks were analyzed as a function of age. Sex and ethnic group were ignored since so few Ss were tested. Answers to several open-ended questions were examined in order to supply additional information about how Ss were using or misusing adjective terms and structures. It was hoped that this information would suggest how existing tasks might be modified and which new tasks might be added during Phase II.

Performances during Phase II testing were analyzed more completely. Measures displaying a sufficient range of scores were subjected to analyses of variance. The independent variables were: sex, ethnic group, and age. Post hoc comparisons using Tukey's method were utilized to locate differences appearing as a function of age. To compare performances between tasks, responses were analyzed in terms of pass-fail criteria and the results were inspected for developmental patterns. Also X^2 tests of independence and correlation coefficients between pairs of tasks were calculated.

Task Development. Through extensive pilot work, various problems regarding adequate testing procedures as well as tasks were detected and resolved. Because the experimenter's energies were fully consumed by task administration requirements, it was necessary to rely almost entirely upon a tape recorder for collecting response data. Thus, all pertinent information had to be conveyed in the auditory mode, either by E or by S. To accomplish this, all objects were assigned phonetically distinct proper names (e.g., Art, John), and E identified by name the referents designated by children in their responses.

Also, problems in the wording of directions and questions were uncovered. In asking a child to choose objects which illustrated particular properties, if the child was not sure of the answer, he was likely to be influenced by the number of objects implied in the instructions. For example, in the task to measure comprehension of coordinated language, use of a plural adjective rather than one implying either singular or plural possibilities (i.e., "Show me some buildings that are tall and fat.") appeared to suggest to the child that more than one building was correct and that buildings possessing only one as well as both of the properties were acceptable. Use of "any" rather than "some" combined with a followup question, "Are there any others?" was found to be more effective in discriminating between children who could and could not comprehend coordinated language.

Production tasks and their instructions were found to be much more difficult to design than comprehension questions. Not only did such instructions have to make clear to the child what aspects of the stimuli to center on, what knowledge to bring to bear on the problem, and what sort of response to emit, but also the instructions had to appeal to the child in a way which motivated him to respond. Unless such conditions were met, one could not draw inferences about productive competence. Of course, one never really knows whether the subject who does not respond correctly lacks the underlying competence or is prevented from displaying his competence by some performance factor.

The tasks presented to children utilized a variety of stimulus materials as well as instructions and questions. Both comprehension and production skills were assessed. Open-ended questions were used more extensively during Phase I in order to uncover interesting and perhaps unsuspected processes. Rather than using performance on preliminary tasks as a basis for determining whether a particular S would be given more complex tasks, it was decided to design the tasks so that they could be administered to all children. In cases where tasks were beyond the child's level, if he appeared to be losing interest, a shortened version was administered. This was done only in Phase I testing. During Phase II, tasks were constructed so that children of all age levels could complete them. Phase I tasks were evaluated in terms of their capacity to elicit intended processes clearly and to distinguish between less and more advanced levels of development. In the report to follow, results of Phase I testing are mentioned only when they add information not evident in Phase II findings.

Eight tasks were designed and administered in each phase. A complete description of the procedures, instructions, and stimuli are found in Appendix A for Phase I and Appendix B for Phase II. The presentation order of tasks adopted for Phase I was: (1) Negative Word Association; (2) One-dimension Description; (3) Coordinated Language; (4) Seriation Description; (5) Clay Manipulation; (6) Dimensional Discrimination: (7) Transformation; (8) Shifting Context. During Phase II, tasks were presented in the following order: (1) Negative Word Association; (2) One-Dimension Description; (3) Hungry Pig; (4) Coordinated Language, Part I; (5) Transformation, Part I; (6) Coordinated Language, Part II; (7) Transformation, Part II; (8) Language and Seriation Production; (9) Seriated Pictures Comprehension; (10) Clay Manipulation. Only the tasks included in Phase II and their Phase I antecedents are described below.

1. Negative Word Association Task.

The purpose of this production task was twofold: to prime Ss for the use of specific adjective terms in subsequent tasks, and to measure the extent to which Ss possessed an adjective lexicon organized into pairs of opposites. During Phase I, 44 antonyms were presented. For each, the child was asked to give the term which corresponded to the negation of the presented antonym (i.e., "When something is not big, it is what?"). If a child responded with a noun, the question was repeated with the noun inserted in place of the pronoun. A shortened version of the task (23 items) was prepared for Ss unable or unwilling to respond. Because comparison of Ss was made difficult by the use of a shortened version during Phase I testing, the number of stimuli was reduced to 32 terms, and these items were given to all Ss. Retained from the Phase I list were those antonym pairs used in subsequent tasks. Added were some adjectives referring to number dimensions. During testing, if the child was unable to produce at least an approximate antonym response, then he was prompted with a noun, one supplied either by the child or by E. For example, if the child failed to give an opposite for "not long," he was asked, "When a pencil is not long, it is what?"

2. One-Dimension Description Task.

This task was intended to measure the child's use of specific antonyms to describe pairs of objects, each differing along one dimension. During Phase I, this task consisted of two parts. First, Ss were presented with 12 pairs of objects or pictures, and they were asked to describe how one member differed from the other. Following this, each pair was re-presented and Ss were asked to recognize which object corresponded to a particular polar term given by E and to produce an appropriate label for the other object. Objects differing in the following ways were utilized: big-little, fat-skinny, long-short, many-few, heavy-light, tall-short.

One problem realized during Phase I testing was that even Ss who possessed specific labels were not using them to describe differences. More priming appeared to be needed to activate this lexicon, and so during Phase II testing the two parts of the task were integrated.

Following questions eliciting descriptions for each object pair, an opposite elicitation question was presented, one which gave the child a specific adjective and asked him whether the term applied to both objects and if not what other term was needed. Also, the Phase II task differed from Phase I in that two additional pairs of terms were included, more-less and hard-soft, and the total number of items was increased to 15.

3. Coordinated Language Task.

This task was intended to measure both comprehension and production of coordinated language, that is, language consisting of descriptives referring to two dimensional variations coordinated together in one utterance. During Phase I, this task consisted of the presentation of nine sets of four objects, each set varying along two of the following dimensions: height, length, width, overall size (big-little), weight, number, happy-sad, dirty-clean, hard-soft. For each set, S was first asked to describe how pairs of objects varying in two respects differed. Then all four of the objects were presented and he was asked to select the objects which possessed one or two particular polar characteristics. All questions were presented together for each object set.

Because the task proved to be quite lengthy and tedious for younger Ss (i.e., 10 out of 22 Ss were given the shortened version), the task was divided into two parts administered on separate days, and production and comprehension questions were intermixed in order to vary the pace and to tap maximum productive competence. Also, only three object sets were used: block buildings varying in height and width, two dimensions confused by many Ss; styrofoam Easter eggs varying in size and weight, of medium confusability; and miniature beds, varying in length and hardness, two dimensions not confused by Ss. Questions examining the child's comprehension of coordinated language were expanded to include negative forms (i.e., "Are there any buildings that are fat but not short?") as well as affirmative forms. Following every other comprehension question, a production question was given, one in which E selected two objects differing in two respects and inquired, "How is this one different from that one?" "Any other ways?" The objects to be described were always taken from the same set referred to by the previous comprehension question but were always ones not described by this question. This arrangement of questions was used in order to enhance the likelihood of eliciting coordinated language. During Phase I, in which comprehension questions always followed production questions for each object set, very little coordinated language was elicited from Ss.

This task was intended to determine whether the child would spontaneously produce descriptions in which both dimensional variations were mentioned together whether he could do this for dissimilar dimensions but not similar dimensions which he might not yet distinguish, and whether he could comprehend coordinated language. Also, his errors were examined in order to determine to what extent he could think separately about two very similar dimensions.

4. Hungry Pig Task.

This task was intended to supplement the coordinated language task and to assess the child's comprehension of differences among four types of conjunctions used to link pairs of adjective descriptives: and, but not, or, or else not. The task was conceived following Phase I testing as a means of extending the investigation of structures underlying the use of pairs of adjectives.

The task involved the presentation of a large pig constructed out of a coffee can and pink paper. Its face, specifically its mouth, consisted of a slot into which could be dropped pieces of cardboard of various shapes and colors. There were 16 of these cardboard goodies, each varying in color (red, green or yellow), number of colors evident (one solid vs. two half-and-half), size (big vs. little), and shape (circle vs. square). Before testing began, the child's comprehension of single adjectives (i.e., green, yellow, red, big, little, round, square) was checked by asking him to point to an instance of each feature. Two Ss encountered trouble with some of these, and E attempted to teach them referents for the terms before beginning. Ss were told that the piggy is always hungry but he will eat only certain things and that E would tell him what the piggy was hungry for and he could feed those items to piggy. The following sorts of descriptives were given to the child: little and yellow, red but not little, big or else square, square or green, etc. For each, the conjunction was stressed. The properties chosen were ones which, unlike many of the dimensions included in the other tasks, were all visible and familiar to even the youngest Ss. This was done to insure that knowledge of conjunction structures rather than specific concepts was being measured.

5. Transformation Task.

This task was intended to determine whether children were aware of the implications of particular adjective structures, that is, whether they could compute equivalences of meaning underlying various descriptive forms.

Phase I testing involved presenting the child with 14 pictures in which focal characteristics were hidden from view. The relevant parts of the picture were described (e.g., "These boys are sitting in their car waiting for their mother."), a relational statement regarding these parts was presented (e.g., "John is taller than Bill."), and then three transformational questions were given (e.g., "Which boy is shorter?"). In the pictures, dimensional referents (e.g., boys' heights) were always depicted as equivalent (e.g., boys were seated in car and only heads were visible). The child's ability to perform various transformations among maxi-poles, mini-poles, comparatives, equatives and negatives was examined. A variety of dimensional terms was included.

Results of Phase I testing indicated that the task was feasible and produced interesting results. Ten out of 23 children, mostly older Ss, obtained scores at a level greater than that expected by chance (probability of getting at least 9 out of 14 items correct by chance is .09).

However, because dimensional terms which proved to be unfamiliar to younger children were included, it was unclear whether lexical or structural capacities accounted for results. Thus, in Phase II, only adjectives known by both younger and older Ss were used. Also, Phase I testing included too great a variety of transformations, thereby preventing any reliable estimate of capacities with any one type. So, in Phase II, more instances of fewer transformational types were included. Furthermore, answers to only the first of the three questions per picture was found to be worth analyzing since this was the only one free of contamination from other responses, and so only one question per picture was presented to each S during Phase II. The number of pictures was increased from 14 to 22, and the task was presented in two parts. Because most Ss missed the first item during Phase I despite the fact that it was not difficult, it was regarded as an example and not counted during Phase II testing.

6. Language and Seriation Production Task.

This task was intended to examine the language used by children of various ages to describe sets of objects varying in the extent to which each possessed a particular dimensional attribute. During Phase II of the study, the task was extended to include items assessing whether the child could also order the sets of objects.

The task used during Phase I consisted of presenting six sets of three objects, one set at a time, and asking the child to describe how each member differed from the other members. The objects in each set were identical except for size (big-little; tall-short; fat-skinny; long-short), weight, or color shade (dark-light). Results were interesting both in terms of exposing the forms used by children and in revealing confusions among adjectives appropriate for describing the various dimensions. However, because only three objects comprised the set, finding distinctive labels for each of the objects was an easy matter for children (i.e., papa, mama, baby) and the full nature of their descriptive comparative system was not always exposed. Also, it became of interest to examine the operational capabilities of Ss able to describe differences accurately. Could Ss capable of describing object differences also arrange a greater number of objects in order?

As a consequence, Phase II testing was modified to include more objects (i.e., 5) in each set to be described, fewer sets (three), a request to order as well as to describe the object sets, and the addition of a task requiring the child to order 8 balls varying in size and then to match 5 of the balls to a set of 5 dogs varying in size. This task preceded the object description items. Furthermore, in introducing the object sets, only three objects were given to the child at first, and when he had described these, then the remaining two were presented. The request to order all 5 objects followed the description request for each object set.

7. Seriated Pictures Comprehension Task.

This task was intended to determine to what extent Ss could comprehend language used to describe sets of seriated objects. During Phase I,

comprehension of the affirmative comparative form was examined as a part of the Seriation Description task. However, since object sets varying along several dimensions were used, performance reflected not only comprehension of comparative forms,but also comprehension of specific lexical-dimensional terms, some of which proved to be unfamiliar to younger Ss. Thus, results did not yield a very clear measure of linguistic-structural comprehension capabilities. For Phase II testing, it was decided to restrict the adjectives to "big" and "little," to expand the number of linguistic relational structures to include not only affirmative comparative forms but also negative comparative, affirmative equative, negative equative, double comparative, and superlative forms, and to use, rather than actual objects, pictures in which the order of the objects in terms of size was always clearly evident. It was thought that this would provide a better measure of the child's comprehension of language describing sets of seriated objects.

During Phase II, children were presented with six pictures displaying five objects varying in size. For the first picture, comprehension of the superlative inflection was examined. For the 6th picture, the child was asked to coordinate two comparative forms (i.e., "Which flower is bigger than Kay and smaller than Bess?"). For each of the remaining four pictures, he was presented along with the picture a cutout of the middle-size object and was asked four questions comparing this standard to the five objects in the pictures: Which airplane is bigger than Bill (the standard)? not bigger than Bill? as big as Bill? not as big as Bill? Following each question, he was asked "Any others?" until he said "No." Each question type was presented for each of the four pictures. However, the order of questions was varied for each picture. The child was not given this task until after he had completed the Seriated Language Production Task.

8. Clay Manipulation Task.

This task was intended to measure comprehension of various comparative forms by having the child manipulate the size of clay balls. During Phase I, a number of single and double adjective comparatives were examined (e.g., bigger, a lot littler, a little bigger, as big as, biggest). In all cases, the child was instructed to regulate the size of his ball so that it would bear a certain relation to the ball held by E. The initial size of the two balls was varied. Sometimes they were equal, sometimes different. Given these conditions, it was possible to examine not only comprehension of various descriptives but also recognition of the match or mismatch between the descriptions and the initial relative sizes of the two balls. For example, the child was given a ball already smaller than E's ball and told to "make your's littler than my ball." Although the task appeared to present intruiguing possibilities for exploring the meanings assigned by children to adjective forms, the task did not prove to be a good one. Because children were asked to manipulate repeatedly the same materials (plasticine clay), many became restless and bored and refused to complete the task. Thus, the scope and length of the task was reduced for Phase II.

The purpose of the Phase II task was to determine whether children fully comprehended the modificational system which many Ss were observed

to use extensively in their descriptions of seriated object sets during Phase I testing. Specifically, it was of interest to see whether they could separate the pole from the polar modifier and assign appropriate meanings. For example, when told to make the ball "a lot smaller," would they increase or decrease the ball's size? Furthermore, would they remove or add a sizeable amount or a small amount of clay? Only one ball was presented for each item. Sometimes it was small, sometimes big. Prior to assessment, the child was asked to demonstrate comprehension of each of the terms separately (big, small, lot, little bit). All of the Ss were able to do this.

Results

Results for the two phases of the study are included in the presentation below. Emphasis is placed upon Phase II results since this involved twice as many subjects. Performances in each of the tasks are analyzed first. Following this, relationships between tasks are explored.

1. Negative Word Association Task.

Responses indicating to what extent Ss possessed an opposites vocabulary were scored in terms of the total number of correct antonyms produced for each stimulus both with and without the aid of noun prompts. Analyses of variance on both sets of scores revealed a main effect of age, with $F(4, 20) = 17.01$, $p < .01$, for the total number correct per child, and $F(4, 20) = 20.35$, $p < .01$, for the number correct without prompts. No other effects were significant. These results are depicted in Figure 1.

Insert Figure 1 about here.

Post hoc pairwise comparisons using Tukey's method revealed that 4 year olds produced significantly fewer correct responses than each of the other age groups. Also, 5 year olds produced significantly fewer than 7 and 8 year olds in the total correct analysis and significantly fewer than the 8 year olds in the without-prompt analysis. From Figure 1 it is evident that the antonym lexicon gradually increases as the child grows and that the greatest increase occurs between the ages of 4 and 5. This is somewhat earlier than is suggested by Entwisle's (1966) data in which opposites were reported to emerge between the ages of 6 and 8. However, in her study, children were asked only to respond associatively to stimulus words, not to produce opposites.

Comparison of the scores with and without noun prompts in Figure 1 reveals that 4 year olds profitted more from the noun prompts than the other age groups for which very few prompts were required to elicit antonym responses. These results are reminiscent of the shift from syntagmatic to paradigmatic responses observed in child word association

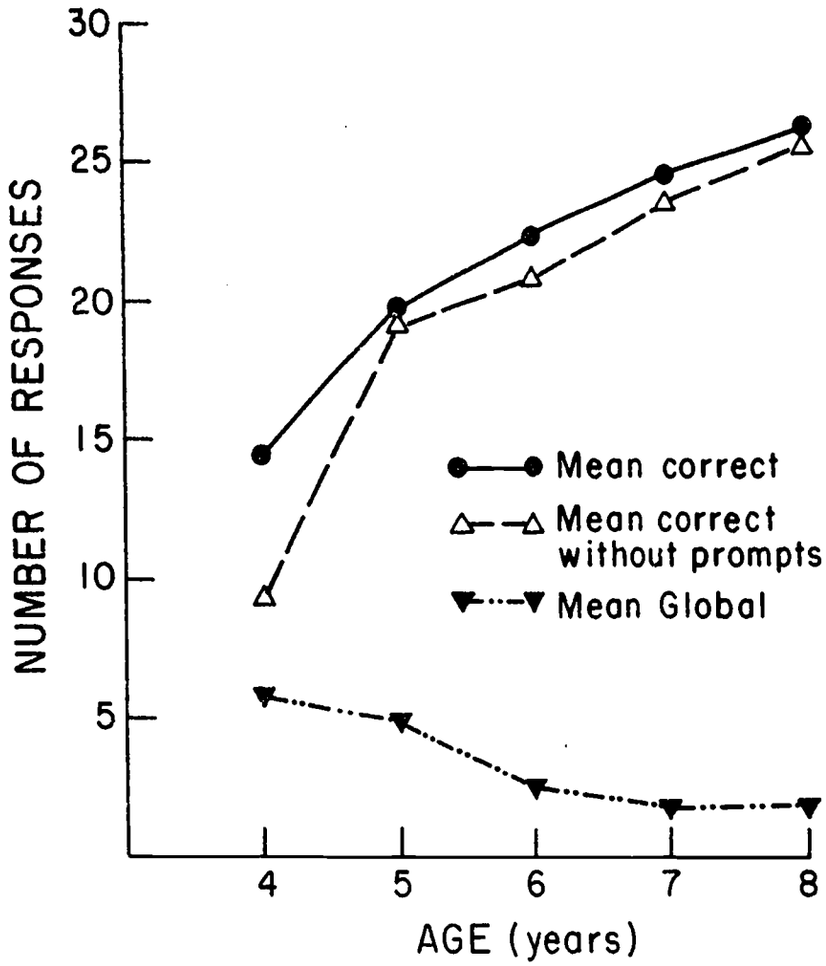

Fig. 1. Negative Word Association Task, Phase II: Mean number of correct and global antonyms produced as a function of age.

response data (Ervin, 1961) although they are evident in younger children. Such results are consistent with speculation that adjectives begin separating from noun contexts and forming polar or contrast relationships around the age of 4.

Also plotted in Figure 1 are the mean numbers of global responses (i.e., big, little) given as opposites to more specific stimuli. Results indicate that such productions are prevalent among the antonyms given by 4 and 5 year olds, and that they drop to a minimum level at age 6 when more specific terms gain a strong foothold.

Examination of the frequencies of correct antonyms as a function of both age and items revealed that not all of the contrast pairs reflected the developmental pattern evident in total mean scores. These results are presented in Table 1. The first five pairs listed as well as responses to "small" and "a lot" were known by a majority of the Ss in each age

- - - - - - - - - - - - - -

Insert Table 1 about here

- - - - - - - - - - - - - -

group. In contrast, the final pair listed, "many-few" was known by only two 8 year olds. Results of Phase I testing revealed that correct responses were also almost never given for the terms "rough" and "smooth." Responses to three stimuli were found to distinguish clearly between younger and older Ss in Phase I results as well as Phase II results: short, heavy, and long. In fact, of the 7 Ss producing the fewest responses during Phase I, none gave correct opposites for these stimuli while all but two of the other Ss responded appropriately to at least one of these terms. Furthermore, in response to the stimulus "light," none of the seven gave the opposite "heavy." Table 1 reveals that in addition to these terms, "high-low," "strong-weak," and "more-less" were associated with developmental patterns in which knowledge of opposites emerged gradually between the ages of 4 and 6 or 7.

On the list of stimuli were included some adjectives serving as polar terms for two different dimensions. In Phase II, these adjectives were always presented first before either of their opposites appeared on the list. In Table 2 are given responses and response frequencies for

- - - - - - - - - - - - - - -

Insert Table 2 about here.

- - - - - - - - - - - - - - -

these terms. In the cases of "hard" and "light," the opposites "soft" and "dark" dominated respective replies. This dominance was especially evident among the younger Ss (4-5 yr.) who never gave "easy" and only once gave "heavy" as a reply. When responses to the stimulus "short" were examined, neither of the two possibilities was overrepresented. Both "tall" and "long" were produced with almost equal frequency. The importance of presenting a double-polar stimulus first before either of its

Table 1

Negative Word Association Task, Phase II: Total Number of Children at Each Age Level Producing Correct Antonyms for Each of the Adjectives. (Presentation position of each item is given in parentheses.)

Stimulus Adjectives	Age 4	5	6	7	8	Total
slow (#2)	8	8	8	8	8	40
fast (#28)	6	8	8	8	8	38
dirty (#12)	8	8	8	8	8	40
clean (#3)	7	7	8	8	8	38
big (#1)	8	7	8	8	8	39
little (#19)	8	8	6	7	7	36
hot (#5)	7	7	8	8	8	38
cold (#18)	5	4	7	7	7	30
soft (#23)	6	7	8	8	8	37
hard (#8)	5	7	7	8	8	35
skinny (#4)	4	8	8	8	8	36
fat (#11)	4	7	8	8	8	35
sad (#16)	4	7	8	7	8	34
happy (#6)	2	6	8	8	8	32
small (#24)	8	7	6	5	7	33
large (#21)	4	7	7	4	8	30
dark (#27)	3	7	7	8	7	32
heavy (#17)	1	2	3	5	6	17
light (#9)	4	6	5	7	7	29
a lot (#26)	6	5	5	4	6	26
a little bit (#32)	1	6	5	5	6	23
low (#30)	1	4	6	7	8	26
high (#20)	1	2	5	7	6	21
strong (#31)	2	4	4	6	8	24
weak (#13)	0	2	3	5	5	15
long (#25)	1	3	4	6	5	19
tall (#14)	0	0	2	3	3	8
short (#7)	1	1	5	5	5	17
more (#10)	0	1	2	5	7	15
less (#22)	1	2	3	5	4	15
many (#29)	0	0	0	0	2	2
few (#15)	0	0	0	0	0	0

Table 2

Negative Word Association Task, Phase II: Responses and Response Frequencies for Some of the Stimuli

Stimulus	Correct Response	Frequency	Other Responses Given at Least Twice*
short	tall	9	big (15), fat (2), little (4)
	long	8	
tall	short	8	little (19), small (10)
long	short	19	little (13), small (3)
small	big	32	tall (4), little (2)
	large	1	
large	small	14	big (5)
	little	13	
high	low	21	little (8), small (2), short (3), down (2)
low	high	26	big (2), large (2), tall (3)
hard	soft	28	
	easy	6	
light	dark	18	hard (3)
	heavy	11	
dark	light	32	white (2)
heavy	light	17	soft (3), easy (4)

*Numbers in parentheses refer to response frequencies.

two opposites appeared in the list was suggested by a contrasting finding in Phase I for the term "short" where "tall" but not "long" preceded this stimulus and "tall" but never "long" was produced as an opposite. During Phase I, another double-polar term, "old," was examined, and responses were observed to favor "young" over "new" (i.e., 8 vs. 4 productions), in this case though despite the fact that "new" had already appeared on the list. (See Appendix C for other Phase I response frequencies.)

Examination of the errors produced by Ss revealed that global terms (i.e., big-small, little) as responses to more specific dimensional adjectives decreased substantially from ages 4 to 6. Mean values for each age group are plotted in Figure 1. Inspection of the particular stimuli to which global responses were given disclosed that most involved more specific descriptions of size (high-low, long-tall-short). However, almost twice as many global responses were given to "tall" as to "long." Furthermore, although global frequencies declined with age for "long," they did not for "tall" where a majority (from 5 to 7) Ss at each age level produced "little" or "small." Inspection of these two global productions as a function of age disclosed that older Ss were the ones to claim "small" as the opposite of "tall" while younger Ss stuck to "little." This suggests that perhaps "tall" goes through a sequence of opposites, beginning with "little," progressing to the global rhyming term "small," and then settling finally on "short."

One set of adjective pairs, those referring to number, was separated out for analysis. Six such stimuli were included on the list: more-less, many-few, a lot-a little bit. Table 3 indicates the frequency of responses

- - - - - - - - - - - - -

Insert Table 3 about here.

- - - - - - - - - - - - -

given to each. First, it is evident that although the terms occurred late in the list, "a lot" and "a little" were the most popular antonyms used to contrast numbers. Also, "less" occurred frequently as an opposite response. In contrast, "many" and "few" were rare productions although the number of correct approximate opposites in Table 3 indicates that these poles were comprehended as well as the other number adjectives. It is interesting to note the cases where synonyms rather than antonyms were given. It is likely that at least some of these occurred because Ss thought that the stimulus denoted maxi- rather than mini-number, or mini- rather than maxi-number. Comparison of the frequencies of each of these error types revealed that whereas 14 of the former occurred, only one of the latter type appeared. These results are consistent with Donaldson & Wales' (1970) findings that often mini-terms when they enter the lexicon are regarded as maxi-terms. This sort of error was observed most often (i.e., 9 times) for the mini-term "few." One other type of production was observed. In response to all of the number descriptives, terms referring to the absence of quantity (i.e., nothing, none) were given frequently. Analysis by age reveals that most of these opposites were produced by Ss 6 or younger. The fact that these terms were given as opposites for both mini- as well as maxi-terms (i.e., 10 vs. 14) is

Table 3

Negative Word Association Task, Phase II: Frequency of Responses to Adjectives Referring to Number

Stimulus	Response: more	less	many	few	lot	little	Total Resp.	Total Correct	Order in list	None, Nothing as Resp.
more	-	15	0	0	0	7	22	22	10	5
less	15	-	0	0	4	3	22	19	22	4
many	0	7	-	2	1	15	25	24	29	4
few	4	3	0	-	14	6	27	18	15	3
a lot	0	5	0	1	-	24	30	30	26	4
a little bit	2	2	0	0	(6)* 21	-	31	29	32	3
Total	21	32	0	3	46	55				
Approximate Antonyms	6	12	0	1	18	22				
Errors	0	5	0	0	1	9				

*In response to "a little bit" six Ss said "a whole bunch." This was the only case where this was used.

somewhat surprising in view of the hypothesis proposed above that the dimensional structure underlying mini-terms incorporates the zero point. This hypothesis would suggest that these terms should be assigned as opposites of maxi-adjectives only. Perhaps this matter regarding the emergence of the child's awareness of a zero point for the number dimension is worth further study. It may be that when the child acquires the concept "none," this is incorporated as the mini-pole of his number dimension, and other mini- as well as maxi-number terms get assimilated to the opposite of "none," that is, "some." Given this conceptualization, these number terms would constitute synonyms rather than antonyms. This possibility suggests the need to examine how the child hooks up the dichotomous contrast "some-none" with dimensional number contrasts such as "a lot-a little bit" and "more-less."

One other especially interesting interchange among adjectives was observed. Terms from the pairs "light-heavy," "hard-soft-easy," and "strong-weak" were sometimes mixed up by Ss in their attempts to identify antonyms (see Table 2). At first glance, one might wonder how a child could confuse these dimensions, since they appear to be quite different experientially, at least to an adult. Responses in this task disclosed the specific nature of the child's connections. In reply to the question, "If something is not heavy, it is what?" some of the younger Ss said, "It is easy to carry." "You can pick it up." "It is soft--not strong." In reply to "not strong," another S said, "Can't pick up nothing." Such errors were observed not only in this task but also in others. These replies suggest that the semantics of these dimensions are tied up with agents and objects involved in the action of lifting: strong vs. weak men; hard vs. easy task; heavy vs. light object; soft vs. hard object. (Note that soft objects are usually light and easy to lift.) Given this action scheme, the relationships among these terms and the possibility of a child's confusing them become more plausible. These results support Piagetian emphases upon action as a basic component of word meanings for children.

2. One-Dimension Description Task.

Performances in this task where Ss were asked to produce and to comprehend antonyms describing a dimensional difference between two objects were subjected to various analyses. The mean number of times each S produced correct specific descriptions for each pair in response to the question, "How is one different from the other?" was scored. The results for maxi-adjective production and mini-adjective production are depicted in Figure 2 as a function of age and sex. An analysis of variance

- - - - - - - - - - - - - - -

Insert Figure 2 about here.

- - - - - - - - - - - - - - -

revealed main effects of age, $F(4, 20) = 10.41$, $p < .01$, and adjective polarity, $F(1, 20) = 44.81$, $p < .01$, and an interaction between polarity and sex, $F(1, 20) = 10.22$, $p < .01$. Productions increased with age. Maxi-terms were produced more frequently than mini-terms. And this polarity production difference was greater in the responses of males

of cases where only one descriptive term was produced revealed an even clearer maxi-adjective dominance for all pairs except "fat-skinny" where the mini-term was favored. Examination of the means used by Ss to mark the mini-pole in speech in these instances disclosed that Ss either found substitute terms or did not mention the pole at all. For variations in height, Ss tended to call mini-objects "small" rather than "short" and to regard this as the antonym for "tall." To express mini-weight, no single substitute term appeared to be readily available and so Ss were observed to "fish around" for some sort of label. As a consequence, objects were referred to as "weak," "soft," "skinny," "low heavy," "sort of heavy," "just a little bit heavy," "a bottle that someone can hold up," or "not heavy." Expressions of mini-number involved counting (i.e., "only 4"), using the global term "a little," or a negative form of the maxi-term (i.e., "don't got a lot"). However, in many cases, no reference to this pole was made. These results suggest that the reduction in maxi-mini production differences observed during Phase II might have been a consequence of the fact that E was priming Ss for mini-production by the inclusion of comprehension questions amidst production questions.

Analysis of the responses of Ss performing most poorly on Phase II of this task (five 4-year olds and one 5-year old) revealed excessive use of the terms "big" and "little" to describe differences. For pairs where these terms were not appropriate Ss applied them anyway, denied the existence of a difference, or invoked other adjectives. Of the 6 Ss, 4 used "a lot," "whole bunch" or "a little" to describe varying numbers, and 4 Ss utilized "hard" or "soft" (also "easy" or "squishy" for "soft") to describe variations in hardness. In response to the opposite comprehension-elicitation questions, these Ss produced very few correct antonyms. Among those few produced by at least two Ss were: little, skinny, hard, and soft. During Phase I of this task, the poorest Ss were observed to use, in addition to these adjectives, the terms "tall" and "fat" to describe objects. These results suggest that of the dimensions examined in this task, overall size, number and hardness are among the first to emerge during development and that, in addition, the properties "tall," "fat" and "skinny" are perhaps more salient for younger Ss.

Analysis of the errors produced by Ss provided some additional insight into the conceptual relations among adjectives seen by children. Objects differing in hardness were occasionally called "easy" rather than "soft." More elaborate replies by some of the Ss clarified the basis for this confusion. Soft objects were called "easy" because they are "easy to lift." More frequently, Ss (N = 5) referred to heavy objects as "hard." Not only the association "hard to lift" but also "hard as rocks" is involved in this mistake, as revealed by the reply of one S who claimed that one object had "hard rocks in it." (Although one of the heavy objects was slightly more lumpy both objects were equally hard when squeezed.)

Confusions by Ss among size adjectives were also observed. "Long" and "tall" were often interchanged. More interesting was the assignment of seemingly contradictory descriptions to objects, perhaps a consequence of the child's attending to relative aspects of size. The pair of objects arousing the most confusion involved two ropes, one very thick

(one inch diameter) and one quite thin (1/4 inch diameter). Both were the same length (26 inches). A 5-year old, apparently preoccupied with the relative lengths of the two ropes ended up calling the thin rope "big" and the thick rope "little," although subsequently he identified correctly the fat one and labeled the other "skinny." Similarly, a 7-year old called the thin rope "longer" and the other one "fatter." An 8-year old got himself into quite a bind: "This one is fatter and its longer. This one's longer and it's skinnier." To E's query "Longer?" he modified his description of the thick rope, "This one's shorter and it's fatter." Descriptions of other objects revealed similar confusions. For pairs equally wide but varying in height, some Ss said that the tall one was "bigger and skinnier." Perhaps Ss knew what they meant but were unable to select distinctive terms to express these ideas about differences. Or perhaps their lack of distinctive terms prevented them from focusing on and holding clearly in mind the specific difference between the objects. Or thirdly, perhaps Ss were really producing statements of attributes rather than relations (i.e., this rope has length, that one width as a salient property). Evidence presented subsequently suggests that Ss do produce comparative statements without intending a relational meaning. Subsequent research might examine whether the S means what he says through the use of a recognition-identification task.

In the development of Phase II tasks, an attempt was made to study these confusions observed during Phase I testing. This task involved presenting some of the item pairs used in the One-Dimension Description Task as well as some other items, asking Ss whether one object could be described by a particular adjective (one not acceptable to an adult), and if so what made it so. Since the task proved time-consuming and frustrating to both E and S, it was dropped. However, responses from three Ss (a 5, 6 and 8 year old) were collected. These replies confirmed previous observations. Ss were quite willing to apply the inappropriate labels. Only two were rejected. One S refused to call the darker of a pair of dark and light cards "heavier," and two Ss objected to calling the harder of a pair of hard and soft foam pads "heavier." "Bigger" and "fatter" were accepted for heavier objects, "longer" and "taller" were accepted as synonyms, "skinnier" was approved for both a shorter whistle and a taller fruit jar, "weaker" and "softer" were permitted for objects lighter in weight. The complete acceptance of "softer" to describe the lighter of two wooden blocks was especially surprising, since neither block yielded when squeezed. Perhaps this approach is worthy of pursuit in subsequent studies.

The above results are quite surprising to adults in whose semantic systems these terms have long since separated. They suggest that the processes involved in the emergence of this separation are quite complex and not at all completed by the age of 8, despite the presence of distinctive terms in the child's lexicon.

One phenomenon detected in Phase II testing of this task raises a question regarding the effects of the procedure of following each production question with a comprehension question in which specific adjectives are given to S. One child was observed to pick up and apply incorrectly one of these adjectives. A 7-year old when asked on the

first item whether one spoon was larger, replied "No." E then asked her whether she knew what "larger" meant. She replied, "It means that it's not that--it's not so tall and not so little." Following this, she designated the smaller (also shorter) spoon as being "larger". Subsequently, she employed this description to mark the mini-poles for five pairs of objects varying in size or amount. She also called some of these items "little." In addition to the term "large," she was observed to pick up the term "less" and to apply it appropriately to a set of coins as well as inappropriately to a short whistle which she had previously called "large." Her reactions on this task suggest that Ss at this age are very sensitive to these terms and engage in much hypothesis testing in order to discover their meanings. It is possible that the procedure of mixing production and comprehension questions activated such processes and thus contaminated these measures of lexical development.

This procedure was adopted in the present study in order to enhance the quality of productions and the likelihood that Ss capable of producing specific adjectives to describe objects would do so. During Phase I in which all production questions were presented before any comprehension questions, some Ss were seen to utilize only "big" and "little" as descriptions despite possession of a more elaborate lexicon as revealed on other measures. Although this approach of question mixing appears justified, it is important to try to identify its effects on performance. To do this, response data for object pairs varying along the same dimension and occurring earlier and later in the task were compared. It was reasoned that, if the presentation of specific adjectives in the comprehension questions for one pair of objects caused Ss to incorporate and use these terms, then the production frequencies for these terms ought to increase more than the frequencies of terms not previously mentioned by E when the second pair of objects was presented. If, however, the procedure exerted only a general facilitating effect, then production frequencies of all terms ought to increase regardless of whether or not they were given by E. Relevant data are presented in Table 5. These results provide some evidence to suggest that the procedure of mixing

- - - - - - - - - - - - -

Insert Table 5 about here.

- - - - - - - - - - - - -

production and comprehension questions tended to enhance the subsequent production of those terms previously mentioned. All but one of these adjectives increased in frequency, unlike the other terms of which only half increased. A binomial test suggested that the likelihood of observing a value as small as one out of six possibilities was .11. Although this value is not significant, $p > .05$, it is of sufficiently small magnitude to preserve the possibility that such an effect was operating. Further study is clearly needed to determine the extent to which this priming procedure did indeed (1) activate already existing lexical components, or (2) arouse familiar but incompletely mastered terms, or (3) introduce totally unfamiliar adjectives into the descriptions of Ss. This seems central to the business of identifying how new words and their concepts get assimilated to the lexicon.

Table 5

One-Dimension Description Task, Phase II: Number of Adjectives for Which Production Frequencies Increased or Did Not Increase on Children's Descriptions of the Second of Two Object Pairs as a Consequence of E's Having Mentioned or Not Mentioned the Term on the First Object Pair

	Number of adjectives for which production frequencies from first to second object pair:		
	Increased	Remained same or Decreased	
Terms mentioned previously[1]	5	1	6
Terms not mentioned previously[2]	3	3	6
	8	4	12

[1]Six adjectives mentioned: skinny, short, heavy, tall, less, hard

[2]Six adjectives not mentioned: fat, long, light, short, more, soft

There was in this task as well as the Negative Word Association task some evidence suggesting that maxi-terms emerge earlier than mini-terms and that initially some mini-terms are mistaken to mean the same thing as their maxi-counterparts. On the comprehension questions, 13 Ss (10 of these between 4 and 6 years old) selected the item containing more candy when asked for the one having "less" and then labeled the other item "a little bit" or "small." Similar mistakes (6 errors) of this sort were made with the mini-term "few." However, no more than once or twice were the other mini-terms (short, soft, light) mistaken for maxi-poles. And there occurred one maxi-term which was mistaken for its mini-pole. In response to the term "larger," 5 Ss interpreted it as a mini-pole meaning "little." This was observed in Phase I testing as well. Perhaps the fact that "large" resembles other mini-terms phonetically (i.e., initial "l" sound as in "less," "light" and "little") accounts for this error. These cases constitute exceptions to the mini-to-maxi assimilation pattern observed by Donaldson (1970) and others, and they raise a question about whether this phenomenon is a general one characteristic of the emergence of all dimensions or whether it is specific to only some. Evidence in the present study suggests that the latter is the case. Whereas "less" and "few" present a polar identity problem for the child, other mini-terms do not, perhaps because their lexical histories differ. Results of the present study suggest that the term "light" enters the child's vocabulary long before it is associated with "heavy." On the Negative Word Association task, "dark" was given as the opposite of "light" by 9 out of 16 four and five year olds while "heavy" was given by only one S, a 5 year old. Furthermore, before "light" achieves exclusive reign over the mini-pole its referent dimension is mixed up with other dimensions such as "hard-soft," "hard-easy," and "strong-weak." As a consequence, in learning "light" as the opposite of "heavy," the child has no trouble identifying it as a mini-pole since it is already associated with other mini-terms and concepts such as "soft" and "easy to lift." A similar history may hold for "short" which emerges out of a global bag of mini-size synonyms dominated by "little." In contrast to these, "few" and "less" may have no prior association with other mini-terms when they enter the lexicon and so Ss are confronted with the polar identity problem. These speculations remain to be confirmed in future research.

Another point on adjective lexical development suggested by results of the present study is that the concept of a mini-pole appears to exist prior to the emergence of a specific lexical term to denote this pole, at least for some of the dimensions. For example, in the present study, to refer to mini-weight, Ss lacking the appropriate antonyms were observed to negate the maxi-term or to use a global modifier (i.e., not heavy, a little bit heavy) rather than to omit mentioning the mini-pole. In 9 out of 13 cases where "heavy" but not "light" was produced by 4 and 5 year olds, a negative or modified form was included to describe the mini-object. These results suggest that for at least some dimensions, the mini-pole is present conceptually prior to the time the specific antonym enters the lexicon. If this is the case, then it should be possible for a child to learn these specific mini-terms rather quickly once the particular dimension and its maxi-term are known.

3. Coordinated Language Task.

Performances in this task were of two sorts. Ss' comprehension of coordinated language was measured in terms of the number of times Ss selected correct objects from sets of four in which two dimensions were varied. Ss' ability to produce coordinated language was indexed by counting the number of times such forms were emitted to describe differences between pairs of objects varying in two respects.

Various decisions were required in order to decide what constituted an instance of coordinated language. According to Inhelder et al. (1966), "coordinated descriptives" involve focusing upon and describing two dimensional variations at once. This is contrasted with less advanced descriptions which involve either mentioning only one of the dimensions or centering first upon one and then upon the other dimension. Whereas the former involves two-part, two-dimensional descriptions in which both variations are conceptualized simultaneously (i.e., "He has more marbles marbles but they are smaller"), the latter consists of 4 parts in which the two dimensions are conceptualized separately and mentioned succcssively (i.e., "He has got a lot, she has got a little, his marbles are small, and her marbles are big").

Although this distinction appears clearcut, it was found to be incomplete as a basis for distinguishing between coordinated and non-coordinated productions. In the present study, the following criteria were added. Since coordinated language is defined structurally rather than lexically, global as well as specific descriptions of size (e.g., height called "big" and "little") were accepted as long as S used distinct polar terms to represent the two dimensions. If the child mentioned two variations for one object in the "same breath" but placed the adjectives in separate kernel sentences linked by a conjunction (e.g., X is big and X is lighter than Y), then this was regarded as an instance of coordinated language. One type of production counted but ambiguous in terms of Inhelder's specifications consisted of that in which the child, in the process of describing the four characteristics of the two objects, mentioned the two poles for one object back to back (i.e., "Ross is short, Art is tall, Art is fat, Ross is skinny"). Although the entire utterance is in a form involving successive focusing, it is not clear that the middle of it differs at all from productions in which the child says only, "Art is tall & Art is fat." Since the latter was counted as an instance of coordinated language, the former was also. Although this perhaps questionable candidate qualified as coordinated language, another sort of production did not (i.e., "Roy is fatter than Ed, and Ed is lighter than Roy."). This was not counted because S switched the subject of his description from one object to the other as he switched the dimension. Although implied in his double comparative is a simultaneous, two-dimensional conceptualization of one object, because the dimensions were segregated in speech, it was not accepted. However, this decision did not have the effect of excluding any S from the group regarded as coordinated language producers since Ss producing these forms also gave acceptable coordinated utterances, a fact which suggests that the form in question does constitute a type of coordination.

When an analysis of variance was applied to the number of coordinated descriptives produced by Ss, a main effect of age emerged, with $F(4, 20) = 5.50$, $p < .01$, as expected. These results are depicted in Figure 3 where it is apparent that a sizeable increase in the mean

- - - - - - - - - - - - - -

Insert Figure 3 about here.

- - - - - - - - - - - - - -

number of productions occurred between the ages of 7 and 8. Post hoc comparisons using Tukey's method revealed that 8 year olds produced significantly more coordinated descriptives than all groups but 6 year olds. There were no differences in the numbers produced by the other age groups. Neither of the other variables, sex or race, was associated with any differences in performance.

In addition to the number of coordinated descriptives produced, Figure 3 displays an index of the number of opportunities Ss had for producing coordinated language. That is, it displays the mean number of times Ss at each age level mentioned both dimensional variations in response to the 12 production questions. Two sets of values are given, one indicating production of only specific terms, and the other the production of specific and/or global terms combined. (It should be noted that these curves provide relative indices of opportunity. They are not comparable in absolute value to the coordinated production means since the sets of values were tallied differently, with a ceiling of 12 for the two-dimension opportunity productions and a ceiling of 24 for the coordinated descriptives.) If one examines the differences between the opportunity curves and the coordinated production curve, one sees that the gap increased at the 6 and 7 year levels and then narrowed substantially at age 8. Thus, there appears to be a lag between the presence of two dimensions conceptually and the tendency to express both variations in one utterance. Until age 8, Ss appear quite resistant to the option of combining the two dimensions in their descriptions of object differences. To what extent this is a consequence of the Ss adopting a set to focus successively and to what extent it reflects lack of competence with coordinated structures is not completely clear. However, the fact that most of the 6, 7, and 8 year olds were observed to produce at least one coordinated descriptive suggests that the former may be the case. The numbers of coordinated producers at each age level are given in Table 6.

- - - - - - - - - - - - - -

Insert Table 6 about here.

- - - - - - - - - - - - - -

The adoption of this successive focusing set, in addition to reflecting the difficulty of integrating recently acquired dimensional structures in speech, might also be a consequence of another factor. E phrased all the production questions as comparatives (i.e., "How is Art different from Dan?"). If a S felt compelled to reply using the same form, then in order to generate an appropriate expression he had to both coordinate

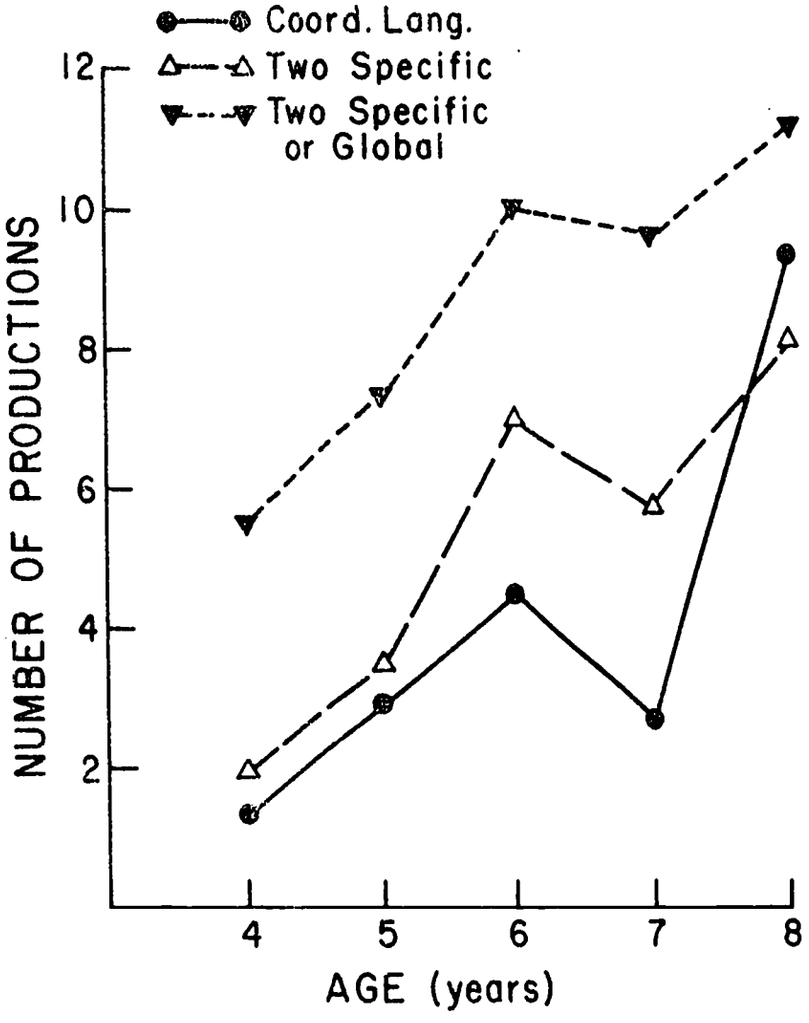

Fig. 3. Coordinated Language Task, Phase II: Mean number of instances of coordinated language produced, and mean number of times two specific and/or global terms produced as a function of age.

Table 6

Coordinated Language Task, Phase II: Summary of the Characteristics of Coordinated Language Produced by Ss. (Proportions refer to ratio of specific number to total number of productions for each age group.)

	Age 4	5	6	7	8
Number of Ss producing coordinated language at least once	5	4	7	7	8
Total number of coordinated productions	11	23	36	22	75
Mean number of productions per S	2.2	5.75	5.14	3.14	9.4
Defects					
(1) Proportion of Productions with Global Term	.91	.65	.47	.55	.27
(2) Proportion produced in context of successive labeling	.36	.26	.25	.09	.09
(3) Proportion of productions with terms in separate kernel sentences	.45	.35	.50	.41	.29
Proportion of productions lacking global & context defects	.00	.22	.31	.41	.65
Proportion of productions lacking the above three defects	.00	.09	.19	.18	.52

Table 6 (continued)

Coordinated Language Task, Phase II: Summary of the Characteristics of Coordinated Language Produced by Ss. (Proportions refer to ratio of specific number to total number of productions for each age group.)

	Age 4	5	6	7	8
Proportion of times coordinated language produced for both objects of pair	.57	.44	.33	.29	.53
Proportion of productions for:*					
Buildings	.55 (3)	.52 (3)	.58 (7)	.73 (6)	.41 (6)
Beds	.41 (2)	.17 (2)	.19 (5)	.09 (2)	.32 (6)
Eggs	.09 (1)	.30 (3)	.22 (3)	.18 (3)	.25 (7)
Proportion of productions:					
Maxi-Maxi or Mini-Mini	.45	.30	.57	.36	.55
Maxi-Mini	.55	.70	.42	.64	.45
Proportion of productions:					
Two uninflected polar adjectives	.55	.52	.56	.68	.40
Mixed: one polar, one comparative	.27	.09	.08	.14	.04
Partial or full comparative sentences (i.e., includes "than") or pair of inflected adjectives	.18	.40	.39	.18	.56

*Values in parentheses refer to the number of Ss contributing to this proportion.

and compare simultaneously. That is, not only did he have to say that X was big and heavy but also he had to embed this in a comparative context with each term inflected and both objects mentioned (i.e., "X is bigger and heavier than Y."). Thus, inability to manipulate both comparative and coordinated forms simultaneously might have accounted for the less frequent use of coordinated language by younger Ss capable of conceiving of the two dimensional variations at once.

There is some evidence suggesting this. Examination of the coordinated descriptives produced by Ss revealed only one instance of this comparative coordinated form, given by a 5 year old. However, there were a number of double comparatives either lacking the final phrase "than X" or placed in separate kernel sentences with a common subject (i.e., X is bigger than Y and (X is) heavier than Y). The proportions of these occurrences are given at the bottom of Table 6 for each age group. These results suggest that many Ss were attempting to include in their response a comparative as well as a coordinated form. That this suppressed the number of coordinated language productions observed is suggested by the performance of one 4 year old who only gave 2 cases of coordinated language in response to E's production question but generated 21 instances (consisting of two uninflected adjectives linked by a conjunction) on the comprehension questions where the focus was upon one object and its various properties. Thus, the measure of coordinated language production capabilities used in the present study appears to have been contaminated by the operation of this other presumably separate capability.

In connection with this, it is important to note that Inhelder (1966) in her investigation of coordinated language production also confounded these two capabilities. In fact, Inhelder's definition does not clearly separate the two forms. Her example of coordinated language consisted of not only two adjectives but also a comparative context (see above description of marbles taken from Inhelder et al., 1966). In the present study, uninflected polar adjectives linked by conjunctions (i.e., X is big and heavy) were regarded as pure instances of coordinated descriptives. In fact, all of the comprehension questions were expressed in this form. This suggests that in future research, three sorts of production capabilities should be distinguished, and the measures of each should be kept separate: the ability to produce coordinated forms; the ability to produce comparative forms; and the ability to produce coordinated comparative forms. It may be that non-conservers as well as conservers are able to generate each type by itself but that only conservers can integrate the two forms into one statement.

Among the 31 producers of coordinated language in the present study, there were 14 who emitted at least one integrated form. Although a conservation task was not included in the present study, many other tasks were, and so it is of interest to examine the relationship between this sort of ability and other performance capabilities. This distinction between coordinated comparative producers and non-producers as well as the distinction between simple coordinated language producers and non-producers is included in the analyses of inter-task performance patterns reported below.

appears that whereas the comprehension of coordinated language jumped dramatically for females between the ages of 4 and 5, this sizeable increase did not occur until a year later, between the ages of 5 and 6, for males.

Although examination of polarity means revealed that comprehension of identical polarity adjective pairs was superior to comprehension of crossed pairs, it is likely that this difference was artifactual and so should be ignored. Specifically, this task was administered in two parts, and overall performance improved substantially on the second part (i.e., $\bar{X}_1 = 8.23$ vs. $\bar{X}_2 = 9.95$). A matched pair sign test revealed that this difference was significant, $z = 3.16$, $p < .01$. Since the polarity items were unevenly distributed on the two parts, with more identical pole items on Part Two, and more crossed pole items on Part One, it is likely that identical pole performance surpassed crossed pole performance for this reason. Comparison of comprehension scores for identical and crossed terms in Phase I testing where no such distribution problem existed revealed that comprehension values were almost indistinguishable. An average of 11.4 Ss was successful at comprehending each identical pole pair, and an average of 11.3 Ss was able to comprehend crossed pairs. Thus, in spite of Phase II findings, it is likely that children can comprehend crossed pole coordinated descriptives as easily as identical pole descriptives just as they can comprehend negative as easily as affirmative pairs (which were evenly distributed on both parts). Factors accounting for the emergence of a four-way interaction involving these two factors are indeterminate, especially in view of the above item distribution problem.

In order to assess the relationship between coordinated language comprehension and production, pass-fail criteria were identified for both tasks. In the distribution of values on the comprehension task, 8 Ss received scores of 8 or less (maximum = 24) and so were regarded as failing. The remainder obtained scores of 12 or more. Since this constituted the largest gap between scores, the latter Ss were assigned passes. On the production task, Ss were divided according to whether they produced or did not produce at least one instance of coordinated language. The distributions of these pass-fail pairs are displayed in Table 7. A χ^2 test of independence was significant, with $\chi^2_1 = 5.67$, $p < .05$. Whereas the non-producers were divided in their success or failure on the comprehension task, all but two of the Ss producing

- - - - - - - - - - - - - -

Insert Table 7 about here.

- - - - - - - - - - - - - -

coordinated language passed the comprehension test. These results suggest that comprehension tends to precede production of coordinated descriptives. The Pearson product-moment correlation coefficient between the actual values of these two sets of scores was also significant, with $r = .44$, $t = 9.08$, $p < .01$, indicating that higher production scores were associated with higher comprehension scores.

Table 7

Coordinated Language Task, Phase II: Number of Ss Passing and Failing Comprehension and Production Tasks

		Comprehension		
		Pass	Fail	Total
Production	Pass	29	2	31
	Fail	4	5	9
	Total	33	7	40

The results of Phase I testing for the comprehension and production of coordinated language are summarized in Table 8. These findings

- - - - - - - - - - - - - - -

Insert Table 8 about here.

- - - - - - - - - - - - - - -

show that very few instances of coordinated language were observed. As stated above, the procedure of placing production questions before comprehension questions was altered to maximize the likelihood of coordinated production. Although other problems are created by the mixing of comprehension and production questions, most importantly the possibility that S is enabled to perform beyond his level of competence, at least in Phase II unlike Phase I testing, production capabilities were more likely to be exposed. The fact that during Phase II, nine Ss despite heavy linguistic modeling by E did not produce any coordinated language plus the fact that children younger than 8 years old although capable did not produce many instances suggests that the procedure was not as seductive as might be thought. Perhaps when one is investigating structural aspects of language, the problem of contamination is less serious. Under- rather than over-estimation of competence is usually the bane of experimenters' investigations of production capabilities. However, subsequent work is needed to determine just how much Ss were led to over-produce under these conditions.

One other phenomenon is evident in Table 8. A dip occurred in the production scores at the 7 year level. The same sort of temporary decline was observed during Phase II testing (see Figure 3). It is possible that this growth error phenomenon is real and worthwhile pursuing in future studies. Perhaps the emergence of some other capability is interfering and thus temporarily suppressing coordinated language production.

4. Hungry Pig Task.

This task was intended to measure the child's comprehension of four conjunctions linking pairs of adjective descriptives. However, performances proved difficult to analyze because it was thought that they did not clearly reflect underlying capabilities. Patterns of success or failure appeared to be obscured by the unnecessary complexity of the stimulus goodies and the insufficient number of test questions of various sorts. If this task had been pilot tested in Phase I, such problems might have been resolved and the task simplified. Thus, the results discussed below remain most tentative, in need of further verification.

The total number of items correct (maximum = 19) on the task was subjected to an analysis of variance. No main effects or interactions as a function of age, sex, or race emerged as significant. Mean values for each age group, from youngest to oldest were: 3.6, 4.8, 6.4, 7.1, 5.9. Although increases occurred with age, these were not significant, with $F(4, 20) = 2.22$, $p > .05$. This failure to detect even age differences is very likely a consequence of this insensitive measure of

Table 8

Coordinated Language Task, Phase I: Mean Number of Comprehension and Production Responses at Each Age Level

	Age				
	4 yr.	5 yr.	6 yr.	7 yr.	8 yr.
Mean proportion correct responses per S on comprehension of coordinated language*	.21	.45	.71	.58	.81
Mean number of coordinated language responses produced per S	.67	1.00	3.33	1.40	3.00
Number of Ss producing coordinated language 3 or more times (Pass)	0	1	3	1	2
Number of Ss on which calculations are based	3	4	6	5	4

*Note: This value was calculated to adjust for the fact that several younger Ss took the shortened form of the task and so were not tested on as many items as older Ss.

comprehension. In addition to giving children an unequal number of test items for each conjunction (i.e., and (5), but not (6), or (5), or not (3)), there was an unequal number of correct goodies for the various constructions. On the disjunctive conjunctions, a child had to select many more goodies than on the conjunctive conjunctions in order to be correct.

When the scoring criteria were altered to take account of these differences, and when performance was examined for each conjunction type, differences as a function of age became clearer for some conjunctions. These criteria and success values are presented in Table 9.

- - - - - - - - - - - - - -

Insert Table 9 about here.

- - - - - - - - - - - - - -

There were no age differences in the comprehension of "or" for which about half of the Ss were successful. In contrast, only a few older Ss recognized the meaning of "or else not." Six and seven year olds appeared to do slightly better than 4, 5, and 8 year olds on the comprehension of "and" although a majority of Ss in each age group was successful.

To determine whether the differences in number of Ss succeeding with each conjunction were significant, statistical tests on the proportions of Ss passing pairs of conjunctions were conducted. The difference between "and" and "but not" was not significant, with $z < 1$. However, more Ss succeeded with both of these conjunctions than succeeded with the conjunction "or," with $z = 3.65$, $p < .01$ for "and," and $z = 3.17$, $p < .01$ for "but not." There were too few Ss to contrast the proportions of successes for the conjunction "or else not" with the others. However, the large differences suggest that this conjunction was comprehended by substantially fewer Ss than the other conjunctions.

Examination of the relationship among success on the various conjunctions revealed that the majority of Ss who knew "and" also knew "but not." These results are presented in Table 10. Whereas 28 Ss performed

- - - - - - - - - - - - - -

Insert Table 10 about here.

- - - - - - - - - - - - - -

successfully on both items, there were only 8 Ss who passed one but not the other, five succeeding only on "and" and three on "but not." These results are consistent with the absence of differences in the comprehension of affirmative and negative coordinated language in the preceding task. Thus, it appears that the two conjunctions emerge close together during development. Also, these two terms appear to precede the emergence of "or." Of the 16 Ss who passed "or," 15 of these also passed one or both of the conjunctive conjunctions while only one S passed "or" but failed "and" and "but not." The relationship between "or" and its negative form is less certain because so few Ss were successful. However, there were 13 Ss who passed "or" but did not pass "or else not,"

Table 9

Hungry Pig Task, Phase II: Number of Ss in Each Age Group Meeting Criteria of Success for Each Conjunction Type

	Age					
	4	5	6	7	8	Mean
And (at least 2/5 items correct)	5	5	8	8	6	6.4
But not (at least 2/6 items correct)	3	6	8	6	7	6.0
Or (at least 2/5 items where at least one from each of 3 sets* and no extra-set goodies selected)	3	4	3	3	3	3.2
Or else not (at least 1/3 items where at least 1 from each of 3 sets* and no extra-set goodies selected)	0	0	1	2	1	0.8
Mean	2.75	3.75	5.0	4.75	4.25	

*Three possible sets: A intersection B; A but not B; B but not A.

Table 10

Hungry Pig Task, Phase II: Number of Ss at Each Age Level Passing Various Combinations of Conjunctions*

	Age 4	5	6	7	8	Total
Only one type passed						
And				1		1
Or		1				1
But not						0
Or else not						0
Only two types passed						
And; but not	2	4	5	4	4	19
And; or	2	1				3
But not; or		2			1	3
And; or else not				1		1
But not; or else not						0
Or; or else not						0
Only three types passed						
And; but not; or	1		2	2	1	6
And; but not; or else not						0
But not; or; or else not						0
All passed			1	1	1	3
None passed	3					3
					Total	40

*Pass-fail criteria given in Table 9.

only one S who passed the latter but not the former, and three Ss who passed both. This latter group was also successful with the first two conjunctions. These results combine to suggest a tentative developmental scale. "And" and it's negative form "but not" emerge close together, and they precede the appearance of "or." In contrast, "or" appears before its negative counterpart "or else not" which comes in last.

5. Transformation Task.

Performance on this comprehension task in which Ss were asked to perform various mental transformations among relational statements was scored in terms of the number of correct objects identified out of 22 pictured pairs described by E. Since the probability of a correct response by chance for each item was .50, any shifts in choice were ignored and the first name given by S was the one scored.

An analysis of variance performed on the number of correct responses in Phase II revealed no main effects or interactions as a function of age, race, or sex. The means for each age group were 16.5 for 4-year olds, 16 for 5-year olds, 16.4 for 6-year olds, 19 for 7-year olds, and 17.9 for 8-year olds. Only three Ss obtained scores close to that expected by chance. A 4, 5, and 6 year old responded correctly on 9, 9, and 13 items, respectively. All other Ss received scores of 14 or better. (Probability of obtaining at least 14 by chance is .10.) These results are quite surprising in light of Phase I results which indicated that less than half of the Ss, mostly older children, could perform these mental transformations. It is likely that the disappearance of age differences in Phase II resulted from task modifications, specifically the fact that lexical development was eliminated as a factor influencing performance. In the Phase II version of this task, only size adjectives familiar to most Ss were used. These results suggest that most children by the age of 4 have acquired the ability to comprehend at least some transformational relations.

When performance as a function of specific structural-transformational types was examined, results suggested that some structural relations were more difficult to compute than others. These results are presented in Table 11. The mean number of errors per item is given.

- - - - - - - - - - - - -

Insert Table 11 about here.

- - - - - - - - - - - - -

When these transformational relations are ordered from easiest to most difficult, the following array emerges:

(1) X is bigger than Y. Who is not bigger? (2.5 errors)

(2) X is smaller than Y. Who is not bigger? (3.0)

(3) X is bigger than Y. Who is smaller? (4)

(4) X is smaller than Y. Who is not smaller? (4.5)

Table 11

Transformation Task, Phase II: Mean Number of Errors Per Item*
as a Function of Form of Assertion and Form of Question (maximum = 40 errors)

Form of Assertion		Form of Question: Comparative Affirmative — Maxi	Comparative Affirmative — Mini	Comparative Affirmative — Mean	Comparative Negative — Not Maxi	Comparative Negative — Not Mini	Comparative Negative — Mean
Comparative Affirmative	Maxi	-	4		2.5	13.5	8.0
	Mini	6.7	-		3.0	4.5	3.75
	Mean			5.33	2.75	9.0	5.88
Negative Equative	Maxi	8.5	7.5	8.00	-	-	
	Mini	18.0	18.5	18.25	-	-	
	Mean	13.25	13.0	13.18			

*There were two items for each of the constructions represented by each cell except the comparative affirmative construction for which there were three items. Sums of errors were divided by the number of items to yield comparable values.

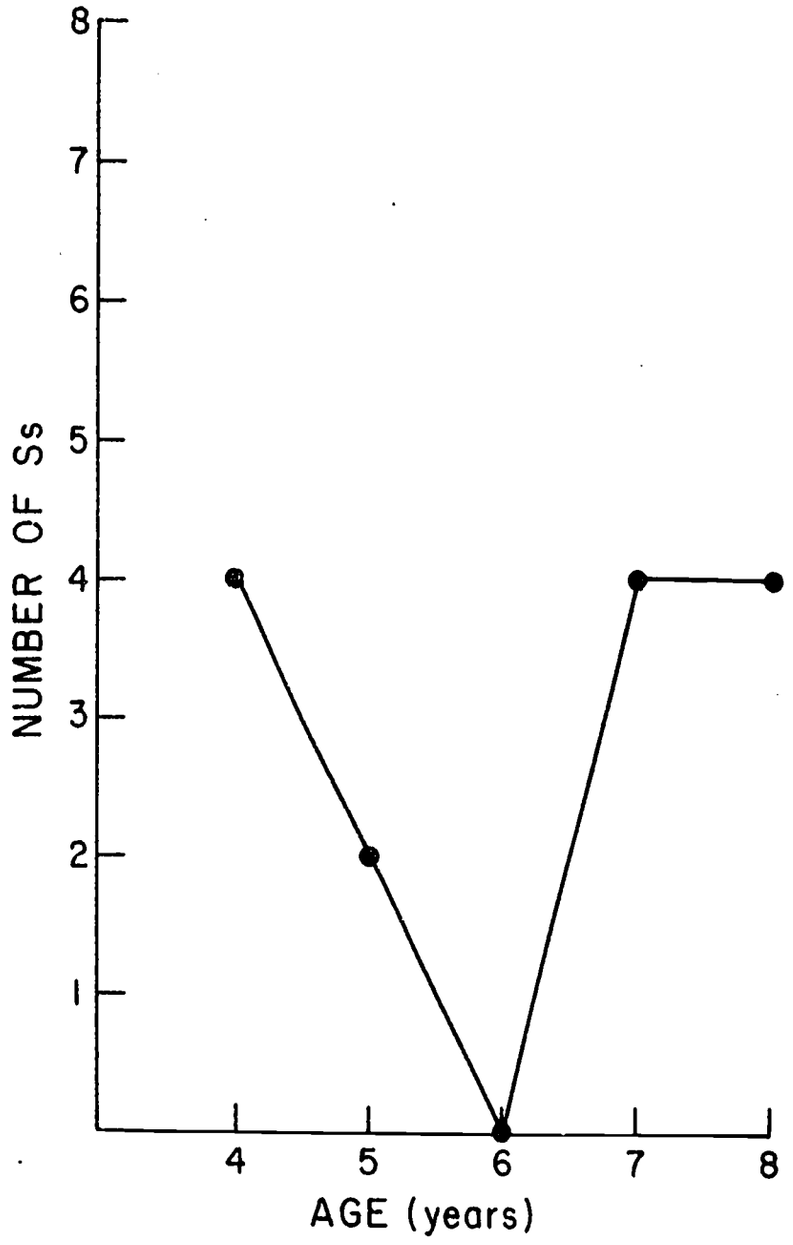

Fig. 5. Transformation Task, Phase II. Number of Ss in each age group answering correctly on a majority of items for five transformational types.

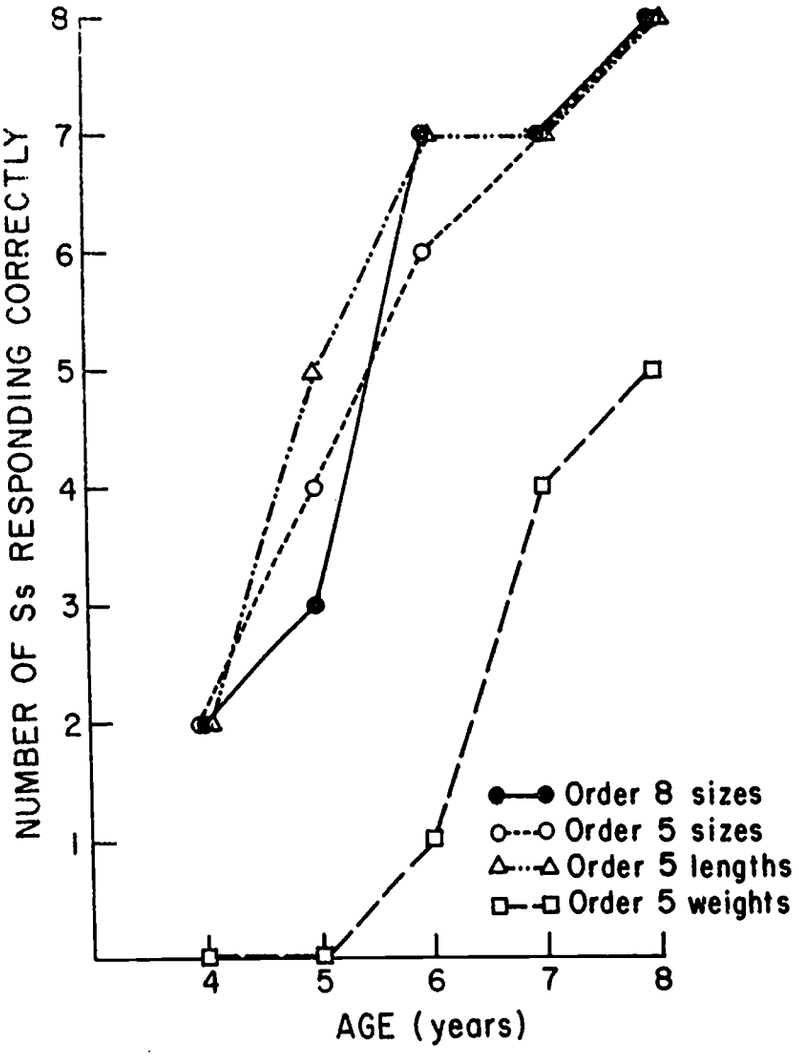

Fig. 6. Language and Seriation Production Task, Phase II: Number of Ss in each age group succeeding on each ordering task.

This is confirmed by an inspection of the ranges which differed very little. The greatest difference, found for the number of absolute descriptives used, yielded $t = 1.67$, $p > .05$. Although conclusions remain tentative since there were so few Ss, these results suggest that differences in the adjective forms used by seriators and non-seriators very close in age were non-existent.

That age makes a greater difference than operational capability in linguistic production tendencies is suggested by Tables 13 and 14 which show that the language of older Ss and older seriators was quite

- - - - - - - - - - - - - - - - - -

Insert Tables 13 and 14 about here.

- - - - - - - - - - - - - - - - - -

different from that of younger Ss, whether they were seriators or non-seriators. Specifically, older Ss utilized a greater proportion of full comparatives (i.e., bigger than, not as big as, not bigger than) to describe object differences than younger Ss who did not differ in this respect regardless of their seriation capabilities. Although age appears to be more highly correlated with linguistic production than operational capabilities, there is some evidence to suggest that the latter capability is not completely unrelated to language. In the present study, two older non-seriators were identified, a 6 and a 7 year old. Table 14 indicates that their comparative descriptions resembled the productions of younger rather than older Ss. Also, there were three 5 and 6 year olds who revealed partial seriation, and the extent of their productions of full comparatives was inbetween that of younger Ss and older seriators. These results suggest that the tendency to rely exclusively on comparatives to describe differences increases as a function of age combined with the ability to seriate. Older seriators tend to limit their descriptions to comparative forms while older non-seriators do not. However, this is not the case for younger seriators and non-seriators who may or may not adopt comparatives with equal likelihood. This is perhaps a consequence of the fact that these comparative forms enter the speech of children before they have full grasp of the underlying relational semantic system. Although younger children use comparatives in their descriptions, they select other forms as well because the comparatives do not communicate for them the full meaning which they wish to convey. (This possibility will be better established subsequently.) The above conclusion appears to differ from that drawn by de Zwart (1969) who claimed that seriators regardless of age were more likely to produce comparatives to describe differences than non-seriators. Although provocative, these generalizations are quite tentative and require further verification since so few Ss comprised the critical categories, namely, younger seriators and older non-seriators.

To determine the extent to which seriators and non-seriators understood the meanings of comparative and equative forms applied to an ordered array of objects, their scores on the Seriated Pictures Comprehension task were examined. These values are given in Table 14. In

Table 13

Language and Seriation Production Task, Phase II:
Descriptions Produced as a Function of Age

	Age 4	5	6	7	8
Mean number of adjectives produced to describe 5-object sets*	19.0	17.0	14.0	11.1	7.5
Proportion of productions consisting of full comparative form	.18	.27	.53	.53	.75
Range of proportions	.00 to .82	.00 to .71	.00 to 1.00	.00 to 1.00	.27 to 1.00
Number of Ss whose proportions of comparatives exceeded .50 (maximum = 8)	1	1	4	4	7

*Note: The drop in total number of productions as a function of age is partly a consequence of E's tendency not to ask as many questions of older subjects.

Table 14

Language and Seriation Production Task, Phase II: Relationship Between Language Produced to Describe Five-Object Sets, Ability to Order Sets of Objects by Size, and Comprehension of Seriation Language

Subject Groups	Mean Number of Linguistic Productions	Proportion of Productions Expressed as Full Comparatives	Range of Full Comparative Proportions	Mean Scores on Comprehension (Seriated Pictures) Task
Younger Non-seriators: 4 and 5 yr. olds who failed all 3 ordering tasks (N = 9)	17.2	.22	.00 to .82	4.8
Older Non-seriators: 6 and 7 yr. olds who failed all 3 ordering tasks (N = 2)	24.0	.21	.09 to .32	6.5
All Non-Seriators: 4, 5, 6, and 7 yr. olds who failed all 3 ordering tasks (N = 11)	18.5	.22	.00 to .82	5.1
Partial Seriators: 5 and 6 yr. olds who passed only some of ordering tasks (N = 3)	19.3	.34	.19 to .47	4.0
Younger Seriators: 4 and 5 yr. olds who passed all 3 ordering tasks (N = 5)	18.4	.19	.00 to .41	8.2

Table 14 (continued)

Language and Seriation Production Task, Phase II: Relationship Between Language Produced to Describe Five-Object Sets, Ability to Order Sets of Objects by Size, and Comprehension of Seriation Language

Subject Groups	Mean Number of Linguistic Productions	Proportion of Productions Expressed as Full Comparatives	Range of Full Comparative Proportions	Mean Scores on Comprehension (Seriated Pictures) Task
Older Seriators: 6, 7, and 8 yr. olds who passed all 3 ordering tasks (N = 21)	9.43	.65	.00 to 1.00	8.3
All Seriators: All Ss who passed all 3 ordering tasks (N = 26)	11.6	56.1	.00 to 1.00	8.3

contrast to the absence of language production differences between younger seriators and non-seriators, these results revealed that seriators comprehended almost twice as many items as non-seriators, with $t_{12} = 2.92$, $p < .01$, for the comparison of younger Ss, and $t_{35} = 4.03$, $p < .01$ for the comparison between all seriators and non-seriators.

Furthermore, in contrast to the presence of a production difference above, the comprehension scores of younger and older seriators did not differ, with $t < 1$. Although these results suggest that seriators comprehended comparative forms better than non-seriators, closer inspection of comprehension scores revealed that not every S fit this pattern. Deviations occurred mainly among non-seriators. There were two younger and one older non-seriator (out of 11) who received comprehension scores just below the mean of the seriators (values of 8). However, none of the younger seriators and only one of the older seriators (an 8 year old) obtained scores as low as the non-seriator mean (value of 4). These results suggest that comprehension of forms describing object size differences may be a necessary but not a sufficient condition for the ability to order these objects. In other words, to be a seriator one must possess some facility in the comprehension of comparatives. However, attainment of this level of proficiency does not thereby insure the capability to seriate.

This relationship between comprehension of comparatives and seriation is in marked contrast to the absence of a relationship between comparative production tendencies and seriation. The only two Ss (two 4 year olds) who failed a majority of all the comprehension item types (total scores of 1 and 2) were also unable to seriate, but were observed to produce full comparatives, particularly one boy who used it in 82 percent of his five-object size descriptions. These findings suggest the possibility that comparative forms may enter the speech of some children before, not after, these forms are fully comprehended. In the present study, there were 6 Ss who received scores of 0 or 1 on the 4 affirmative comparative comprehension questions. Of these, three also produced a negligible number of full comparatives (totals of 0 or 1) and inflected adjectives (totals from 1 to 4) while the other three Ss generated several full comparatives (totals from 4 to 9) and numerous inflected adjectives (totals from 17 to 34) in their descriptions. Inspection of comprehension errors of these high producers-low comprehenders indicated that one S was selecting only the extreme object rather than both objects which were bigger or smaller than the standard. Errors of the other two Ss lacked any pattern. These results support the possibility that production may precede full comparative comprehension. At least they suggest the need to determine the meanings assigned by Ss learning how to use comparatives. Premature producers may be regarding this form in a class rather than a relational sense (i.e., "bigger than" as being synonymous with "all the big ones" or "the biggest one").

Closer inspection of both the linguistic and ordering responses of non-seriators was undertaken in order to discover the nature of the errors they were making. Some of the non-seriators but none of the seriators were observed to include in their descriptions comments about the "sameness" among objects in response to E's difference question. Regarding the two biggest sink plugs, one S said, "This one's almost

like this one, so it goes with that one." This boy's responses were heavily laced with these "like" and "goes with" comparisons. Another non-seriator replied, "They're not the same all the time." A third S produced the following descriptives which reflect vascillation between the notions of sameness and difference. In response to E's question, "How are these three plugs different?" she said, "Cause this one's bigger, and this one's little. And then both of these are the same size. But this one is bigger like this one..." Subsequently, to describe three pencils, she said, "The yellow one is so little, and this one is almost bigger like him." When 5 pencils were presented, she tried to explain about the two longest pencils. "If I put this right here (the longest),he'll be the father and he'll be real bigger. And if this guy (next longest) be real bigger like him, he'll be just like this man." And later, "Cause this one is not bigger than these, and so when this one grows up like them, it'll be the same." Clearly, she is struggling for a way to handle simultaneously the discrepancy between the objects' class similarities and relational dissimilarities. That this was a general problem among non-seriators is reflected in their attempts to order the object sets. An older non-seriator surprisingly produced the correct arrangement in his speech, "It's taller than the green one (#2), the red one (#3), the white one (#4), and the yellow one (#5)," but proceeded to reverse the 4th and 5th objects when ordering them. The fact that this S applied only two polar labels (tall and short for the pencils and big and small for the plugs) in the majority of his comparisons suggests that he had in mind two groups of objects rather than a seriated array and so did not notice the reversals in his ordering. The other older non-seriator in fact verbalized this grouping strategy as she was ordering the five objects: "All the little ones go on the end. Right? All the big ones go right here." Not just these Ss but most of the non-seriators revealed this strategy in their object orderings. In arranging the first five-object set, 7 out of 11 Ss placed either the two biggest and three smallest plugs together (e.g., order: 1, 2, 4, 3, 5) or the three biggest and two smallest plugs together (e.g., order: 1, 2, 3, 5, 4). On the second set, almost all of the Ss (10 out of 11) displayed this approach to arranging the pencils. This constitutes very strong evidence suggesting that one of the problems of non-seriators is that they possess two conflicting strategies, one involving the grouping of similar objects, and another systematizing their differences. That they are aware of both similarities and differences is evident in their speech as well as their orderings illustrated above. However, they appear to be confused by and lack a means of coordinating the visible differences in size with the similarities imposed by (1) their language (i.e., some are "big" and some are "small") and (2) the identical properties among the objects (i.e., all are instances of the same thing). It is important to note that these Ss were invoking descriptives similar to those used by seriators. Perhaps because there exists no single linguistic structure in English capable of representing simultaneously an ordered array comprised of more than two objects, language does not provide the solution to seriation and in fact may interfere by causing Ss to ignore visible differences in favor of similarities imposed by a common label.

It has already been established that except for verbalizations indicating a conflict between grouping and contrasting operations among

some non-seriators, production differences associated with the ability to seriate (with age held constant) were not clearly evident in the present study. Nevertheless, it is instructive to identify the various strategies used by Ss to describe object differences in order to provide a basis for the more careful design of future studies to verify whether there is or is not a relationship between language production and seriation capabilities. Some Ss employed quite elaborate modificational systems in order to talk about object differences. The most productive use of such a system was displayed by a 4 year old seriator in describing the 5 pencils. His labels included the following: variations in the repetition of "real" preceding "big" and "little" to indicate degrees of size; use of "just" and "a little bit" to designate the middle objects, as in "just big" (for Object #2), "just a little bit of big" (#4), "a little bit of real big" (#3). He appeared to be using these two modifiers as other Ss used "almost" or "kind of" to generate labels for medium-size objects. Perhaps the most unexpected adoption of a modifier to represent middle objects was the use of "too." A 6 year old struggling to explain how the #4 pencil differed from the one he had called "littler" (#5), came up with "too little" for #4 and then said of #3, "The red's too big, too little too." This strange production is perhaps partly explained by another S's responses observed during Phase I testing, a S who used "too" regularly in her descriptions. Although she was not able to position all the terms correctly in speech, she appeared to be trying to say of the middle of three pencils, that it was too little to be big and too big to be little. Her production came out, "It's too big to be big and this one's too big to be little." "Too" was apparently being used like the other modifiers "just," "almost," and "kind of" to mean not quite big or not quite little above.

In addition to attaching adjective modifiers to polar terms to express degree, Ss sometimes introduced a third polar term to represent the middle object. For some, "small" or "short" was employed between "big" and "little" to designate middle-size objects. Sometimes Ss searching for distinctive labels went to family names adopting not only papa, mama, and baby but also aunt and big brother. One S in fact remarked, "They're a whole family."

Rather than generate distinctive labels, other Ss repeated the comparative form and coordinated this with the order in which they pointed to objects being described. One seriator started with the second smallest object and called it "more bigger than" the smallest, then pointed to each in ascending order repeating the same form. She thus did not rely solely on her language to represent all differences but combined her language with her actions. This approach was used mostly by older seriators.

Not only the above S but other Ss were observed to add modifiers to their comparative forms (e.g., "more bigger than," "still bigger than," "much bigger than"). It is possible that such over-engineered descriptions were felt to be necessary by Ss in order to make sure that their forms conveyed the relational rather than the absolute meaning of the adjective. There is other evidence among responses to suggest that many times Ss employed comparative forms such as "bigger than" or "bigger" when they meant nothing more than the absolute "big." For

example, some Ss were observed to combine adjectives with modifiers which conveyed their intended meaning and then to add a semantically useless inflection to the adjective: "kind of bigger" or "between bigger" to describe a middle object; "the real biggest" or "real real bigger" or "the most bigger one" to describe the biggest object. In fact a few Ss in generating such combinations ended up intending the opposite of what they were actually saying, as when a child called the #1 object "bigger" and then the #2 object "a little bigger." Some over-engineered descriptions also reflected Ss' confusion between relational and absolute meanings of adjective forms. For example, a 7 year old claimed that the #2 pencil was "a middle-size bigger than all of 'em." A 4 year old called the #5 pencil a "baby one" and then said #3 was not because it was "almost bigger than" the baby one. Whereas this S applied "almost bigger" to the bigger of two objects, another S used this same expression to describe the smaller of two objects (i.e., #2 is "almost bigger than" #1). In all of these, the child appears to have mixed the strategy of generating distinctive labels with the strategy of using comparative forms to mark the difference in speech. This might have been partly a consequence of the fact that E always phrased her questions as comparatives (i.e., "How is one different from (or than) the other?") making the S feel compelled to respond in like form. Several Ss did try to combine their absolute terms with the conjunction "than" as in "This one is biggest than all of these;" "This one's middle-size(er) than both of these." However, it is unlikely that all of the above malproductions were completely foreign to Ss. Rather it is probable that these forms reflected their attempts to bring together components of their linguistic systems with components of their conceptual systems. This is an intriguing process which needs to be studied in more detail.

Completion of this section requires one footnote. When this study was undertaken, it was expected that clearcut all-or-none patterns would emerge in the responses of children. Cognitive structural predictions and interpretations of data, it would seem, require confirmation in this strong sense. However, the results were found to be somewhat disappointing. For example, although comprehension means for younger seriators were similar, the particular items passed were not. Of the two 4-year olds who could seriate, one was able to pass a majority (3 out of 4) of the affirmative comparative questions but the other was not (1 out of 4 correct). However, the latter S was able to pass some of the other item types (i.e., affirmative equative and negative comparative) that the first S failed. It may be that these results reflect the fact that Ss may master these forms in various orders, no one being a prerequisite for any other, and that to seriate one must have succeeded in acquiring at least one type. It is also possible that the search for evidence supporting strong all-or-none inferences is like chasing wild gooses. Performance factors will always mitigate against clearcut patterns and so, such noise must be tolerated. Another illustration of this was also bothersome. As has been pointed out, although the group means were different, there existed overlap in the distribution of comprehension scores for seriators and non-seriators. Specifically, while the highest score of a non-seriator was 8, there were 12 out of 26 seriators who received scores of 6 or 7 and one who got only 4 correct. Given this state of affairs, the question arises:

Is it legitimate to claim, for example, that comprehension of descriptive forms precedes the ability to order? It is not at all clear how much of the noise in the data can be attributed to measurement error and how much constitutes negative evidence, especially when the inferences being drawn are not stated probabilistically. Some guidelines for cognitive psychologists regarding this dilemma perhaps need to be formulated.

7. Seriated Pictures Comprehension Task.

Performance on this task in which Ss were asked to demonstrate comprehension of comparative and equative constructions and their negative counterparts was subjected to an analysis of variance. In addition to the emergence of a main effect of affirmation-negation, with $F(1, 20) = 26.34$, $p < .01$, an interaction between the affirmative-negative factor and the comparative-equative factor was detected, with $F(1, 20) = 54.41$, $p < .01$. Whereas affirmation exceeded negation for comparative forms, the reverse was true for equative constructions. A main effect of age was significant but only at $p < .05$, with $F(4, 20) = 3.47$. Inspection of mean scores as a function of both age and type of construction indicated that growth curves were steeper for some than for other forms. This accounts for the weak overall effect of age observed. These results are depicted in Figure 7.

- - - - - - - - - - - - -

Insert Figure 7 about here.

- - - - - - - - - - - - -

Performance was very poor at all age levels for negative comparatives. This proved to be a consequence of the fact that, to be correct, a S had to include the object which was the same size as the standard (i.e., "not bigger" designates those which are "as big" as well as those which are "smaller"). Two-thirds of the errors on these items were ones where S omitted this object.

In contrast, comprehension of affirmative comparatives increased substantially with age, especially between the ages of 4 and 5. For the older children this was the easiest form to comprehend. Examination of the errors of Ss in response to affirmative comparatives revealed that 61 percent of these involved the selection of only the one maxi-est or mini-est object. Perhaps these Ss were regarding the comparative as a superlative form, or perhaps they lacked compulsion to identify all set members satisfying the criterion, or perhaps the meaning of the adjective was regarded as polar rather than comparative (i.e., big rather than bigger).

The next easiest was the equative construction, with the negative slightly superior to the affirmative, especially among younger Ss. Inspection of errors with affirmative-equative forms revealed that most of these Ss regarded the statements as comparatives and so selected either the one or two maxi-est or mini-est objects. Seventy-two percent of the errors were of this sort. Examination of negative equative errors failed to uncover one dominant strategy. Rather two tendencies were

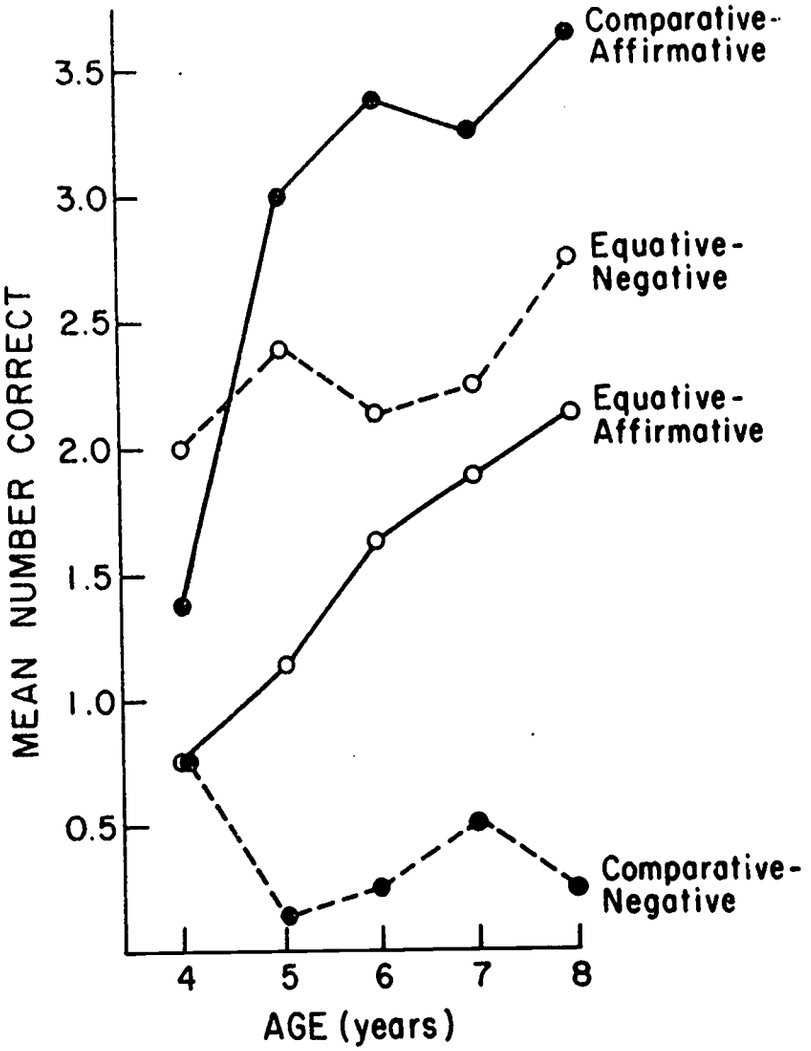

Fig. 7. Seriated Pictures Comprehension Task, Phase II: Mean number of correct responses as a function of age and relational construction.

observed with substantial frequency. About 26 percent of the errors consisted of identifying only one of the two correct objects. These Ss either were not giving complete answers, or were regarding the form as a simple negative polar (i.e., not big or not little). The other type, accounting for one-third of the errors, involved regarding the form as an affirmative comparative. That is, Ss appeared to transform "not as big as" into "bigger than" and to select either one or two objects larger than the standard. This most surprising response strategy was evident with the mini as well as the maxi negative equative form.

Although the above analysis did not include polarity as a factor (i.e., maxi vs. mini terms), comparison of maxi and mini values within each construction indicated only very slight differences consistently favoring neither pole. These results are presented in Table 15. The

- - - - - - - - - - - - -

Insert Table 15 about here.

- - - - - - - - - - - - -

absence of a difference for the negative equative form, where means of 1.1 for maxi-terms and 1.2 for mini-terms emerged, is especially interesting in light of results reported in the transformation task in which relations underlying mini-negative-equative constructions (double negatives) were harder to compute mentally than relations underlying maxi-negative-equative constructions (single negatives). These results contribute to the hypothesis entertained previously that this double negative construction creates additional problems only under certain conditions, when the S is required to manipulate it mentally, not when he is required to simply comprehend its meaning in terms of an array of objects in which the relations are clearly visible.

Analysis of responses on the items designed to measure comprehension of the superlative inflection (i.e., biggest, smallest) revealed that 73 percent of the Ss selected the one biggest object and 63 percent selected the one smallest object in the arrays. This tendency was strongest among the 6 year olds where all but one S responded perfectly on both questions. The mean number of Ss (out of a total of 8 per age group) succeeding on both superlative questions for each age level in order from 4 to 8 years was: 3.5, 4.0, 7.5, 6.5, and 5.5. Dominant errors produced by Ss consisted of naming either 2, 3, or 4 of the 5 objects for the maxi-superlative and selecting the two smaller objects for the mini-superlative. Comparison of the errors of younger and older Ss revealed clearcut differences in their maxi-superlative response patterns. Whereas all the errors produced by 4 and 5 year olds (N = 6) consisted of selecting two or three biggest objects, all the errors produced by 6, 7 and 8 year olds (N = 5) involved selecting the 4 biggest out of 5 objects. When responses were examined more closely, the cause of these errors became apparent. Ss were excluding the one biggest object previously selected and were pointing to the next biggest object each time E asked, "Are there any other that are biggest?" Older Ss continued in this fashion until all but the smallest object had been identified before they replied, "No." In contrast, younger Ss stopped after the first two or three objects. This difference suggests that older Ss

Table 15

Seriated Pictures Comprehension Task, Phase II: Total Number of Correct Responses as a Function of Age, Polar Term, and Item Construction (maximum per cell = 16)*

		Age 4	5	6	7	8	Total
Comparative	Maxier than	6	12	14	13	14	59
	Minier than	5	13	13	13	15	59
	Total	11	25	27	26	29	118
Equative	As maxi as	3	3	8	8	9	31
	As mini as	3	5	5	7	8	28
	Total	6	8	13	15	17	59
Neg. Comp.	Not Maxier than	1	1	2	2	1	7
	Not Minier than	5	0	0	2	1	8
	Total	6	1	2	4	2	15
Neg. Equat.	Not as maxi as	9	9	7	7	12	44
	Not as mini as	7	10	10	11	10	48
	Total	16	19	17	18	22	92
Total		39	53	59	63	70	284

*Note: Each S may contribute a maximum of 2 correct responses per cell. Thus, these sums are not based on independent observations and so differences are less reliable.

but not younger Ss were aware of the relational nature of the term and the fact that the term could be used even with smaller objects making up a set. The absoluteness of younger Ss' responses was reflected both in their refusal to call the fourth object "biggest," and in their descriptions of the remaining two objects, "These ones are little." In addition to being unable to conceive of shifting subsets of objects to be compared, it is likely that some younger Ss did not possess the distinction between superlative and comparative forms and in fact regarded all of these as free variants of the polar term. (There exists some evidence for this in production data reported above.) The more sophisticated basis for older Ss' responses perhaps accounts for the slight decline in scores after the 6 year level.

When errors for mini-superlative terms were analyzed, the same difference as a function of age was not evident. Only one 8 year old shifted subsets three times in response to E's repeated questioning. All other Ss would only acknowledge one or two objects as being the littlest. This suggests the possibility that maxi-inflected terms can be used in a strictly relational sense earlier than mini-inflected terms.

In the analysis of responses to double comparatives, very few Ss were found to be able to comprehend this form. The numbers of Ss getting at least one of the two questions correct, for each of the age levels from 4 to 8 was: 0, 1, 1, 2, and 6. Thus, not until the age of 8 was a majority of the Ss able to succeed on this item. Such a question requires Ss to hold in mind and coordinate two comparative relations. Analysis of errors on these items revealed no major interpretive strategies.

8. Clay Manipulation Task.

This task was designed to reflect comprehension of the modificational system involving combinations of the terms "a lot" or "a little" with "bigger" or "smaller." Performance was analyzed as a function of age for the various item types. These results are presented in Table 16.

- - - - - - - - - - - - -

Insert Table 16 about here.

- - - - - - - - - - - - -

It is evident that most of the Ss comprehended the double maxi-pole combination "a lot bigger." Also, all but four Ss knew to add clay when a mini-modifier was combined with a maxi-comparative term. However, performance was slightly poorer on items where either modifier was combined with a mini-comparative. Closer inspection of the responses of the 11 Ss who failed at least one item on this task revealed that 8 of these failed the items requiring removal of clay. This was because they adopted the strategy of adding clay regardless of the instructions. This suggests that perhaps these Ss were not really comprehending any of the adjective combinations. Of the other three Ss, two missed only one item, probably accidently, and one S, rather than removing clay, tried to roll, flatten or otherwise compress the clay to reduce its size. Since he used this approach only on the clay removal items, his answers were accepted as correct.

Table 16

Clay Manipulation Task, Phase II: Number of Children in Each Age Group Performing Successfully on the Various Item Types (maximum = 8)

		Age 4	5	6	7	8	Mean
Number of Ss correctly adding or removing clay*							
Lot bigger (add)		7	7	7	8	8	7.4
Little bit smaller (remove)		5	5	6	8	8	6.4
Lot smaller (remove)		4	5	7	8	8	6.4
Little bit bigger (add)		5	7	7	8	8	7.0
		4	5	6	7	8	Mean
Number of Ss responding correctly to the modifier**							
Adding a lot		0	2	5	3	7	3.4
Removing a lot		1	3	6	7	5	4.4
Adding a little bit		5	4	3	3	3	3.6
Removing a little bit		3	3	4	5	4	3.8
Interpretation of Polar Adjective Modification: Number of Ss							Total
"Make this big ball a little bit big."	Add	4	7	5	8	5	29
	Remove	3	0	1	0	3	7
"Make this small ball a little bit small."	Add	3	2	0	0	0	5
	Remove	4	5	6	8	8	31

*Two items were included to measure comprehension of maxi-mini combinations whereas only one item measured each of the identical polarity terms. Success meant passing all of the items.

**The criterion used to decide whether "a lot" or "a little" had been manipulated involved judging whether the child increased or decreased the size of the ball by more or less than one-half its original size.

Regarding the 8 Ss who failed the removal items (four 4-year olds, three 5-year olds, and one 6-year old), all displayed the ability to comprehend the terms presented singly. In response to the combinations, however, these Ss appeared to be either ignoring the instructions or selectively attending only to the maxi-term, perhaps because they were unable to resolve the maxi-mini polar discrepancies. There were four Ss who added clay to every item. Another S appeared to focus upon the maxi-term "a lot" and to ignore its companion in the combination. The only ball which he reduced in size was the one lacking this term (i.e., "a little bit smaller"). And when asked to make the ball "a little bit bigger," he replied "I can't!" Three of the children despite successful performance with the single terms did not appear able to comprehend at all the combined term instructions and just rolled or squeezed the ball haphazardly in response to each item.

When the language used by these eight Ss to describe object sets in the Language and Seriation Production Task was examined, at least one of these combinations was found in the productions of five of the Ss. These productions consisted of the modifier "a little" or "a little bit" combined with either a maxi- or a mini-adjective. Why these Ss did not display comprehension of these forms is not clear. This evidence suggests, though, that it is possible for production of combinations to precede comprehension. Perhaps this can be attributed to differences in demands made by the two tasks on the child's developing cognitive equipment. In the production task, the S is pressing himself to come forth with some good descriptives and so "accidentally" he generates some of these forms. However, in the comprehension task, he is bombarded with many combinations and these forms come from the outside. Since he lacks semantic control over the full underlying modificational system, he is unable to sort out the meanings and respond correctly. Just as previous results suggested for comparative forms, the present results indicate that for modifiers as well, it may be the case that production is developmentally prior to comprehension for the reason that successful comprehension but not production requires full mastery of the whole system.

In Table 16 are also displayed Ss' interpretations of the terms "a little bit big" and "a little bit small" to compare one object to another. The inclusion of these was suggested by responses of Ss who produced such descriptives during Phase I testing. It appeared that they were using them to mean either a little bit bigger or not quite as big as another object in the case of the first term, and a little bit smaller or not quite as small as another object in the case of the second term. In fact, some Ss appeared to be assigning both meanings to the same term at different times in their productions. To determine how Ss interpreted these forms, the two items were included in this task. These items preceded all the items discussed above containing the comparative inflection to avoid contamination. Results suggested that interpretations varied only among the younger Ss for the mini-polar combination. Most Ss regarded "a little bit small" as meaning "smaller." However, alternative interpretations to "a little bit big" were more frequent. A few of the oldest as well as youngest Ss appeared to recognize that the absence of the inflection on "big" might mean a reduction in size. Most of the Ss, though, regarded this form as synonymous with "a little bit bigger." In fact, they often produced the inflected form

as they were manipulating the ball in order to verify their interpretation. The extent to which Ss could recognize and accept both interpretations was not exposed in this task. However, some of the verification queries of Ss suggested that they were not completely certain about their particular interpretations. It may be that these forms are seen as ambiguous by children at a certain point in their adjective development.

The observation of instances where S produced the same form sometimes to mean one thing and sometimes to mean another is interesting food for speculation. As has been suggested above, it is possible that in response to the need to find adequate language to describe differences among objects varying along one dimension, Ss generate forms which possess more semantic potential than is realized (i.e., understood). The lack of a fully developed underlying system would mean the absence of a basis for controlling and rendering consistent the relation between a descriptive and its referent from one point in time to another. This explanation may also apply to the child discussed in the Language and Seriation Production task who produced "almost bigger" to refer to objects both bigger and smaller than the focal object. The results in both of these tasks suggest that it would indeed be worthwhile to conduct a more detailed inspection of the whole adjective combinatorial system to determine how children at various points in development comprehend and use these descriptives.

During Phase I of this task, in which not only more adjectives and adjective combinations were examined but also the relations between these and the two objects described were varied, many interesting responses were observed, although they were not pursued in Phase II. These are illustrated below.

When asked to make their clay balls so that they had less than E's ball, 40 percent of the Ss added clay to the ball. Their remarks confirmed that they thought "less" meant "more." One S after hearing the instructions asked, "Less more than yours?" and then added clay to her ball. Another child thought that "less" was synonymous with "as big as" and that both meant "more." She replied to E, "Okay. I'm gonna make it as big as yours. (Note: Her ball was already bigger.) I'm gonna make it as lest as yours." When asked what that meant, she replied, "More," and then tripled the size of her ball. Another S queried, "What means 'less'? Oh, it means 'have more clay.' It already have more clay." A productive use of "less" followed on the heels of this child's rendering of "less." When told to make her ball a lot bigger than E's, she increased its size and then described it as being "less bigger than yours." She claimed that this meant the same as "a lot bigger." These findings are consistent with the work of others such as Donaldson and Wales (1970) who showed that initially kids interpret "less" to mean "more." These findings also suggest that this confusion involves not only the lexicon but also some of the syntactic forms used to express comparisons.

Another item eliciting interesting reactions was the one where S, possessing a ball already bigger than E's ball, was told to make his "as big as" E's ball. Six Ss, 5 to 7 in age, saw no problem and promptly reduced the size of their ball. One S, when asked what he did,

said "I made sure mine's the same--not as big as yours." (He seemed to mean "like" rather than "as" here, that is, "not big like yours.") However, other Ss found the solution much less obvious. One child whose performance was superior on several other tasks claimed, "I can't get it that way." She appeared to recognize that the form "as big as" implied the operation of increasing the size of hers as well as making the objects the same, whereas the less advanced Ss interpreted the form only to mean "the same as." These results suggest the value of investigating performances in this sort of task with older Ss, perhaps 6 to 10 in age. These items were found useful for testing comprehension of equative as well as comparative forms and the child's ability to coordinate their meanings with referent objects. The only problem was that younger Ss became bored with this especially long task. This was why much of it was eliminated from Phase II testing. A procedural modification might have solved part of this problem and also might have been fruitful as another way of exposing Ss' language and thinking. As E was testing one 6 year old, the child insisted on turning the tables and presenting E with similar problems. Perhaps in tasks such as this one, in which the same stimuli are used repeatedly for each question, this role-reversal strategy might maintain the child's interest.

Inter-task Analysis

One of the purposes of the present study was to examine relationships among performances in the various tasks to determine which capabilities are developmentally prior to others and which appear to be prerequisites for other capabilities. To do this, pass-fail scoring criteria were identified for measures taken in each task. An attempt was made to work between a definition of what would constitute success and the empirical distribution of scores for those measures. Where there occurred a sizeable gap between very low scores and the others, and when these differences were consistent with ones notion of what it meant to give evidence of some competence for this capability, the gap was used to separate the two groups. The measures, scoring criteria, and pass-fail frequencies are identified in Table 17. Since the sample

- - - - - - - - - - - - - -

Insert Table 17 about here.

- - - - - - - - - - - - - -

size was less than 100, a Guttman scalogram analysis was not possible. However, other forms of analyses were conducted to yield the desired information.

In order to determine to what extent the measures indexed a sequence of prerequisite capabilities, the proportions of Ss passing each measure were calculated and on this basis the measures were ordered from easiest to most difficult. This order is given in Table 18. These proportions

- - - - - - - - - - - - - -

Insert Table 18 about here.

- - - - - - - - - - - - - -

Table 17

Pass-Fail Scoring Criteria Applied to Various Task Measures

Task	Measure	Scoring Criteria	Frequency
1. Negative Word Association	Number of correct opposites produced without noun prompts (maximum = 32)	Pass: At least 12 correct responses	35
		Fail: 8 or fewer correct responses	5
2. One-Dimension Description	Number of object pairs for which at least one specific contrast adjective descriptive produced (maximum = 15)	Pass: At least 4 specific terms	35
		Fail: No more than 2 terms	5
3. Hungry Pig	Number of adjective-linking conjunctions comprehended:		
	(1) And (maximum = 5)	Pass: At least 2 correct	32
		Fail: Less than 2 correct	8
	(2) But not (maximum = 6)	Pass: At least 2 correct	30
		Fail: Less than 2 correct	10
	(3) Or (maximum = 5)	Pass: At least 2	16
		Fail: Less than 2 (see Table 9)	24
	(4) Or else not (maximum = 3)	Pass: At least 1	4
		Fail: None (see Table 9)	36
4. Coordinated Language	(1) Number of coordinated adjectives comprehended (maximum = 24)	Pass: At least 12 correct	33
		Fail: No more than 8 correct	7

Table 17 (continued)

Pass-Fail Scoring Criteria Applied to Various Task Measures

Task	Measure	Scoring Criteria	Frequency
4. Coordinated Language	(2) Number of instances of coordinated language produced	Pass: At least one production	31
		Fail: None	9
	(3) Number of instances of comparative coordinated language produced	Pass: At least one production	14
		Fail: None	26
5. Transformation	Number of transformation correctly comprehended (maximum = 22)	Pass: At least 14 correct	37
		Fail: Less than 14 correct	3
6. Seriation and Language Prod.	(1) Ability to order size object sets (maximum = 3)	Pass: At least one of sets ordered	29
		Fail: None	11
	(2) Reliance on full comparative forms to describe object differences	Pass: At least one full comparative produced	33
		Fail: None	7
7. Seriated	Number of structures comprehended:		
	(1) Comparative Affirmative (maximum = 4)	Pass: At least one correct	38
		Fail: None	2
	(2) Equative Negative (maximum = 4)	Pass: At least one	38
		Fail: None	2
	(3) Equative Affirmative (maximum = 4)	Pass: At least one	20
		Fail: None	20

Table 17 (continued)

Pass-Fail Scoring Criteria Applied to Various Task Measures

Task	Measure	Scoring Criteria	Frequency
	(4) Comparative Negative (maximum = 4)	Pass: At least one	11
		Fail: None	29
	(5) Comprehension of first three forms above	Pass: At least one item correct on two forms and at least 3 correct on one form	35
		Fail: Not meeting above criteria	5
	(6) Double Comparative (maximum = 2)	Pass: At least one	10
		Fail: None	30
8. Clay Manipulation	Number of adjective modifications comprehended (maximum = 6)	Pass: At least 5 items correct	32
		Fail: At least three missed (clay removal items)	8

Table 18

Difficulty of Tasks as Indicated by Number of Ss Passing Each

Task Measure	No. of Ss Passing (Max. = 40)	Proportion of Ss Passing Each
1. Comprehension of Affirmative Comparative Form (Seriated Pictures)	38	.95
2. Comprehension of Negative Equative Form (Seriated Pictures)	38	.95
3. Comprehension of Transformational Relations (Picture Transformation)	37	.93
4. Production of Opposites (Negative Word Association)	35	.88
5. Production of Specific Adjective Descriptives (One-Dimension Description)	35	.88
6. Comprehension of Some Comparative and/or Equative Forms (Seriated Pictures)	35	.88
7. Production of Full Comparative Forms (Language and Seriated Production)	33	.83
8. Comprehension of Coordinated Language (Coordinated Language)	33	.83
9. Comprehension of Maxi-Mini Adjective Modifier Combinations (Clay Manipulation)	32	.80
10. Comprehension of "And" Conjunction (Hungry Pig)	32	.80
11. Production of Coordinated Language (Coordinated Language)	31	.78
12. Comprehension of "But not" Conjunction (Hungry Pig)	30	.75
13. Seriation: Ordering Size Object Sets (Language and Seriation Production)	29	.72
14. Comprehension of Affirmative Equative Form (Seriated Pictures)	20	.50

Table 18 (continued)

Difficulty of Tasks as Indicated by Number of Ss Passing Each

Task Measure	No. of Ss Passing (Max. = 40)	Proportion of Ss Passing Each
15. Comprehension of "Or" Conjunction (Hungry Pig)	16	.40
16. Production of Coordinated Comparative Form (Coordinated Language)	14	.35
17. Comprehension of Negative Comparative Form (Seriated Pictures)	11	.27
18. Comprehension of Double Comparative Form (Seriated Pictures)	10	.25
19. Comprehension of "Or else not" Conjunction (Hungry Pig)	4	.10

were tested to examine for significant differences among adjacent pairs. Results revealed that the hardest measure (No. 19) was passed by significantly fewer Ss than the second hardest measure (No. 18), with $t_{38} = 3.15$, $p < .05$. Measure 14 was passed by fewer Ss than Measure 13, with $t_{38} = 2.02$, $p < .05$. None of the other adjacent differences was significant. These results suggest a division of the tasks into three levels of difficulty.

After the tasks were ordered, Ss were ranked in terms of their proficiency on the tasks (i.e., the number of measures each had passed). Each S occupied one row in the matrix from least to most proficient, and each task arranged from most to least difficult occupied a column. The resulting table, presenting individual pass-fail patterns was inspected in various ways. (This matrix is given in Appendix I.)

It was reasoned that if the measures reflected a developmental sequence, then the items passed by any one S should be less difficult (with difficulty level defined by the proportion of Ss passing that item) than the items missed. In terms of the above three significantly different categories of measures, inspection of the matrix revealed that no S passed No. 19 who did not also pass at least two items in the next hardest set (No. 13-18) and at least 10 items in the easiest set (No. 1-13); similarly, no S passed at least one item in the middle set (No. 14-18) who did not also pass at least six items in the easiest set (No. 1-13).

Another more refined way of assessing to what extent a developmental sequence existed among all tasks consisted of dividing the matrix into two regions (roughly following the diagonal), an expected pass region where the easier of all the items for each S achieving a certain number of passes were identified, and an expected fail region where the harder of all the items expected to be missed by each S at his pass level were separated out. The results of this analysis are revealed in Table 19.

- - - - - - - - - - - - - - -

Insert Table 19 about here.

- - - - - - - - - - - - - - -

It is clear that most (i.e., 83 percent) of the passes and fails fell in the expected regions. This lends support to the possibility that the difficulty ordering among measures emerging when Ss' responses were pooled also reflected the order in which these capabilities emerged in individual Ss. Harder items tended to be passed by Ss also passing most of the easier items. However, the relationship was not perfect. Seventeen percent of the passes and fails constituted exceptions to this pattern.

Another way to determine to what extent individual Ss passed all easier items and failed those more difficult was to subtract the difficulty level (i.e., the proportion of passes) of the easiest item missed from the difficulty level of the hardest item passed for each S. To the extent that a S's pass-fail pattern conformed to the general order of item difficulty, one would expect differences to be slight in cases where items were very close in difficulty, and to be non-existent where no easier items were missed. Results revealed that

Table 19

Numbers and Proportions of Passes and Fails Observed in the Expected Pass and Fail Regions of the Pass-Fail Subject-by-Measure Matrix

Total cells in theoretical fail region = 246

	Number	Proportion
Passes	62	.25
Fails	184	.75
	246	

Total cells in theoretical pass region = 514

	Number	Proportion
Passes	450	.88
Fails	64	.12
	514	

Total cells = 760

	Number	Proportion
Pass or fail as expected	634	.83
Pass or fail contrary to expectations	126	.17
	760	

response patterns of only three Ss conformed perfectly to this pattern. (These Ss passed from 13 to 18 items.) When slight differences in difficulty were disregarded (i.e., differences less than .09), four Ss were added to this group. Response patterns of the remainder of the sample, 33 Ss, were less consistent with the general pass-fail pattern. The frequencies with which various differences in difficulty levels between the hardest item passed and the easiest item missed are presented in Table 20. It is evident that performances of over half of

- - - - - - - - - - - - - - -

Insert Table 20 about here.

- - - - - - - - - - - - - - -

the Ss (i.e., 22) revealed differences greater than .20, suggesting that item difficulty patterns are not very well preserved in the response patterns of individual Ss. Of course, this conclusion is based on a very strict analysis of responses. Given the fact that many item difficulty proportions were quite similar and also the fact that only two of the proportions of adjacent measures were found to differ significantly, these results are perhaps not surprising.

To examine for the possibility that a few specific measures were obscuring the view of a general pattern replicated in individual responses, the role of each measure in success-failure patterns was assessed. First, those measures interrupting runs of two or more successes on adjacent measures for each S were identified. Two measures were found to be more disruptive than any of the others. The measure assessing the production of full comparatives in the Language and Seriation Production Task broke five success runs, and the measure of affirmative equative comprehension in the Seriated Pictures Task broke three runs. (Thirteen other measures broke between one and two runs.) When these two measures were eliminated, the consistency between individual and general patterns improved somewhat. These results are presented in Table 20. (See the frequencies in parentheses.) Without these two measures, the number of Ss revealing differences less than .09 increased from 6 to 10. Thus, 25 percent of the Ss could be said to pass all the items up to a certain point and fail the rest. This finding, combined with the previous analysis, constitutes some evidence supporting the existence of a sequence of mastery among at least some of the capabilities reflected by 17 of these measures. Perhaps refinement of the tasks and measures would serve to enhance the frequency of appearance of this pass-fail pattern.

Alternatively, perhaps these capabilities do not really constitute a sequence of prerequisites. This possibility is suggested by a couple observations. First, most of the tasks were guilty of disrupting at least one success run. The two tasks eliminated accounted for only one-third of the disruptions. Second, 13 of the measures (Nos. 1-13) varied only moderately in difficulty, from .72 to .95 proportion successes. Inspection of the patterns of successes within this set revealed that it might have been regarded better as a block rather than a sequence of capabilities. For pass-fail patterns of Ss passing fewer than 13 items, 45 percent of the cells in the expected fail region consisted of passes. This contrasts with 25 percent for the whole matrix (see Table 19).

Table 20

Frequency of Occurrence of Various Difficulty Difference Values Among Ss in Pass-Fail Matrix Together With Mean Number of Tasks Passed by Ss in Each Difference Group

Differences in Difficulty Level* Between Hardest Measure Passed and Easiest Measure Missed	Frequency of Occurrence** (No. of Ss)	No. of Items Passed by Ss in Each Interval	
		Mean	Range
.0 to .09	6 (10)	14.5	9-18
.10 to .19	12	17.6	3-18
.20 to .29	5 (7)	14.0	12-15
.30 to .39	1	12.0	
.40 to .49	6	12.0	9-16
.50 to .59	6 (5)	13.2	11-16
.60 to .69	2	9.0	8-10
.70 above	2 (1)	14.0	13-15

*Difficulty level defined as proportion of sample passing that measure.

**Numbers in parentheses refer to changes in frequencies resulting when two measures disrupting the most runs of successes were eliminated.

In other words, within this block there occurred many more items of greater difficulty passed than there occurred over the whole matrix. Furthermore, of the 23 Ss passing 13 or more measures, 17 revealed perfect runs on Measures 1 to 13. These findings suggest that at least some of the measures may emerge in parallel rather than in sequence. Third, there exists little justification on logical grounds (i.e., in terms of a logical analysis of inter-task relations) to expect the capabilities to emerge in a fixed sequence. In fact, it is possible that other kinds of relations might hold among the tasks. For instance, it may be that the appearance of some capabilities might temporarily interfere and suppress successful performance on tasks measuring other capabilities. There is some evidence in the present study to suggest the presence of growth errors in performances on some measures. An analysis treating development only as the unfolding of a series of capabilities, each building on and adding to the existing set, is insensitive to and in fact ignores this sort of relationship among emerging capabilities.

Although no invariant pass-fail pattern among the set of measures considered as an ordered array was detected in the responses of individual Ss, there still remains the possibility that smaller subsets, specifically pairs of measures, were related such that success on one appeared to be a prerequisite for success on another. One way to examine for this sort of relationship is through the creation of contingency tables based on pass-fail criteria and the application of χ^2 tests of independence. Such relationships have already been examined for one pair of measures. In the Coordinated Language task, comprehension appeared to be a prerequisite for production of coordinated language (see Table 7).

In the two tasks examining seriation-related abilities, not contingency tables but other approaches were used to draw conclusions about the presence or absence of relationships among the three measured abilities: production of full comparatives, comprehension of comparative and equative forms, and seriation. The only relationship found significant was the one between comprehension and seriation. Seriators obtained higher scores on the comprehension measure than non-seriators. Contingency tables for these three measures are given in Table 21. Chi-square tests on these values, though, failed to yield any significant relationships with $\chi^2_1 < 1$ for all of the comparisons. Thus, it is questionable

- - - - - - - - - - - - - -

Insert Table 21 about here.

- - - - - - - - - - - - - -

whether comprehension of comparative and equative forms can be regarded as a prerequisite for seriation abilities.

Tables 22 and 23 present contingency tables for all those pairs of

- - - - - - - - - - - - - - - - - - - -

Insert Tables 22 and 23 about here.

- - - - - - - - - - - - - - - - - - - -

Table 21

Contingency Tables Revealing Relationships
Among Seriation Task Measures

		Comprehension of Seriated Language[1]			Production of Full Comparatives		
		P	F	Total	P	F	Total
Seriation	P	22	7	29	25	4	29
	F	3	8	11	8	3	11
	Total	25	15	40	33	7	40

		Production of Full Comparatives		
		P	F	Total
Comprehension of Seriated Language[1]	P	20	5	25
	F	13	2	15
	Total	33	7	40

[1]The scoring criteria identified in Table 17 for this task were not used here. Rather, all those Ss receiving total scores of 7 or more correct were regarded as passing on this measure and Ss receiving scores of 6 or less were considered failures.

Table 22

Contingency Tables Revealing Significant Relationships Between Pass-Fail Performances in the Negative Word Association Task, the One-Dimension Description Task, and Various Other Measures

		Production of Opposites		
		P	F	Total
Production of Specific Descriptives	P	33	2	35
	F	2	3	5
	Total	35	5	40

		Production of Opposites			Prod. of Specific Descriptives		
		P	F	Total	P	F	Total
Compreh. of Coordinated Language	P	32	1	33	32	1	33
	F	3	4	7	3	4	7
	Total	35	5	40	35	5	40

		Production of Opposites			Prod. of Specific Descriptives			
		P	F	Total		P	F	Total
Compreh. of Maxi-Mini Adj. Modifier Combinations	P	30	2	32	P	31	1	32
	F	5	3	8	F	4	4	8
	Total	35	5	40	Total	35	5	40

		Production of Opposites			Prod. of Specific Descriptives			
		P	F	Total		P	F	Total
Seriation	P	28	1	29	P	29	0	29
	F	7	4	11	F	6	5	11
	Total	35	5	40	Total	35	5	40

Table 23

Contingency Tables Revealing Significant Relationships Between Pass-Fail Performances on Two Pairs of Measures

		Comprehension of Seriated Language		
		P	F	Total
Comprehension of Maxi-Mini Adjective Modifier Combinations	P	30	2	32
	F	5	3	8
	Total	35	5	40

		Comprehension of Coordinated Language		
		P	F	Total
Seriation	P	28	1	29
	F	5	6	11
	Total	33	7	40

tasks (i.e., nine) found to be significantly related ($p < .05$). The findings revealed in Table 21 suggest that lexical development is a prerequisite for success on several of the other tasks. Two measures of the child's possession and use of a sufficiently elaborate adjective vocabulary were included in the present study, an opposite production measure (Negative Word Association task) and a measure reflecting the extent to which a S used specific rather than global adjectives to describe object differences (One-Dimension Description task). These measures were found to be significantly related to each other, with $\chi^2_1 = 15.03$, $p < .05$, and a product-moment correlation coefficient of .70 between raw scores on the two measures, $t_{38} = 6.04$, $p < .05$. Furthermore, both of these measures proved to be significantly related to three other measures: comprehension of coordinated language, $\chi^2_1 = 13.60$, $p < .05$, for the opposite measure, and $\chi^2_1 = 13.60$, $p < .05$ for the descriptive measure; comprehension of adjective combinations on the Clay Manipulation task, $\chi^2_1 = 4.34$, $p < .05$, for opposites, and $\chi^2_1 = 9.76$, $p < .05$, for descriptives; and ability to seriate, with $\chi^2_1 = 4.25$, $p < .05$, for the opposites measure, and $\chi^2_1 = 8.11$, $p < .05$, for the descriptives measure. These results all suggest that Ss without sufficient lexical development are not likely to be able to comprehend coordinated language, to separate out modifier from modified maxi-mini adjective relations, or to arrange object sets in order. In other words, some progress in lexical-conceptual adjective development appears to be a necessary but not a sufficient condition for successful performance on these other tasks. These results are especially significant in view of the fact that only one of the tasks, that measuring comprehension of coordinated language, was manifestly related to lexical development in the sense that successful performance required comprehension of specific adjectives. In the other two tasks, structural or operational capabilities rather than vocabulary were examined, and the child was not required to verbalize at all. In the Clay Manipulation task, Ss were asked to display comprehension of adjective combinations, and all Ss were able to demonstrate their understanding of the adjective terms making up these combinations. In the seriation task, the instructions contained no difficult adjective concepts. Although, from a structural linguistic standpoint, vocabulary growth is seen as a superficial and less interesting characteristic to study, results of this investigation suggest that it is a very important component or at least predictor of the emergence of underlying structures or operational capabilities of interest to the cognitive psychologist. In line with this, it might be noted that on the Stanford Binet IQ test, scores on the vocabulary items correlate most highly with overall IQ scores. These conclusions regarding the importance of lexical growth do not agree with those drawn by de Zwart (1969) who claimed that lexical development is less important than linguistic structural capabilities in the emergence of operational capabilities. Present findings indicate that both may be important prerequisites. Although results in the present study are highly suggestive, it remains for future research to determine more specifically the nature of this relationship between lexical-conceptual components and structural-operational components of intellectual development and functioning, and more importantly, to determine how much the teaching of these concepts might facilitate the emergence of structural and operational capabilities.

Tests of independence were significant for two other pairs of tasks. Comprehension of some comparative and/or equative forms (a combined measure from the Seriated Pictures task) was found to be related to the ability to comprehend maxi-mini adjective modifier combinations (Clay Manipulation task), with $\chi^2_1 = 4.34$, $p < .05$. Inspection of Table 23 reveals that very few Ss who failed on the Seriated Pictures measure were able to comprehend the adjective combinations. This finding eludes explanation since it is not clear how the two capabilities are related in a logical sense. A more interesting relationship was detected for the other pair of tasks. Only one out of 29 Ss who failed to comprehend coordinated language was able to order object sets by size, with $\chi^2_1 = 5.36$, $p < .05$. The correlation coefficient between absolute scores on these two measures was .77, which is significant, with $t_{38} = 7.40$, $p < .05$. These results suggest that success on the coordinated language comprehension task is a necessary but not a sufficient condition for success on the seriation task. A logical analysis of the two tasks suggests a reason for this. Success on the comprehension task is thought to require the ability to hold in mind two relations simultaneously (i.e., X is big but light). The seriation task also requires this ability (i.e., B is bigger than C yet smaller than A). However, the successful seriator must also be able to coordinate these relations across several objects. Thus, the seriation task requires not only this capability but another as well.

Relationships found to be significant through the use of χ^2 tests of independence all occurred among measures which were passed by at least 72 percent of the Ss. This test is not sensitive to cases where fewer Ss passed one of the measures, yet it is of interest to determine whether differential pass-fail patterns occurred between these more difficult measures and others. Those cases were identified in which at least 25 percent of the Ss passing the target task also passed the comparison task while none of the Ss failing the target task passed the comparison task. It was thought that this pattern would serve to identify those easier (target) capabilities which might be necessary but not sufficient for successful performance on more difficult (comparison) capabilities. Pairs of tasks meeting this criteria are presented in the filled cells of Table 24. Statistical tests of significance between

- - - - - - - - - - - - - -

Insert Table 24 about here.

- - - - - - - - - - - - - -

proportions (i.e., values given in the table vs. .00) cannot be performed since in each case the assumption $N_2p_2 > 5$, is not met. However, because absolutely none of the Ss in the fail groups passed the comparison task while at least one-fourth of the success Ss did, perhaps these results are useful for suggesting relationships worthy of further study.

Findings involving the two measures of lexical development (i.e., the first two rows in the table) indicate that Ss lacking an adjective vocabulary did not pass several of the more difficult tasks. This is consistent with previous results suggesting the importance of lexical-conceptual development as a basic prerequisite.

Table 24

Cases (Filled Cells) Where None of Ss Who Failed Target Measure* Passed Comparison Measure While At Least 25 Per Cent of Ss Who Passed Target Measure Also Passed Comparison Measure. (Proportions refer to proportion of target Pass Ss also passing Comparison Measure.)

Target Measure	Comparison Measure: 4PCC Prod. of Coord. Comparatives	60 Seriation	7AE Compreh. of Affirm. Equat.	7CN Compreh. of Neg. Compar.	7D Compreh. of Double Compar.
1. Production of Opposites (Negative Word Association)			.57		.28
2. Production of Specific Descriptives (One-Dimension Description)	.40	.83			.28
3A. Comprehension of "And" Conjunction (Hungry Pig)				.34	
4P. Production of Coordinated Language (Coord. Language)	.45				
60. Seriation of Objects (Language & Seriated Prod.)	.48				
6L. Production of Full Comparatives (Language & Seriated Prod.)	.42				.30
7T. Compreh. of Some Comparative and/or Equative Forms (Seriated Pictures)			.57		.28
8. Compreh. of Maxi-Mini Adjective Modifiers (Clay Manipulation)	.44				.31

*Only cases where number of Fail Ss $\geq$ 5 are considered.

Inspection of the column values indicates that it takes a specially qualified child, one who possesses at least one of several other capabilities to produce coordinated comparatives and to comprehend double comparatives. These tasks might in future research be extended to older Ss in order to confirm and clarify the nature of these prerequisite relations and their emergence. Too few Ss successful on these tasks were found in the present sample.

Another way of examining relationships among pairs of measures is to calculate correlation coefficients, although these values are perhaps less indicative of prerequisite relationships than are contingency tables. This was done for some of the measures considered above, those consisting of a substantial number of observations for each subject. Results are presented in Table 25. It should be mentioned that scores

- - - - - - - - - - - - - - -

Insert Table 25 about here.

- - - - - - - - - - - - - - -

on three of these measures differed slightly from those on which pass-fail criteria were imposed. The Hungry Pig measure involved the total number of conjunctions correctly comprehended. The seriation production measure included the matching and weight ordering tasks as well as the three size ordering tasks. And the seriation comprehension measure consisted of the sum of all correct affirmative and comparative responses.

Correlations appearing in Table 25 support previous conclusions about the relationships between pairs of tasks based on pass-fail scoring. In fact, except for the correlation between production and comprehension of coordinated language ($r = .44$), all of the correlations for pairs of tasks found significant above were exceptionally high, exceeding $r = .68$. High correlations also emerged between other measures although these relationships were not significant in the χ^2 tests. Measure 7 involving the total number of comparative and equative forms comprehended in the Seriated Pictures task was strongly related to several other measures. Perhaps if better pass-fail criteria had been utilized, relationships might also have been detected in the χ^2 tests. Pass-fail criteria for this task were perhaps more liberal than for the others.

All of the correlations which failed the test of significance involved either the transformation measure and other tasks or the measure of ability to comprehend coordinated conjunctions (Hungry Pig task) and other measures. Why these tasks did not make a better showing is not clear. Scores on both were significantly correlated with the three measures revealing the greatest number of significant correlations with other measures: the two measures of lexical development (No. 1 and 2), and the ability to seriate (No. 60). Perhaps these tasks need to be improved to provide clearer indices of the underlying capabilities. Alternatively, perhaps the capabilities are indeed distinct and independent of the others. Or perhaps their developmental course differs from the others. There is some evidence in the present study to suggest that this is the case for the transformation measure. Figure 5 suggests that Ss' performance on this task deteriorated before it improved across

Table 25

Correlation Coefficients Between Pairs of Tasks*

		1	2	3	4C	4P	5	60	7
1.	Negative Word Assoc.	-	.70	.42	.78	.45	.42	.68	.62
2.	One-Dimension Descr.	-	-	.35	.74	.38	.38	.74	.41
3.	Hungry Pig - Total	.42	.35	-	.37	.11 n.s.	.23 n.s.	.37	.21 n.s.
4C.	Coord. Lang. Compreh.	.78	.74	.37	-	.44	.27 n.s.	.77	.54
4P.	Coord. Lang. Prod.	.45	.38	.11 n.s.	.44	-	.26 n.s.	.46	.54
5.	Transformation	.42	.38	.23 n.s.	.27 n.s.	.26 n.s.	-	.34	.30 n.s.
60.	Ser. Prod. Ordering	.68	.74	.37	.77	.46	.34	-	.59
7.	Seriation Compreh.	.62	.41	.21 n.s.	.54	.54	.30 n.s.	.59	-

*For correlation to be significantly different from .00, $r > .30$ at $p < .05$, and $r > .40$ at $p < .01$.

age levels. As mentioned above, the growth error phenomenon is not revealed in a pass-fail analysis of the sort performed here.

In conclusion, results of the comparison among performances in the various tasks suggest that not all but some of the capabilities appear to precede other capabilities developmentally, and that there is at least an empirical although not always a logical basis for claiming that one capability is a prerequisite for another. Clearly, further work is needed to substantiate and to illuminate the nature of and bases for these relationships.

Conclusions and Recommendations

The present project was undertaken to explore processes involved in the child's acquisition and use of antonym adjective pairs and related linguistic structures. Previous research suggested that between the ages of 4 and 8, children are most busily engaged in mastering these structures. Logical analysis of the structures to be mastered suggested that there are many interrelated facets to be explored and that acquiring competence in this linguistic-cognitive domain is not at all simple or straightforward. From a preliminary attempt to identify and develop appropriate tasks, the following capabilities were selected for more extensive investigation:

(1) Ability to produce correct specific opposites for antonym adjectives

(2) Ability to produce specific adjectives to describe how two objects differ along one dimension

(3) Ability to comprehend and produce coordinated language (i.e., language capturing in one structure and suggesting one integrated conceptualization of two dimensional differences between two objects)

(4) Ability to comprehend affirmative and negative conjunctive and disjunctive conjunctions used to designate subsets of objects similar in two respects (i.e., "and," "but not," "or," "or else not")

(5) Ability to perform mental transformations and to recognize equivalences of meaning among various linguistic structures describing relations among two objects (i.e., maxi-poles, mini-poles, comparatives, equatives, negatives)

(6) Ability to arrange sets of seriated objects in order by size and weight

(7) Ability to produce language (i.e., full comparatives) to describe differences among seriated objects

(8) Ability to comprehend affirmative and negative comparative and equative syntactic forms, superlative inflections, and double comparative constructions describing sets of seriated objects.

(9) Ability to comprehend double adjective combinations in which the first adjective serves to modify the second (i.e., a lot bigger, a lot smaller, a little bigger, a little smaller)

Not only performance within each task as a function of age, sex, and ethnic group was examined, but also the extent to which Ss passed or failed various combinations of tasks was analyzed.

Results were multi-faceted. Most salient among the analyses in terms of subject variables was the total absence of any effects as a function of race. Also, sex emerged only twice as a significant variable. In contrast, age differences predominated in most of the tasks, often with the greatest performance differences occurring between the younger Ss (ages 4 and 5) and older Ss (ages 6 to 8). Analyses of performances within the various tasks revealed many provocative findings hinting at the nature of underlying structures and processes in the midst of formation.

Two indices of lexical-conceptual development were included, one based on S's ability to produce opposites in response to verbal stimuli, and one involving S's use of specific adjectives to describe object differences. Results suggested that much of this growth occurred prior to age 6. As specific terms entered the lexicon, the tendency to rely on global descriptives declined. However, the general pattern varied somewhat depending upon the specific adjective pairs examined. For example, whereas "fast-slow" and "hard-soft" were familiar even to most 4 year olds, specific terms for length, weight, and number did not emerge until later, with the pair "many-few" being rare among the productions of even 8 year olds. In their descriptions of objects Ss, especially males, tended to use more maxi- than mini-polar terms. Whether this occurred because the former are developmentally prior to the latter or because people in general are more likely to couch their comparisons in terms of the maxi-pole is unclear. When the production frequencies of the adjective pairs were contrasted, retarded mini-adjective production was evident for only some of the dimensions. Donaldson and Wales (1970) have shown that when some mini-terms first enter the lexicon, they are treated by the child as denoting maxi-poles (i.e., "less" means "more"). There was evidence in the present study to confirm this. However, inspection of the use of various mini-adjectives suggested that such a pattern did not apply generally but rather was peculiar to only some antonym pairs. This may be a consequence of the differing lexical histories of specific mini-adjectives. That is, the mini-term may or may not be treated initially as a maxi-term depending upon whether, prior to its hookup with a dimension, it has been associated with other terms whose polar markings are known by the child. Furthermore there was evidence to suggest that such confusions regarding the polarity markings of adjectives were word-specific and did not reflect a general structural inadequacy involving the status of underlying dimensional bipolarity. Even the youngest Ss were observed to create terms to denote mini-polar concepts in the absence of a sufficiently elaborate vocabulary, indicating that the mini-pole structure was already there.

Inter- as well as intra-dimensional confusions were examined, and findings suggested that although Ss possessed specific distinctive adjectives, the meanings of many of these terms had not yet been clearly separated even at the 8 year level. This was suggested by the fact that Ss were willing to interchange descriptives not regarded as interchangeable

by adults. Not only were Ss observed to confuse terms, but also some Ss engaged in hypothesis testing activities for terms not yet mastered in the course of their attempts to describe object differences and to get feedback from E regarding the accuracy of their descriptions. All of these results suggest the fruitfulness of further explorations of structures and processes involved in the emergence of a more elaborate adjective lexicon.

Not only lexical but also linguistic-structural capabilities were examined in the present study. Inhelder et al. (1966) suggested that comprehension precedes production of coordinated language, and results of the present study confirmed this. However, although younger Ss were found to be capable of comprehending and producing such forms, coordinated language did not predominate in descriptions until the 8 year level. This lag between the awareness of two dimensional variations and the tendency to integrate the differences into one description/conceptualization may have resulted from the confounding of coordinated forms with comparative forms. Inhelder did not separate the two in her discussion of coordinated language, and in present study E's question may have imposed both forms on Ss descriptions, thereby enhancing the difficulty of the task and reducing the number of productions.

Although it was thought that Ss might have more trouble producing coordinated forms involving physically similar than dissimilar dimensions, the opposite appeared to be the case in the present study. Coordinated language was produced more frequently by Ss for objects varying in height and width than for objects varying in size and dirtiness, both visible dimensional pairs. Two other hypotheses were also disconfirmed in the present study: the notion that coordinated language consisting of adjectives identical in polarity would be easier to produce and to comprehend than adjectives opposite in polarity; and the notion that affirmative coordinated forms would be easier to comprehend than forms consisting of a negative marker attached to one of the adjectives. Neither production nor comprehension scores were affected by polarity differences. And comprehension did not suffer more when descriptives consisted of negations.

In addition to coordinated terms, Ss' ability to comprehend differences among conjunctions used to link two adjective descriptives was examined. Although there were problems in the design of this task, results suggested that the conjunctions "and" and "but not" did not differ in difficulty and these two forms were the easiest of the four to comprehend. "Or" was passed by fewer Ss, and "or else not" proved to be the hardest.

Another linguistic-structural comprehension capability investigated in the present study involved Ss' success at performing mental transformations among relational statements. It was surprising to discover that most of the Ss were able to pass this task. Even the four year olds, in the absence of stimulus support, could compute two-object relations between assertion-question pairs such as "bigger" and "not bigger," "smaller" and "not bigger," "bigger" and "smaller," etc. In fact, there was some evidence that the youngest and oldest Ss did better on this task than Ss in the middle age ranges. This sort of

task needs to be repeated with Ss younger than age 4, and also the growth error phenomenon needs to be verified and explained. It may be that the emergence of some competing capability is temporarily interfering with successful performance on this sort of task.

Findings regarding the relative difficulty among various structural transformations in this task were consistent with Huttenlocher's (1972) claim that combining a mini-adjective with a negative marker yields a double negative which is harder to process than a single negative (i.e., the maxi-negative form). The fact that such double negatives did not always prove more difficult in other tasks included in the present study suggests that the double negative may become a special burden to Ss when the meaning is not represented in and so cannot be read off the concrete stimulus but rather must be determined by performing mental deductive operations.

There were two tasks included in the present study for the purpose of examining linguistic-structural and operational capabilities applied to sets of seriated objects. More Ss were found to be able to order objects by size than by weight, and all Ss who could do the latter could also do the former. This suggests that the phenomenon of horizontal decalage exists for seriation abilities as well as conservation abilities. Inspection of the comparative language used by size seriators and non-seriators to describe object differences failed to yield clearcut differences when age was eliminated as a variable. In fact, several non-seriators were observed to produce full comparatives, a structural form predominating in the descriptions of older seriators. In contrast to the absence of linguistic production differences distinguishing seriators from non-seriators, scores on the Seriated Pictures Comprehension test were found to be higher for seriators than for non-seriators, and this relationship held regardless of age. Furthermore, the comprehension scores of younger seriators were as great as the scores of older seriators. Results combine to suggest that production of comparative forms may precede developmentally the full comprehension of these forms, and that comprehension but not production may constitute a prerequisite for the ability to seriate by size. This contrasts with the general pattern of a production lag observed for other capabilities and also with the observations of de Zwart (1969) who found that seriators regardless of age were more likely to produce comparatives than non-seriators. The appearance of comparative production prior to comprehension capabilities might be a consequence of the fact that successful comprehension requires mastery of an underlying system, not just a single referent, and that production of forms based on partial comprehension is possible and in fact may be a useful testing device facilitating mastery of the full system. Confirmation of such speculation, though, requires more careful exploration of these processes.

Although the production of comparative linguistic forms did not distinguish seriators from non-seriators, there was some evidence suggesting that, unlike seriators, non-seriators tended to confuse the operations of grouping and contrast in their size descriptions and in their size orderings. That is, non-seriators tended to focus on and mention how objects were "almost the same" as well as how they were different. Also, in arranging the objects, they tended to form

two groups comprised of the "big ones" and the "little ones." This suggests that non-seriators lacked the ability to coordinate visible differences in size with similarities imposed by category labels (e.g., big, little) and by the identical properties existing among the objects.

Analysis of the unusual or unexpected approaches adopted by Ss to describe differences among the seriated objects revealed the use of elaborate modificational systems in which several adjectives were combined to generate unique labels for each of the objects, particularly those in the middle of the array. Often these descriptives were over-engineered in the sense that many unnecessary components were included, creating much redundancy and in some cases contradiction among the parts. In these productions it appeared that Ss were attempting to construct distinctive labels for each object as well as comparative forms identifying the relations among objects. Such behavior suggests the possibility that these Ss were not aware of the full meaning carried by the components they were putting together. Other Ss did not struggle to find distinctive terms, but rather coordinated their language (consisting of the same comparative forms repeated) with their actions (pointing to each object in ascending or descending order). This approach tended to be adopted by the older seriators.

Comparison of Ss performances on the Seriated Pictures Comprehension task revealed differences in the ease of interpreting various forms. Whereas affirmative comparatives were easier than negative comparatives, the reverse was true for equatives in which negatives surpassed affirmatives. Comprehension of negative comparative forms and also double comparatives was especially difficult, achieved by only a few Ss. Analysis of errors with all of these forms suggested that in some cases, Ss may have lacked the compulsion to identify all set members satisfying the criterion of comprehension. However, in other cases, clear mistakes in comprehension were evident. Some Ss interpreted comparatives and superlatives in an absolute rather than a relational sense. The reason so many Ss missed the negative comparative construction was that they neglected to include among the items "not bigger than X" the one as big as X. Some Ss treated the equative forms as comparatives. This was especially surprising for negative equatives where several Ss regarded "not as big as" as meaning "bigger than." It was interesting to note that in contrast to the transformation task, double negative forms such as the mini-term negative equative construction were not harder to process than comparable single negative forms. As suggested above, when stimulus support exists for these forms, they may not be more difficult to comprehend.

The final task assessing Ss' mastery of the adjective modificational system uncovered 8 Ss six years or younger who were unable to analyze combinations such as "a lot smaller." Inspection of their performance in the Language and Seriation Production task revealed that some Ss had produced these very combinations in their descriptions of object differences. It may be with this capability as with comparative constructions, that production based on partial comprehension precedes mastery of the underlying system.

Two other interesting results occurred in the Clay Manipulation task. Performances revealed that, in contrast to adults, most youngsters regarded the combination "a little bit big" as meaning "a little bit bigger." However, a few Ss perceived this as an ambiguous form and a few others recognized that it signaled a decrease rather than an increase in bigness. This is interesting because during Phase I as well as Phase II descriptions of seriated objects included this form used to denote sometimes objects bigger than the focal object and sometimes objects smaller than the focal object. To most adults, the form carries only the latter meaning.

Also, during Phase I testing, performance on the clay task disclosed an interesting developmental phenomenon connected with the interpretation of clay manipulation instructions involving the equative construction "as big as" applied in a context where the object to be manipulated was bigger than the comparison object. Such an instruction (i.e., to make X as big as Y) has two components and only the more advanced Ss appeared aware that an increase in the size of the manipulated object as well as the creation of size equivalence was implied. Whereas younger Ss proceeded to reduce the size of the ball of clay to make the balls equal, older Ss hesitated, some declaring that they could not comply with the instructions. Although this phenomenon was not pursued during Phase II, it suggests the worth of designing better comprehension tasks, ones to determine how much of the full meaning of various linguistic-structural forms is recognized by Ss at various levels of development.

The objectives of the present study included not only an analysis of various types of adjective-related capabilities but also a determination of the sequence of emergence of these capabilities during development. Some evidence was obtained suggesting that the general difficulty levels of at least some of the tasks also reflected the sequence of their emergence in individual Ss. However, there were a number of exceptions among the tasks as well as the Ss. Furthermore, logical grounds on which to expect a clear sequence among all of the tasks were not identifiable, and in fact a question was raised regarding the validity of the underlying model of development, specifically, the notion that as capabilities unfold, they merely add to the existing set in an individual's repertoire. It is possible that certain capabilities when first acquired temporarily compete with other capabilities for which performance regresses temporarily. These matters remain to be investigated.

When performances on pairs of tasks were examined to determine whether any might constitute prerequisites for other capabilities, the measures of lexical growth proved to be developmentally prior to several other capabilities, many of which on the surface evidence little relation to vocabulary growth: comprehension of coordinated language, comprehension adjective modificational combinations, and seriation ability. Also, coordinated language comprehension was identified as a prerequisite for seriation. These results conflict with de Zwart's (1969) claims that lexical development is less important to the emergence of operativity than linguistic-structural capabilities. Rather they suggest that both are important. Results do, however, offer some support for her contention that the ability to coordinate is a prerequisite for operativity.

Her index of coordination, though, involved a production measure whereas results in the present study suggest that comprehension is really the significant capacity involved. This discrepancy could be a consequence of several factors. (1) It is very possible that the Piagetian researchers' measure of coordinated language comprehension was inadequate. As discussed in the Introduction, full comprehension appears not to have been tapped by their task. (2) The measure of coordinated language production used in the present study may have been contaminated by E's question which imposed a comparative as well as a coordinated structure on Ss. However, it is not clear that the Piagetians eliminated this as a factor influencing their Ss' productions. (3) Because comprehension and production questions were mixed, too much productive competence may have been inferred in the present study. That this is possible but not likely, though, is suggested by de Zwart's (1969) findings in her attempt to teach Ss to produce coordinated language. She reported that this was the hardest of all three structures (i.e., differentiated terms, comparatives "more" and "less") to train Ss to use. To settle this matter, these possibilities must receive further study. If, however, it turns out that when comprehension and production skills are adequately measured the former prove to be more important for operativity than than the latter as results in the present study suggest, this offers support for the cognitive structural position that response learning and practice are not very central to the emergence of linguistic-cognitive competence (i.e., case in point: Lenneberg's (1962) study of the anarthric child).

In the present study, χ^2 tests of independence were used to identify possible prerequisite relations among pairs of tasks. It must be noted that such results are merely suggestive, not conclusive. In order to demonstrate such a relationship, data must be more than correlational. Some sort of intervention or training study must be executed to verify that such capabilities are indeed necessary and/or sufficient for the acquisition of other capabilities. Results of the present study suggest several types of intervention experiments which might be attempted.

As the discussion above has already revealed, this project was undertaken to check on some of the findings and conclusions reported by Inhelder et al. (1966) and de Zwart (1969). This sort of replication attempt is especially important since their work was with French-speaking, not English-speaking children. It is of course possible that discrepancies between results are a consequence of differences in the two languages and the ease or difficulty of producing and/or comprehending the particular forms being studied.

One other disparity between Piagetian claims and results in the present study remains to be mentioned. Inhelder et al. (1966) identify the production of comparative forms as a significant index of more advanced linguistic-cognitive development. This relationship was not found in the present study. Younger Ss unable to seriate were observed to produce full comparative linguistic structures, and furthermore, production of this sort did not seem to be a very important predictor of success on other tasks. However, full comprehension of comparative forms proved to bear a significant relationship to other capabilities including the measure of operativity (i.e., seriation). Perhaps the

inadequacy of Inhelder's measures of comprehension prevented her from detecting relationships between comprehension capacities and operativity. Also, it is not clear whether her notion of comparative forms is the same as the notion adopted in the present study. Whereas she refers to "more" and "less" as examples of comparative linguistic operators, in the present study constructions involving the inflection "-er" attached to adjectives and the conjunction "than" or constructions consisting of affirmative or negative equatives were considered comparatives. It might be noted that these results suggesting the greater importance of comparative comprehension over production skills resemble conclusions regarding coordinated language comprehension and production in that they too support the cognitive structural position proclaiming the greater significance of comprehension capabilities for cognitive development.

One of the objectives of the present project was to pave the way for future, more carefully designed studies of adjective-related structures and processes as they emerge during development. Certainly this has been accomplished. Many possibilities for future research have been offered. Some tasks need to be improved and elaborated. Others await testing with older or younger Ss. Also, lexical and linguistic-structural tasks found to correlate with seriation operativity need to be extended to other operational capacities. Furthermore, some entrance into an exploration of acquisition processes and the possibility of training needs to be attempted not only for practical ends but also to illuminate the interaction between lexical, structural and operational capabilities. Finally, a re-examination of the conditions under which production precedes or lags behind comprehension should be conducted since results of the present study for at least two structures conflict with the general pattern. Perhaps the tables are turned when an underlying cognitive system is the focus of study. All of these possibilities await further investigation.

References

Braine, M. D. S. The ontogeny of certain logical operations: Piaget's formulation examined by nonverbal methods. Psychological Monograph, 1959, 73, No. 5 (Whole No. 475).

Bruner, J. S. The course of cognitive growth. American Psychologist, 1964, 19, 1-15.

Chase, W. G. & Clark, H. H. Mental operations in the comparison of sentences and pictures. In L. Gregg (Ed.), Cognition in Learning and Memory. New York: Wiley & Sons, Inc. In press.

Clark, H. H. The primitive nature of children's relational concepts. In J. R. Hayes (Ed.), Cognition and the Development of Language. New York: Wiley & Sons, Inc., 1970.

Clark, H. H. & Card, S. K. Role of semantics in remembering comparative sentences. Journal of Experimental Psychology, 1969, 82(3), 545-549.

Chomsky, N. (Comment on the presentation of a research paper.) In Bellugi, Ursula, and R. Brown, The acquisition of language. Monograph of the Society for Research in Child Development, 1964, 29(1).

Chomsky, N. Aspects of the theory of syntax. Cambridge, Mass.: The M.I.T. Press, 1965.

Deese, J. The associative structure of some common English adjectives. Journal of Verbal Learning and Verbal Behavior, 1964, 3, 347-357.

Deese, J. The structure of associations in language and thought. Baltimore: John Hopkins Press, 1965.

DeZwart, Hermina Sinclair. Developmental psycholinguistics. In D. Elkind and J. H. Flavell (Eds.), Studies in Cognitive Development: Essays in Honor of Jean Piaget. New York: Oxford University Press, 1969.

Donaldson, M. & Wales, R. On the acquisition of relational terms. In J. R. Hayes (Ed.), Cognition and the Development of Language. New York: Wiley & Sons, Inc., 1970.

Entwisle, Doris R. Word associations of young children. Baltimore: John Hopkins Press, 1966.

Ervin, Susan. Changes with age in the verbal determinants of word associations. American Journal of Psychology, 1961, 74, 361-372.

Ervin-Tripp, Susan M. & Foster, G. The development of meaning in children's descriptive terms. In J. P. DeCecco (Ed.), The psychology of language, thought, and instruction. New York: Holt, Rinehart, & Winston, 1967, 276-282.

Huttenlocher, J. & Higgins, E. T. Adjectives, comparatives and syllogisms. Psychological Review, 1971, 78, 487-504.

Gruen, G. E. Experiences affecting the development of number conservation in children. Child Development, 1965, 36(4), 963-979.

Inhelder, Barbel. Memory and intelligence. Address, Annual Meeting, American Educational Research Association, 1969.

Inhelder, Barbel, Bovet, M., Sinclair, H. & Smock, C. D. On cognitive development. American Psychologist, 1966, 21(2), 160-164.

Langacker, R. W. Language and its Structure: Some Fundamental Linguistic Concepts. New York: Harcourt, Brace & World, Inc., 1967.

Lenneberg, E. H. Understanding language without ability to speak: A case report. Journal of Abnormal and Social Psychology, 1962, 65, 419-425.

Piaget, J. The child's conception of number. New York: Humanities, 1952.

APPENDIXES

A. Description of Tasks Used in Phase I

The following tasks were administered to subjects in the order presented below. Items within each task marked with an asterisk constitute the shortened version of the task presented to subjects unable or unwilling to respond appropriately.

1. Negative Word Association Task

   a. Introduction: "I am going to say some words and I'd like you to tell me what they mean."

   b. Format of questioning for each item: "When (something/someone) is not _____, (it/he/she) is what?"

      If child responds with noun, experimenter substitutes his term in the indefinite pronoun slot and represents question. When child appears to understand the sort of response desired, E attempts to reduce the question for each item to "Not _____?" If this interferes, E returns to use of the full question.

   c. List of stimulus items (given in order presented to child):

*big	*small	*tall	*short	rich	*few	young	good
*slow	pretty	easy	*hard	*little	*soft	*long	low
*clean	dark	white	*happy	high	full	poor	
*skinny	*fat	*dirty	*heavy	weak	old	*light	
*hot	empty	strong	bad	black	*large	*fast	
new	*sad	smooth	*cold	rough	ugly	*many	

      Final question: "Can you tell me what the word "opposite means?"

2. One-dimension Description Task

   a. Introduction: "Now I am going to show you some objects and I want you to tell me about them.

   b. Instructions to experimenter: Place pictures in front of or hand objects to child. Questions will focus upon pictures or objects whose assigned names begin with letters A through M. The set of 12 pairs is presented twice, the first time to elicit descriptions from the child, and the second time to determine recognition of correct referents and to elicit specific antonyms. Be sure to verbalize the names of objects child identifies in response to questions.

   c. Format of questioning for each pair (illustrated with one of pairs):

      First presentation: Combs identical except for width are handed to child. "What are these?" "This one's name is John and that one is Pete. How is John different from Pete?" If

child does not identify correct dimensional difference: "How else is this one different from that one?"

Second presentation: Same pair of combs is handed to child. "Show me a skinny comb." E point to other comb not selected by child: "Is this one skinny too?" "What is it?"

d. List of stimulus pairs and appropriate descriptions in order presented; first adjective given is one included in opposite elicitation question.

(1) Hair combs: skinny, fat
(2) Pieces of cotton rope: long, short
(3) Pictures of girls carrying red umbrellas: little (small), big (large)
(4) Pieces of wood painted green (same size): light, heavy
(5) Pictures of houses: tall, short
(6) Collections of coins lodged in plastic purses: many (more, most, a lot, whole bunch), few (less, a little)
(7) Pictures of tree trunks: fat, skinny
(8) Pieces of black licorice sticks: short, long
(9) Collections of faces pasted on cards: few (less, a little), many (more, most, a lot, whole bunch)
(10) Plastic hats with crowns varied: short, tall
(11) Pictures of airplanes: big (large), little (small)
(12) Miniature baby bottles (same size): heavy, light

3. Coordinated Language Task

a. Instructions to experimenter: Each set consists of four items which vary along two dimensions. There are three parts involved in the presentation of each set. The first two parts involve presenting pairs of objects differing in two respects and asking the child to describe the differences. The final part involves comprehension and requires the child to select objects possessing one or two particular characteristics.

b. Format of questioning for each item set (illustrated with one of sets):

Part I. "Close your eyes." Present pair of eggs, one of which is big and heavy and is named "Ed," the other of which is little and light and is named "Lou." "Open your eyes. Look at these. Hold them. What are they? Yes, they are eggs. Tell me all the ways they are different?" Repeat child's descriptions but insert names of objects. If child does not mention correct dimensional variations, repeat question: "Tell me all the ways they are different?"

Part II. "Close your eyes again." Put first pair away and introduce second pair of eggs, of which Roy is big and light, and Sam is little and heavy. "Open your eyes." Repeat format given above.

Part III. Present all four objects to child. "Now look at all the eggs. Are there any eggs that are big and heavy?" Report the names of objects selected by child. "Any others?" Repeat this question till child says "No." Repeat this format for each of the following characteristics: big; big and light; little and heavy; heavy; little; little and light; light.

c. List of stimulus sets:

*(1) Varying numbers of birthday candles lodged in chocolate cupcakes: Jim has a few (i.e., four) short candles; Dean many (i.e., seven) tall candles; Stan a few tall candles; Ray many short candles.

*(2) Plastic clown heads with handles for bodies: Abe is light in weight and has a happy (i.e., smiling) face; Keith is heavy and sad; Rob is heavy and happy; Ted is light and sad.

*(3) Wooden blocks painted to look like buildings and glued to pieces of cardboard painted with grass and sidewalks: Art is fat and tall; Don is skinny and short; Ross is fat and short; Tim is skinny and tall.

(4) White cotton squares called hankies: Curt is big and clean; Fred little and dirty: Steve big and dirty; Walt little and clean.

*(5) Blocks padded or not with foam rubber and covered with material to look like beds: Hal is short in length and soft when pressed; Bert long and hard; Ron short and hard; Stu long and soft.

*(6) Styrofoam Easter eggs loaded or not with weights: Ed is big and heavy; Lou is little and light; Roy is big and light; Sam is little and heavy.

(7) Styrofoam or wood dowling made to look like pencils: Hugh is long and heavy; Brad short and light; Phil long and light; Norm short and heavy.

(8) A picture of a boy riding a bicycle without wheels and a set of four wheels which can be placed on the bicycle: Dan is a big wheel and has many spokes; Luke is little and has a few spokes; Rich is big and has many spokes; Scott is little and has a few spokes.

(9) Finger-size bandages cut to vary in only two ways: Ben is short in length and is skinny in width; Chuck is long and fat; Paul is short and fat; Tom is long and skinny.

4. Seriation Description Task

a. Instructions to experimenter: This task involves two parts, a production part followed by a comprehension part. Sets of three objects are presented to the child, one set at a time. He is told to hold and examine them and is asked to describe how each is different from the others. After each set has been inspected and described, all the sets are presented and the child is asked to select particular kinds of items.

b. Format of questioning:

Part I. For each item set, ask: "What are these?" Make sure child knows what they are. Select middle-size object: "How are those two different from this one?" "How else are they different?" Report names of objects being described by child.

Part II. "Find something which is _____ than its friends." "Are there any others?"
Comparative adjectives inserted into above frame: *larger; darker; *shorter; heavier; skinnier; lighter; fatter; *taller; *longer; *smaller.

c. List of stimulus sets:

(1) White rubber sink plugs (big-little)
(2) Miniature trees (tall-short)
(3) Pictures of doors constructed to open (fat-skinny)
(4) Plastic containers with handles called buckets (heavy-light)
(5) Pencils (long-short)
(6) Cards painted gray (dark-light)

5. Clay Manipulation Task

a. Instructions to experimenter: In this task, after the child demonstrates what it means to add or take away clay from a piece, he is instructed to manipulate the size of a ball so that it relates to another ball in a particular way. The experimenter is provided with a record sheet on which she is to diagram how the child changes the size of the ball given him. Her drawing should reflect the relative amount of clay added or taken away. The child is given pieces of clay and a reserve pile of clay.

b. Format of questioning:

Introduction: "Here is some play dough, and here is a piece for you. Show me how to put more clay onto that ball. What happens to the ball?" If child does not reply appropriately: "Does it get little? What happens?" Set aside this ball and take another piece. "Now show me how to take away clay from this ball and put it over here. What happens to the ball?" If reply inappropriate: "Does it get big" What happens?" "Remember, you can either put clay on or you can take it off. And you can use this pile."

Procedure for pairs of balls: "Close your eyes." Shape two balls according to size instructions on record sheet. "Open. That ball is yours and this one is mine. Look at both of them. Make your ball so that it _____ than my ball." Record amount added or taken away. When child is finished: "How is your ball different from my ball?" "Which ball _____?"

c. List of stimulus items inserted into above frames and descriptions of pairs of balls:

*(1) "is bigger" S's ball smaller than E's ball.
*(2) "is littler" S's ball bigger than E's ball.
*(3) "has a lot less" Two balls equal size.
(4) "is as little as" S's ball smaller than E's.
(5) "is bigger" S's ball already bigger than E's.
*(6) "has more" S's ball smaller than E's.
(7) "is as big as" S's ball bigger than E's.
(8) "is a lot littler" Two balls equal size.
*(9) "has less" S's ball bigger than E's.
*(10) "is a lot bigger" Two balls equal size.
*(11) "is as little as" S's ball bigger than E's.
*(12) "is as big as " S's ball smaller than E's.
(13) "is littler" S's ball already smaller than E's.

For final items, three balls (small, medium, and large) are presented:
*(14) "is biggest" S's ball is smallest.
(15) "is littlest." S's ball is biggest.

6. Dimension Discrimination Task

a. Instructions to experimenter: Sheet of paper with nine pink squares of varying sizes attached is presented to child. Also, he is given a single standard pink square to hold. In this comprehension task, he is asked to select squares bearing particular relationships to the standard.

b. Format of questioning: Present sheet and standard square to child. "This is your piece and these are mine. Point to all of those pieces which are _____ than yours." "Any others?" Repeat final question until child says "No" or fails to respond. Report names of squares selected.

c. List of comparatives inserted in above frame: *bigger; *less; larger; *fatter; *taller; *littler; more; *longer; *skinnier; *shorter; smaller.

d. Description of sizes of pink squares relative to standard:

(1) Lou - bigger in height and width
(2) Doug - taller, same width
(3) Joe - wider, same height
(4) Ben - taller, narrower

(5) Ray - wider, shorter
(6) Tom - narrower, same height
(7) Paul - identical
(8) Jack - shorter and narrower
(9) Abe - shorter, same width

7. Transformation Task

a. Instructions to experimenter: This task is designed to examine whether the child can perform specific mental transformations on descriptions he is given. Pictures in which focal characteristics are hidden from view are presented. The characteristic is described and the child is then presented with questions about that characteristic. The assignment of names to positions is randomized from subject to subject.

b. Format of questioning (illustrated with one of pictures): Picture of two boys seated in car is presented to child. Boys are identical in height. "These boys are sitting in their car waiting for their mother. John is on the (left, right). Bob is on the (right, left)." Experimenter points to each boy as he pronounces name. "John is taller than Bob. Which boy is shorter?" "Which boy is not taller?" "Which boy is not shorter?" E names boy child child selects for each question.

c. List of descriptions, assertions, and questions:

(1) These boys are sitting in their car waiting for their mother. J is taller than B.
Which boy is shorter? not taller? not shorter?
(2) These girls are sitting at their desks in school, whispering together.
M has a big mouth. S has a bigger mouth.
Whose mouth is littler? less big? not littler?
(3) Each of these boys is pulling a mouse in the box.
R is as fat as B.
Which mouse is fatter? not as fat? skinnier?
(4) These two mothers are shopping for groceries.
J has less money in her purse than A.
Which mother has more money? does not have less money? has the least money?
(5) These two girls are sleeping.
N is skinnier than P.
Who is not fatter? not skinnier? fatter?
(6) These cars are traveling on the highway.
The green car is going slow. The yellow car is going slower.
Which car is going faster? the slowest? not going faster?
(7) These two boys are eating their lunch, and drinking water with icecubes in it.
H's icecubes are not as big as P's icecubes.
Whose icecubes are littler? bigger?

(8) These two women are drinking tea and chatting.
J's chair is hard. K's chair is harder.
Whose chair is not softer? the hardest? softer?

(9) These two girls are walking and eating cookies.
J's cookies are as little as K's cookies.
Whose cookies are littler? bigger? not as little?

(10) These girls are swinging at the park.
A's hair is short. J's hair is shorter.
Whose hair is not longer? not shorter? the shortest?

(11) These boys are fishing at the beach.
M's fish is not as little as S's fish.
Whose fish is bigger? littler?

(12) This boy has two bones, one in each hand, for the dogs.
The bone on the left is bigger than the bone on the right.
Which bone is not bigger? not littler? the biggest?

(13) These two boys are eating ice cream.
B's ice cream is not as hard as J's.

(14) These two men are waiting for the bus.
S's hand is not as clean as J's hand.
Whose hand is cleaner? dirtier?

8. Shifting Context Task

a. Instructions to experimenter: Sets of three objects varying along single dimensions are utilized. Either the maxi or the mini object differs substantially from the other two for each set. The child is presented first with the two objects, they are labeled and described. Then the third object is introduced and the child is asked to describe it, and then to describe all the objects. Of interest is whether the child alters the descriptions given the first two objects when the altered context changes the appropriateness of the labels.

b. Format of questioning (illustrated): "Close your eyes." Two mice differing in size are presented. "Open. Here are some mice. This yellow one says, 'I am called little.' This brown one says, 'I am called big.' What is each one called?" "Oh oh, another mouse sits on the table." A very tiny red mouse is presented. "What is it called?" "Now, what are all of the mice called?" Report color of objects designated by child. If child uses other labels, ask: "Are they called anything else?"

c. List of item sets:

(1) Mice - big, little, littlest
(2) Flag poles - short, tall, tallest
(3) Necklaces - long, short, shortest
(4) Ropes - skinny, fat, fattest
(5) Purses - light, heavy, heaviest
(6) Bags of candy - many, few, fewest
(7) Eye classes - small, large, largest

APPENDIXES

B. Description of Tasks Used in Phase II

The following tasks were administered to the second sample of subjects. Except where indicated, the order listed below corresponds to the order in which they were presented to subjects. In cases where procedures are identical to those described for Phase I, they are not repeated.

1. Negative Word Association Task

The procedures used were identical to those in Phase I except that only 32 stimulus items were presented, and for cases in which no response was elicited from child, specific nouns were embedded in the question (i.e., When a box is not light, it is what?). Also, the final question regarding the meaning of the word "opposite" was omitted.

List of stimulus items together with their nouns (given in order presented to child); asterisk indicates items not used on Phase I list.

big (box)	light (box)	heavy (bag)	long (pencil)
slow (truck)	*more (candy)	cold (water)	*a lot (sand)
clean (shirt)	fat (girl)	little (shirt)	dark (house)
skinny (boy)	dirty (towel)	high (cloud)	fast (train)
hot (water)	weak (person)	large (ball)	many (sticks)
happy (girl)	tall (man)	*less (money)	low (bridge)
short (stick)	few (rocks)	soft (chair)	strong (boy)
hard (ball)	sad (boy)	small (truck)	*a little bit (grass)

Phase I adjective pairs eliminated from Phase II list:

old-new-young	rough-smooth
pretty-ugly	rich-poor
full-empty	good-bad
white-black	easy

2. One-Dimension Description Task

a. Introduction: "Now I'm going to show you some objects and I want you to look at them and tell me about them."

b. Instructions to experimenter: Place pictures in front of child or hand objects to child. There are 15 pairs of stimulus items to be presented. For each, first try to get the child to tell you how they are different, and then present the opposite elicitation questions. Be sure to report the names of objects identified by child.

c. Format of questioning for each pair (illustrated with one of pairs): "Here are some combs. This is Pete and this is John. How is one different from the other?" Repeat question if child

does not respond appropriately. Then ask, "Is one comb skinnier?" "Which one?" Point to other comb. "Is this comb skinnier too?" "What is it?"

d. List of stimulus pairs and appropriate descriptions in order presented (first adjective given is one used in opposite elicitation question):

(1) Metal tablespoon and teaspoon: large (big), small (little)
(2) Hair combs: skinny, fat
(3) Pieces of black licorice sticks: short, long
(4) Plastic branches with green leaves and red cherries, one branch holding 12 cherries and the other 5 cherries: many (more, most, a lot, whole bunch), few (less, a little)
(5) Brown coin purses: heavy, light
(6) Pictures of jars filled with fruit: tall, short
(7) Jars filled with m&ms: less (few, a little), more (many, most, a lot, whole bunch)
(8) White pads, one styrofoam and the other foam rubber, same size: hard, soft
(9) Miniature imitation trees with trunk and crepe paper top: short, tall
(10) Miniature plastic baby bottles (same size): light, heavy
(11) Collections of coins lodged in plastic purses: more (many, most, a lot, whole bunch), less (few, a little)
(12) Plastic whistles with holes for fingers: long, short
(13) Pieces of rope, same length: fat, skinny
(14) Collections of faces pasted on cards: few (less, a little), many (more, most, a lot, whole bunch)
(15) Miniature rubber mice, one filled with a hard substance and one hollow: soft, hard

e. Phase I task modifications: Rather than presenting the set of object pairs twice, each pair was presented only once accompanied by both types of questions. The number of pairs was increased from 12 to 15 in order to examine two additional dimensions, hard-soft and more-less. Some of the specific objects were changed. And the question eliciting difference descriptions was changed from a nominal to a pronominal form (i.e., the pronouns "one" and "other" were used in place of proper names). This was done to permit the child to focus upon whichever object he preferred in his comparison.

3. Hungry Pig Task (new task)

a. Description of stimuli: A coffee can decorated to look like a pig with an opening at its mouth permitting the insertion of various goodies selected by the child. The goodies available consisted of 16 pieces of cardboard possessing the following properties and a distinctive proper name:

Round:	Big:	Red
		Green
		Half green, half yellow
		Half red, half green

	Little:	Red
		Yellow
		Half red, half yellow
		Half green, half yellow
Square:	Big:	Green
		Yellow
		Half red, half green
		Half red, half yellow
	Little:	Yellow
		Red
		Half red, half green
		Half green, half yellow

b. Instructions to experimenter: Present the piggy and show the child how it can be fed goodies. First, determine whether the child can identify each of the properties singly, and then present adjective-conjunction combinations for which he is to select appropriate referents.

c. Introduction: "Here is a pink piggy. He is always hungry but he will only eat certain things. Here are some goodies that he might like." Spread colored pieces on table in front of child. Ask him to point to one goodie illustrating each of the seven properties: green, red, yellow, big, little, round, square. "Very good. Now I will tell you what piggy is hungry for, and you can feed him."

d. Format of instructions for each adjective-conjunction combination (illustrated with one of items): "The piggy is hungry for a goodie that is red AND yellow. Pick one and feed him." "He's still hungry. He wants some more goodies that are red and yellow. Are there any more for him? Feed him those."

e. List of adjective-conjunction combinations in order presented:

red and yellow	round and red
big or green	red but not square
big and square	green or yellow
round but not yellow	big or else not green
big or red	red but not little
little and yellow	yellow or round
little or else not square	square but not big
square or green	big but not green
little but not round	red and green
yellow or else not round	

The four conjunctions together with their frequencies of occurrence on the above list are: and (5), but not (6), or (5), or else not (3).

4. Coordinated Language

a. Instructions to experimenter: Three sets of four objects are presented to child, each set varying along two dimensions. The

child is presented with two types of questions, one requiring him to describe differences between two objects, and one asking him to select objects possessing two properties. These questions are mixed together in the presentation. The task is divided into two parts (A and B), each equally long. Between the adminstering of each part, one part of another task (Transformation Part A) is given.

b. Introduction: Place the sets of buildings, eggs, and beds in front of child, each set grouped together. Present one set at a time, saying for each: "Here are some buildings. Here are some Easter eggs. Here are some beds."

c. Format of questioning:

(1) Comprehension questions: "Are there any buildings that are fat and short?" "Any other buildings that are fat and short?" Repeat until child says "No."
(2) Production questions: Withdraw from collection and present to child two specific eggs. "How is Roy different from Sam?" "Any other ways Roy is different from Sam?" Repeat question until child says "No."

d. Description of stimulus sets: See Phase I Tasks, Item 3c., No. (3) buildings, No. (5) beds, No. (6) eggs.

e. List of coordinated language to be comprehended:

Buildings: fat and short (A-1)
skinny but not short (A-4)
short but not fat (A-8)
tall and skinny (A-14)
tall and fat (B-1)
fat but not tall (B-5)
skinny and short (B-11)
tall but not skinny (B-16)

Eggs: heavy but not little (A-2)
light but not big (A-7)
little but not light (A-10)
light and little (A-13)
big and light (A-16)
little and heavy (B-2)
heavy and big (B-8)
big but not heavy (B-14)

Beds: long but not soft (A-5)
soft and long (A-11)
hard and short (A-17)
short and soft (B-4)
hard but not long (B-7)
soft but not short (B-10)
long and hard (B-13)
short but not hard (B-17)

f. Coordinated language to be produced: Twelve comparison questions were

presented, six on each part of the task. Each followed a comprehension question referring to the same set of objects. However, the production question involved different objects within the set. The two objects compared were ones which differed in two respects. Each pair was contrasted twice by each subject.

g. Phase I task modifications: Rather than presenting production and comprehension questions separately, they were intermixed. From the nine sets of items examined initially, three were used in Phase II, those sets which appeared to work best. Questions examining comprehension of only one dimension were eliminated. Not only the conjunction "and" but also the conjunction "but not" was included in the comprehension test. The task was presented in two parts, the second following the administration of another task.

5. Transformation Task

a. The instructions and format of questioning for this task were identical to the Phase I task except that only one question was presented for each picture, the number of items was increased from 14 to 22, and the task was presented in two parts, A and B, each 12 items long. Another task intervened between these two parts. Also, in the descriptions and questions, the variety of adjectives was reduced so as to tap underlying structures rather than knowledge of specific lexical items. The adjectives used were ones known by most of the Pase I subjects. A practice item, not counted in the scoring, was included at the beginning of Part A and Part B. Also, rather than verbalizing left and right positions as names were identified, E just pointed and said "This is John. And this Bob," naming first the left and then the right position.

b. List of descriptions, assertions, and questions:

(1) Here are two cowboys. These cowboys have guns in their holsters, and they are getting ready to shoot their guns. Brian's gun is smaller than Joel's gun. Which gun is not bigger?

(2) Here are two brothers. They are sitting in their car waiting for their mother to take them to school. John is shorter than Bob. Which boy is not shorter?

(3) Here are two boys pulling wagons. See. There is a box in each wagon. And inside each box, a mouse is hiding. Roy is smaller than Bill. Which mouse is bigger?

(4) Here are two boys. They are eating scoops of chocolate ice cream in their cups. Bob's scoop of ice cream is not as big as Jim's scoop of ice cream. Which scoop is smaller?

(5) Here are two boys eating lunch. They are drinking cokes with icecubes. Harry's icecubes are bigger than Paul's icecubes. Which icecubes are not smaller?

(6) Here are two dogs greeting their master. The dogs are wagging their tails because this boy has brought a bone for each dog. Luke's bone is not as big as Penny's bone. Which bone is bigger?

(7) Here are two mothers. These mothers are buying groceries for dinner. Each one has a purse with a hankie inside. Mrs. Jones' hankie is smaller than Mrs. Ames' hankie. Which hankie is bigger?

(8) Here are two cats. They have found an ice cream carton and are licking up the ice cream with their tongues. Whiskers has a bigger tongue than Bootsie. Which tongue is not bigger?

(9) Here are two fathers. They are waiting for a bus to come, but the bus is late. They are looking at their watches. Mr. Smith's watch is not as small as Mr. Jones' watch. Which watch is bigger?

(10) Here are two sisters. It is night time and the girls are falling asleep. Nancy is fatter than Patty. Which girl is skinnier?

(11) Here are two dogs. They are looking for food in the garbage cans. They each just found a bone. Fido's bone is not as small as Skip's bone. Which bone is smaller?

(12) Here are two teachers. They are sipping coffee and talking about school. Joan's dress is longer than Kay's dress. Which dress is not longer?

(13) Here are two girls. They are swinging at the park and having a good time. Ann's hair is not as short as Judy's hair. Whose hair is shorter?

(14) Here are two boys. They are racing each other in the swimming pool. Frank's legs are longer than John's legs. Whose legs are shorter?

(15) Here are two trains. If they don't stop right away, they are going to crash into each other. The Penn Central is not as long as the Santa Fe. Which train is shorter?

(16) Here are two chickens. Each chicken has just laid an egg. Norma's egg is smaller than Wilma's egg. Which egg is not smaller?

(17) Here are two girls. They are walking to school and talking about what is in their lunch pails. They both have bananas. Donna's banana is fatter than Betty's banana. Whose banana is not skinnier?

(18) Here are two worms. They have just eaten holes in this apple, and they are going to crawl out and look for another apple to eat. Ferd is not as short as Gar. Which worm is longer?

(19) Here are two girls. They have just come from the bakery where they each bought a bag of cookies. June's cookies are smaller than Joy's cookies. Whose cookies are not bigger?

(20) Here are two girls. They are sitting at their desks pretending to study. But they are really whispering to each other. Mary's mouth is bigger than Sally's mouth. Whose mouth is smaller?

(21) Here are two trees. This boy is looking up at the trees trying to see the very tops of them. The oak is not as tall as the pine tree. Which tree is taller?

(22) Here are two boys fishing. Oh, they have just felt a tug.

A fish has bitten each of their lines. Mike's fish is smaller than Sam's fish. Which fish is bigger?

Practice items (first item):

Part A: Here are two dogs. This one's name is Rover and this is Spot. These dogs are sleeping in their houses. You can't see their tails, but Rover's tail is longer than Spot's tail. Which tail is shorter?

Part B: Here are two cars. One is green and the other is yellow. The green car is moving this way, and the yellow car is moving that way. The green car is not going as fast as the yellow car. Which car is going slower?

6. Seriation and Language Production Task

a. Instructions to experimenter: This task is intended to examine whether the child can arrange in order various sets of objects and whether he can describe these ordering relationships. Also, his ability to match two ordered sets is examined. There are three parts to the task: (1) Ordering eight balls; (2) Matching five balls to five dogs; (3) Describing differences and then ordering each of three sets of objects, five in each set.

b. Procedures for ball ordering: Present to child eight colored balls out of order. "Can you put these balls in order along this line?" (Line is marked on table.) After child positions balls, report color of each from left to right. If child does not arrange them correctly or if he fails to respond, point to the biggest and ask, "How is this one different from all the others?" Then point to the smallest and ask, "How is this one different from all the others?" Then suggest that the child start his line with one or the other. Report colors of balls from left to right when he is finished.

c. Procedures for matching: Set aside the three largest balls from the array used above. Present the five dogs out of order to the child, and ask "Can you show me which balls belong to which dogs?" Report names of dogs and colors of balls combined.

d. Procedures for describing and ordering each of three sets of objects, the first (plugs for a basin) varying in size, the second (pencils) varying in length, and the third (plastic covered buckets) varying in weight.

(1) First, present three of the objects, name each, and say "tell me about them. How are they different?" Then point to each in turn, inquire "How is this one different from those two?"
(2) Introduce remaining two objects. Inquire "How are these two different from the others?" Then point to each and ask "How is this one different from the others?"
(3) After the child's descriptions have been elicited, ask him to put the balls in order along the line on the table.

The particular objects presented first varied for each of the object sets. Of the five objects, numbered in ascending order, the second, third, and fourth plugs were presented first; the first, second, and third pencils were presented first; and the first, third, and fifth buckets were presented first.

7. Seriated Pictures Comprehension Task

   a. Description of stimulus items: This task involves the presentation of pictures. Each picture displays five objects, identical except for size, arranged in order. In addition, a cutout object identical to the middlesize object in the picture accompanies four of the pictures. Each of the objects is accompanied by a proper name. The following object sets are depicted: toothbrushes, candy jars, automobiles, airplanes, baby bottles, flowers.

   b. Instructions to experimenter: Present each of the pictures to the child, and identify the objects depicted. For the pictures with a cutout, show the child that the cutout is just the same size as the middle object. Then present the questions testing the child's comprehension of superlative inflections; comparatives, equative, negative comparative, and negative equative constructions; and double comparative forms.

   c. Format of questioning for items with standard (Item No. 2 through 5 in order of presentation):

      First, present the standard cutout. "Here is a candy jar. It's name is Patty." Then present picture of 5 candy jars. "Here are lots of candy jars. Patty and Jan are just the same size. See." Demonstrate this by matching the two objects.

      Q1: "Which jar is bigger than Patty?" "Any others that are bigger than Patty?" Report names. Inquire until child says "No."

      Q2: "Which jar is as big as Patty?" "Any others that are as big as Patty?"

      Q3: "Which jar is not bigger than Patty?" "Any others that are not bigger than Patty?"

      Q4: "Which jar is not as big as Patty?" "Any others that are not as big as Patty?"

      The presentation order of each adjective construction is varied for each of the four object sets. All four forms are presented once for each object set. For two of the sets, "big" is employed as the adjective. For the other two, "little" is used.

   d. Superlative questions (Item No. 1 in order of presentation):

      Present picture of toothbrushes to child. "Here are a lot of toothbrushes. Which toothbrush is biggest?" "Any others that are biggest?" "Which toothbrush is smallest?" "Any others that are smallest?"

e. Double comparative questions (Item No. 6):

Present picture of flowers. "Here are some flowers. Which flower is bigger than Kay and smaller than Bess?" "Any others that are bigger than Kay and smaller than Bess?" "Which flower is littler than Amy and bigger than Jill?" "Any others that are littler than Amy and bigger than Jill?"

8. Clay Manipulation Task

a. Instructions to experimenter: This task requires the child to manipulate the size of a ball of clay so that it conforms to the experimenter's descriptions. For each description, first shape and present to child a ball of the size designated (either big or little). Then present instructions. Record on data sheet diagram the amount of clay removed or added by child. Make sure the drawing reflects the relative amount of clay involved.

b. Introduction: "Here is some play dough. I'm going to take a piece and roll it into a ball. See how I can take clay away from the pile and add it onto the ball. Also, I can take clay off the ball and put it back on the pile." The experimenter places near the child the pile of extra clay.

c. Format of first four items which examine child's comprehension of the basic termonology utilized in subsequent items.

(1) "Take off a lot of clay (from the pile) and roll it into a ball." E records amount of clay removed from pile by child. "Okay, that's the end of that ball. Pound it into the pile."
(2) The previous script is repeated substituting "a little bit of clay."
(3) "Now make a small ball." Record amount. "Okay, end of ball, pound it into the pile."
(4) Repeat above item substituting adjective "big."

d. Format of next eight items which examine that child's comprehension of combinations of the above terms.

"Now I'll make a ball. Here is a _____ ball. Try to make it _____." When child is finished, record his manipulation on data sheet.
"Okay, end of ball, pound it into the pile."

e. List of stimulus items inserted into the above frames (in order of occurrence):

(1) big - a little bit big
(2) small - a little bit small
(3) big - a lot bigger
(4) small - a little bit smaller
(5) small - a lot smaller
(6) big - a little bit bigger

(7) small - a little bit bigger
(8) big - a lot smaller

f. Phase I task modifications: The task is simplified and shortened. It narrows its focus to the child's ability to comprehend the meaning of adjective combinations and thus to display competence with the adjective modificational system. The use of two balls, a standard and one to be manipulated, is eliminated.

C. Phase I, Negative Word Association: Frequencies of Correct Opposites Given for Antonyms

Frequencies in the third column were calculated only for those subjects who were presented with all the words. A total of 16 Ss was given the long form of this task. Final-column frequencies (i.e., "Other Responses") were taken from productions of all subjects and appear in parentheses.

Stimuli	Correct Responses	Freq.	Other responses given at least twice
Clean	dirty	16	
Dirty	clean	15	
Fat	skinny	15	
Fast	slow	15	
Big	little (11)		
	small (4)	15	
Slow	fast	14	
Happy	sad	14	
Soft	hard	14	
New	old	14	
Pretty	ugly	14	dirty (2)
Bad	good	14	
Large	small (8)		
	little (6)	14	
Skinny	fat	13	
Sad	happy	13	mad (2)
Good	bad	13	old (2)
Little	big	13	tall (2)
Hot	cold	13	
Black	white	13	blue (2)
Dark	light	13	
Easy	hard	13	
Hard	soft (11)		
	easy (1)	12	smooth (2), big (2)
Old	young (8)		
	new (4)	12	
Ugly	pretty	12	
Cold	hot	12	warm (6)
Light	dark (7)		
	heavy (5)	12	hard (2)
Empty	full	12	
High	low	11	little (3)
Heavy	light	10	soft (2)
Young	old	10	pretty (2)
Long	short	10	little (4)
Small	big (9)		
	large (0)	9	tall (5)
Short	tall (9)		
	long (0)	9	big (8), little (3)

Phase I, Negative Word Association (cont'd)

Stimuli	Correct Responses	Freq.	Other responses given at least twice
Strong	weak	9	hard (2)
Weak	strong	9	sad (2)
Poor	rich	9	sad (2), happy (2)
White	black	8	dark (2)
Rich	poor	8	sad (2)
Full	empty	8	
Low	high	8	big (3), tall (3)
Few	many	2	little (2)
Many	few	2	one (2), little bit (2)
Smooth	rough	1	hard (7), soft (4)
Rough	smooth	1	hard (3), soft (3), easy (3)
Tall	short	1	small (10), little (9)

D. One-Dimension Description Task, Phase II: Number of Ss Producing Adjectives in Response to E's Comprehension Question (i.e., "Is the other one small? What is it?")

Adjective Pair

Stimulus	Correct Response	4	5	6	7	8	Total	Other responses given by Ss at least twice
large	small little	3	6	7	6	8	30	*big (5)
skinny	fat	3	7	7	8	6	31	big (5)
fat	skinny	3	7	8	6	8	32	little (2)
short	long	2	2	3	4	4	15	big (20), fat (3)
long	short	1	3	4	5	5	18	little (11), small (6)
many	few	0	0	0	0	1	1	little (bit) (17), less (6)
few	many	0	0	0	0	0	0	lots (17), more (8), *a little bit (4), *less (2)
heavy	light	1	3	4	5	7	20	little (3), not heavy (3), weak (2), small (2), easy (2)
light	heavy	1	3	5	4	6	19	hard (6), dark (3), big (2), *little (2)
tall	short	0	1	1	3	4	9	little (14), small (12)
short	tall	0	0	4	3	2	9	big (22), long (6)
less	more	1	1	3	5	5	15	*a little bit (11), a lot (8), *small (2)
more	less	0	1	2	6	4	13	a little bit (24), only a few (2)
hard	soft	4	6	7	8	8	33	-
soft	hard	5	8	7	8	7	35	-

*Responses where wrong object selected for stimulus and so wrong pole given as response.

Appendixes

G. Transformation Task, Phase II: Mean number of errors Per Item as a Function of Age for the Three Most Difficult Transformations (Maximum per cell = 8)

Transformation	Age				
	4	5	6	7	8
Comparative Assertion, Comparative Negative Mini Question	2.5	2.5	4.5	1.5	2.5
Negative Equative Maxi Assertion, Comparative Question	1.5	2.5	1.75	1.5	0.75
Negative Equative Mini Assertion, Comparative Question	4.0	5.0	4.0	2.25	3.0
Mean	2.7	3.3	3.4	1.4	2.08

H. Mean Number of Tasks Passed by Ss as a Function of Age (maximum = 19)

		Mean	Range
	4	8.88	3 to 15
	5	11.50	7 to 15
Age	6	14.00	10 to 17
	7	14.25	12 to 17
	8	15.63	13 to 18

APPENDIXES

I. Inter-task Pass-Fail Matrix

Task	30N	7D	7CN	4CC	30	7EA	60	3B	4P	3A	8	4C	6L	7T	2	1	5	7EN	7CA
Prop. Passed	.10	.25	.27	.35	.40	.50	.72	.75	.78	.80	.80	.83	.83	.88	.88	.88	.93	.95	.95

No. Passed																			
3													+				+	+	
5											+		+		+		+	+	
7								+		+				+		+	+	+	+
8			+		+				+	+		+	+					+	+
9					+				+	+			+	+			+	+	+
9									+			+	+	+	+	+	+	+	+
10			+			+		+		+	+			+		+	+	+	+
10						+		+	+	+		+	+	+	+	+			+
11							+	+		+	+	+		+	+	+	+	+	+
11					+		+		+	+		+	+	+	+	+		+	+
11							+	+	+	+		+	+		+	+	+	+	+
12						+	+	+		+	+	+		+	+	+	+	+	+
12						+			+	+	+	+	+	+	+	+	+	+	+
12					+	+	+				+	+	+	+	+	+	+	+	+
12		+			+	+		+			+		+	+	+	+	+	+	+
12				+			+	+	+	+	+		+	+	+		+	+	+
12					+	+		+	+		+	+		+	+	+	+	+	+
13	+	+				+	+			+	+	+	+	+	+	+	+		+
13				+		+	+		+		+	+	+	+	+	+	+	+	+
13							+	+	+	+	+	+	+	+	+	+	+	+	+
13				+			+	+	+	+	+	+	+		+	+	+	+	+
14			+				+	+	+	+	+	+	+	+	+	+	+	+	+
14					+		+	+	+	+	+	+	+	+	+	+	+	+	+
14		+					+	+	+	+	+	+	+	+	+	+	+	+	+

I. Inter-task Pass-Fail Matrix (continued)

Task	30N	7D	7CN	4CC	30	7EA	60	3B	4P	3A	8	4C	6L	7T	2	1	5	7EN	7CA
Prop. Passed	.10	.25	.27	.35	.40	.50	.72	.75	.78	.80	.80	.83	.83	.88	.88	.88	.93	.95	.95
No. Passed																			
14						+	+	+	+	+	+	+	+	+	+	+	+	+	+
15			+	+			+	+	+	+	+	+	+	+	+	+	+	+	+
15			+			+	+	+	+	+	+	+	+	+	+	+	+	+	+
15	+				+	+	+	+	+	+	+	+		+	+	+	+	+	+
15		+		+			+	+	+	+	+	+	+	+	+	+	+	+	+
15		+				+	+	+	+	+	+	+	+	+	+	+	+	+	+
15			+		+	+	+	+	+	+	+	+		+	+	+	+	+	+
16			+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
16	+			+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
16			+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+
16		+		+	+	+	+	+	+		+	+	+	+	+	+	+	+	+
16			+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+
17		+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
17		+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+
18		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
18	+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+

J. Of Ss Who Passed Each of the Target Tasks, Proportions Who Also Passed Each of the Other Tasks

Target Tasks	Comparison Tasks											
	1	2	3A	3B	30	30N	4C	4PC	4CC	5	60	6L
1. Neg. Word Assoc.	-	.94	.83	.83	.40	.11	.91	.80	.37	.94	.80	.80
2. One-Dim. Descr.	.94	-	.80	.80	.40	.11	.91	.83	.40	.94	.83	.86
3. Hungry Pig: And	.91	.88	-	.84	.38	.13	.88	.84	.38	.91	.81	.81
BN	.97	.93	.90	-	.40	.10	.87	.83	.43	.97	.83	.77
Or	.88	.88	.75	.75	-	.19	.88	.88	.44	.88	.75	.81
ON	1.00	1.00	1.00	.75	.75	-	1.00	.75	.50	1.00	1.00	.75
4. Coord. Lang.: Comp.	.97	.97	.85	.79	.42	.12	-	.88	.39	.91	.85	.85
Prod. C.	.90	.94	.87	.81	.45	.10	.94	-	.45	.90	.81	.90
Prod. C.C.	.93	1.00	.86	.93	.50	.14	.93	1.00	-	1.00	1.00	1.00
5. Transformation	.89	.89	.78	.78	.38	.11	.81	.76	.38	-	.76	.81
6. Ser. Prod.: Order	.97	1.00	.90	.86	.41	.14	.97	.86	.48	.97	-	.86
Lang.	.85	.91	.79	.70	.39	.09	.85	.85	.42	.91	.76	-
7. Ser. Comp.: CA	.92	.90	.84	.79	.42	.11	.87	.82	.37	.92	.76	.82
EN	.87	.87	.79	.76	.42	.08	.82	.79	.37	.95	.74	.82
EA	1.00	.95	.79	.80	.45	.15	.90	.75	.35	.95	.75	.75
CN	.91	.82	1.00	.91	.45	.00	.91	.91	.55	.91	.82	.82
Tot	.94	.91	.83	.80	.43	.11	.86	.80	.37	.94	.77	.80
DC	1.00	1.00	.80	.90	.50	.20	.90	.80	.60	1.00	.90	1.00
8. Clay Manip.	.94	.97	.81	.81	.41	.13	.88	.78	.44	1.00	.84	.81

J. Of Ss Who Passed Each of the Target Tasks, Proportions Who Also Passed Each of the Other Tasks (continued)

Target Tasks	Comparison Tasks							Number of Ss Passing	Number of Values ≥ .80	Number of Values ≤ .20
	7CA	7EN	7EA	7CN	7T	7D	8			
1. Neg. Word Assoc.	1.00	.94	.57	.28	.94	.28	.86	35	12	1
2. One-Dim. Descr.	.97	.94	.54	.26	.91	.28	.89	35	12	1
3. Hungry Pig: And	1.00	.94	.47	.34	.91	.25	.83	32	12	1
BN	1.00	.97	.53	.33	.93	.30	.90	30	11	1
Or	1.00	1.00	.56	.31	.94	.31	.81	16	10	1
ON	1.00	.75	.75	.00	1.00	.50	1.00	4	9	1
4. Coord. Lang.: Comp.	1.00	.94	.55	.30	.91	.27	.85	33	11	1
Prod. C.	1.00	.97	.48	.32	.90	.26	.81	31	12	1
Prod. C.C.	1.00	1.00	.50	.43	.93	.43	1.00	14	13	1
5. Transformation	.95	.97	.51	.27	.89	.27	.87	37	8	1
6. Ser. Prod.: Order	1.00	.97	.52	.31	.93	.31	.93	29	12	1
Lang.	.94	.94	.45	.27	.85	.30	.79	33	8	1
7. Ser. Comp.: CA	-	.95	.53	.29	.92	.26	.82	38	10	1
EN	.95	-	.47	.29	.87	.24	.82	38	8	1
EA	1.00	.90	-	.30	1.00	.40	.95	20	9	1
CN	1.00	1.00	.55	-	.91	.18	.91	11	13	2
Tot	1.00	.94	.57	.28	-	.28	.86	35	11	1
DC	1.00	.90	.80	.20	1.00	-	1.00	10	14	2
8. Clay Manip.	.97	.97	.59	.31	.94	.31	-	32	11	1

K. Of Ss Who Failed Each of the Target Tasks, Proportions Who Passed Each of the Other Tasks

Target Tasks	Comparison Tasks											
	1	2	3A	3B	30	30N	4C	4PC	4CC	5	60	6L
1. Neg. Word Assoc.	–	.40	.60	.20	.40	.00	.20	.60	.20	.80	.20	1.00
2. One-Dim. Descr.	.40	–	.80	.40	.40	.00	.20	.40	.00	.80	.00	.60
3. Hungry Pig: And	.75	.88	–	.38	.50	.00	.63	.50	.25	1.00	.38	.88
BN	.60	.70	.50	–	.40	.10	.70	.60	.10	.80	.40	1.00
Or	.88	.88	.83	.75	–	.04	.79	.71	.29	.96	.71	.83
ON	.86	.86	.78	.75	.36	–	.81	.78	.33	.92	.70	.83
4. Coord. Lang.: Comp.	.43	.43	.57	.57	.29	.00	–	.29	.14	1.00	.14	.71
Prod. C.	.78	.67	.56	.56	.22	.11	.44	–	.00	1.00	.44	.56
Prod. C.C.	.85	.81	.77	.65	.35	.07	.77	.65	–	.89	.58	.73
5. Transformation	.67	.67	1.00	.33	.67	.00	1.00	1.00	.00	–	.33	1.00
6. Ser. Prod.: Order	.64	.55	.55	.45	.36	.00	.45	.55	.00	.82	–	.73
Lang.	1.00	.71	.86	1.00	.43	.14	.71	.43	.00	1.00	.57	–
7. Ser. Comp.: CA	.00	.50	.00	.00	.00	.00	.00	.00	.00	1.00	.00	1.00
EN	1.00	1.00	1.00	.50	.00	.50	1.00	.50	.00	1.00	.50	1.00
EA	.75	.80	.85	.70	.35	.05	.65	.80	.35	.90	.70	.90
CN	.86	.90	.72	.69	.38	.14	.79	.72	.28	.93	.69	.83
Tot	.40	.60	.60	.40	.20	.00	.60	.60	.20	.80	.40	1.00
DC	.83	.83	.80	.70	.37	.07	.80	.77	.27	.90	.67	.77
8. Clay Manip.	.63	.50	.75	.38	.38	.00	.63	.75	.00	.63	.25	.88

K. Of Ss Who Failed Each of the Target Tasks, Proportions Who Passed Each of the Other Tasks (continued)

Target Tasks	Comparison Tasks							Number of Ss Failing	Number of Values ≥ .80	Number of Values ≤ .20
	7CA	7EN	7EA	7CN	7T	7D	8			
1. Neg. Word Assoc.	.60	1.00	.00	.20	.40	.00	.40	5	3	8
2. One-Dim. Descr.	.80	1.00	.20	.40	.60	.00	.20	5	4	7
3. Hungry Pig: And	.75	1.00	.63	.00	.75	.25	.75	8	4	2
BN	.80	.90	.40	.10	.70	.10	.50	10	4	4
Or	.92	.92	.46	.25	.83	.21	.79	24	8	1
ON	.94	.97	.47	.31	.81	.25	.78	36	8	0
4. Coord. Lang.: Comp.	.71	1.00	.29	.14	.71	.14	.57	7	2	4
Prod. C.	.78	.89	.56	.11	.78	.22	.78	9	2	3
Prod. C.C.	.93	.93	.50	.19	.85	.15	.69	26	6	3
5. Transformation	1.00	.67	.33	.33	.67	.00	.00	3	5	4
6. Ser. Prod.: Order	.82	.91	.45	.18	.73	.09	.45	11	3	4
Lang.	1.00	1.00	.71	.29	1.00	.00	.86	7	8	3
7. Ser. Comp.: CA	-	1.00	.00	.00	.00	.00	.50	2	3	13
EN	1.00	-	1.00	.00	1.00	.50	.50	2	9	3
EA	.90	1.00	-	.25	.75	.10	.65	20	7	2
CN	.93	.93	.48	-	.86	.28	.76	29	7	1
Tot	.60	1.00	.00	.20	-	.00	.40	5	3	6
DC	.93	.97	.40	.30	.83	-	.73	30	8	1
8. Clay Manip.	.88	.88	.13	.13	.63	.00	-	8	3	4

Appendixes

L. Correlation Coefficients Among Measures Taken Within Tasks

1. One-Dimension Description Task

	1	2	3	4
1. Number of items for which at least one specific adjective descriptive produced	--	.92	.71	.86
2. Number of maxi-adjectives produced		--	.69	.83
3. Number of mini-adjectives produced			--	.76
4. Number of correct opposites elicited by comprehension question				--

2. Coordinated Language Task

	1	2	3	4	5	6	7
Comprehension:							
1. Number maxi-maxi or mini-mini (pure)	--	.84	.81	.68	.77	.94	.84
2. Number maxi-mini (crossed)		--	.86	.82	.91	.89	.95
3. Number Pure Negation			--	.84	.91	.88	.95
4. Number Crossed Negation				--	.95	.75	.91
5. Total - Part I Comprehension					--	.79	.96
6. Total - Part II Comprehension						--	.93
7. Total - Compreh.							--

L. Correlation Coefficients (Cont'd)

3. Transformation Task

	1	2	3
1. Part I	--	.54	.87
2. Part II		--	.88
3. Total			--

4. Seriated Pictures Comprehension Task

	1	2	3	4	5
1. Affirmative Comparative	--	.21	-.26	.34	.65
2. Affirmative Equative		--	.01	-.05	.71
3. Negative Comparative			--	-.02	.14
4. Negative Equative				--	.54
5. Total					--

Appendix M-1
Summary Analysis of Variance Table for Mean Number
of Correct Responses in Negative Word Association Tasks, Phase II

Source	df	Mean Square	F
Age (A)	4	168.78	17.01*
Race (R)	1	13.23	1.33
Sex (S)	1	3.03	--
AR	4	2.23	--
AS	4	26.15	2.63
RS	1	5.63	--
ARS	4	7.25	--
Subjects(ARS)	20	9.93	

*$p < .01$

Appendix M-2
Summary Analysis of Variance Table for Mean Number of Correct Responses Minus Noun-Prompted Responses in Negative Word Association Task, Phase II

Source	df	Mean Square	F
Age (A)	4	315.46	20.35*
Race (R)	1	.10	--
Sex (S)	1	2.50	--
AR	4	11.04	--
AS	4	29.81	1.92
RS	1	.10	--
ARS	4	18.29	1.18
Subjects(ARS)	20	15.50	

*$p < .01$

Appendix M-3

Summary Analysis of Variance Table for Mean Number of Correct Specific Antonyms Produced to Describe Object Differences in the One-Dimension Description Task, Phase II

Source	df	Mean Square	F
Age (A)	4	78.22	10.41*
Race (R)	1	2.81	--
Sex (S)	1	19.01	2.53
Polarity(P)	1	117.61	44.81*
AR	4	4.84	--
AS	4	15.41	2.05
RS	1	.61	--
AP	4	4.21	1.86
RP	1	1.01	--
SP	1	23.11	10.23*
ARS	4	2.27	1.00
ARP	4	.61	--
ASP	4	2.96	1.31
RSP	1	.11	--
Subjects(ARS)	20	7.51	
ARSP	4	1.58	--
SubjectsP(ARS)	20	2.26	

*$p < .01$

Appendix M-4

Summary Analysis of Variance Table for Mean Number of Times at Least One Correct Specific Antonym was Produced to Describe Each Object Pair in the One-Dimension Description Task, Phase II

Source	df	Mean Square	F
Age(A)	4	70.96	19.18*
Race (R)	1	10.00	2.70
Sex(S)	1	1.60	--
AR	4	.69	--
AS	4	15.04	4.06
RS	1	.90	--
ARS	4	2.46	--
Subjects(ARS)	20	3.70	

*$p < .01$

Appendix M-5
Summary Analysis of Variance Table for Mean Number of Times Correct Opposite Elicited in Follow-up to E's Comprehension Question in the One-Dimension Description Task, Phase II

Source	df	Mean Square	F
Age(A)	4	83.79	13.51*
Race(R)	1	12.10	1.95
Sex(S)	1	2.50	--
AR	4	5.54	--
AS	4	13.94	2.25
RS	1	.10	--
ARS	4	3.54	--
Subjects(ARS)	20	6.20	

*$p < .01$

Appendix M-6

Summary Analysis of Variance Table for Mean Number of Times Coordinated Descriptives Produced to Describe Object Differences in Coordinated Language Task, Phase II

Source	df	Mean Square	F
Age(A)	4	77.41	5.50*
Race(R)	1	15.63	1.11
Sex(S)	1	3.03	--
AR	4	30.81	2.19
AS	4	19.96	1.43
RS	1	34.23	2.43
ARS	4	13.16	--
Subjects(ARS)	20	14.08	

*$p < .01$

Appendix M-9
Summary Analysis of Variance Table for Mean Number of Correct Responses on Hungry Pig Task, Phase II

Source	df	Mean Square	F
Age (A)	4	15.23	2.22
Race (R)	1	19.60	2.86
Sex (S)	1	2.50	--
AR	4	7.60	1.11
AS	4	4.63	--
RS	1	.40	--
ARS	4	12.15	1.77
Subjects (ARS)	20	6.85	

*$p < .01$

Appendix M-10
Summary Analysis of Variance Table for Mean Number of Correct Responses on Transformation Task, Phase II

Source	df	Mean Square	F
Age (A)	4	12.59	1.05
Race (R)	1	4.90	--
Sex (S)	1	2.50	--
AR	4	1.21	--
AS	4	21.69	1.81
RS	1	.10	--
ARS	4	4.91	--
Subjects (ARS)	20	12.00	

Appendix M-11

Summary Analysis of Variance Table for Mean Number of Object Sets Ordered and/or Matched in the Language and Seriation Production Task, Phase II

Source	df	Mean Square	F
Age (A)	4	19.09	12.52*
Race (R)	1	.23	--
Sex (S)	1	.62	--
AR	4	.91	--
AS	4	4.81	3.16
RS	1	3.03	1.98
ARS	4	.34	--
Subjects (ARS)	20	1.53	

*$p < .01$

Appendix M-12

Summary Analysis of Variance Table for Mean Number of Different Adjective Modifier Produced in the Language and Seriation Production Task, Phase II

Source	df	Mean Square	F
Age (A)	4	1.78	--
Race (R)	1	12.10	1.68
Sex (S)	1	1.60	--
AR	4	4.60	--
AS	4	1.85	--
RS	1	.10	--
ARS	4	20.23	2.81
Subjects (ARS)	20	7.20	

*$p < .01$

Appendix M-13
Summary Analysis of Variance Table for Mean Number of Different Adjectives Produced in Language and Seriation Production Task, Phase II

Source	df	Mean Square	F
Age (A)	4	7.54	1.66
Race (R)	1	2.50	--
Sex (S)	1	.10	--
AR	4	5.31	1.17
AS	4	3.66	--
RS	1	.90	--
ARS	4	3.34	--
Subjects (ARS)	20	4.55	--

*$p < .01$

Appendix M-14

Summary Analysis of Variance Table for Mean Number of Correct Responses on Seriated Pictures Task, Phase II

Source	df	Mean Square	F
Age (A)	4	4.29	3.47
Race (R)	1	3.03	2.44
Sex (S)	1	0.00	--
Valence (V)	1	30.63	26.34*
Cross (C)	1	2.50	2.67
AR	4	3.12	2.52
AS	4	1.25	1.01
RS	1	.23	--
AV	4	3.91	3.36
RV	1	8.10	6.97
SV	1	.03	--
AC	4	.22	--
RC	1	3.03	2.16
SC	1	1.60	1.71
VC	1	112.23	54.41*
ARS	4	1.94	1.57
ARV	4	1.22	1.05
ASV	4	1.62	1.39
RSV	1	.90	--
ARC	4	1.71	1.83
ASC	4	.57	--
RSC	1	.23	--
AVC	4	1.66	--
RVC	1	4.90	2.38
SVC	1	.03	--
Subjects (ARS)	20	1.24	
ARSV	4	1.15	--
ARSC	4	.85	--
ARVC	4	.49	--
ASVC	4	1.08	--
RSVC	1	.10	--
Subjects V(ARS)	20	1.16	
Subjects C(ARS)	20	94	
ARSVC	4	1.77	--
Subjects VC(ARS)	20	2.06	

*$p < .01$