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Cognition and the Acquisition of Selected Syntactic Structures in Children from Six to Ten

Linda DenBesten Jones

Loyola University Chicago

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COGNITION AND THE ACQUISITION OF SELECTED SYNTACTIC
STRUCTURES IN CHILDREN FROM SIX TO TEN

by

Linda DenBesten Jones

A Dissertation Submitted to the Faculty of the Graduate School
of Loyola University of Chicago in Partial Fulfillment
of the Requirements for the Degree of
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VITA

Linda DenBesten Jones was born in Harvey, Illinois, on November 17, 1947. She graduated from Thornridge High School, Dolton, Illinois, in June 1965; from Hope College, Holland, Michigan (Bachelor of Arts) in June 1968; and from DePaul University, Chicago, Illinois (Master of Education) in January 1971.

Since the time of her graduation from undergraduate school she has been employed as a high school social studies/English teacher, fifth grade classroom teacher, learning disabilities resource room teacher, and consultant to learning and behavior disorders programs in a special education cooperative. At the present time she is Director of Special Education in Elementary School District 152 in Harvey, Illinois. In addition she has served as President and Vice President of local Illinois Chapter 377 of the Council for Exceptional Children.

Publications include, "The rights of handicapped children in the state of Illinois," Illinois Schools Journal, Fall 1974, and Options in teaching the learning disabled: A how-to guide, Nos. 6529 and 6530, Oak Lawn, Illinois: Ideal School Supply Co., 1978.

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CHAPTER I

INTRODUCTION

Oral language is a remarkable achievement in the human species. Its regular development in every culture within the global community is a source of continuing marvel. Within today's scientific community language development has sparked new interest. Of particular interest is the creative aspect of language which makes it possible for a child who has never heard a particular utterance to readily interpret and respond to it without hesitation.

Much of the thrust of this interest has been touched off by Noam Chomsky who directed renewed attention to the rule structure of language which gives us insight into how to interpret a speaker's words (1965). Chomsky's work led the research community away from studies which attempted to look only at sentence length and frequency of word usage as indicators of language development. Rather Chomsky concerned himself with the ideal "speaker-listener" and the types of sentences which would be generated within the ideal language community. What particularly interested psychologists was Chomsky's concern with how the speaker learns to relate meaning with sounds and to correctly understand ambiguous sentences which might be interpreted in a number of different ways. His emphasis on the transformations from deep meaning to the surface structure of language to account for the speaker-listener's rule-governed skills paralleled similar cognitive theories within the psychological community, i.e., Piaget.

But Chomsky's concern with an ideal speaker-listener removed from environmental restraints gave rise to a series of research studies concerned solely with syntax. This research virtually ignored the "how" of meaning and instead followed Chomsky's lead by asserting that language was innate and only a limited exposure to the language community was necessary for a child to acquire language. Moreover, few researchers addressed the question of why a child was able to move from one level of syntactical complexity to the next nor what features of the environment were related to such growth.

Cognitive growth is an equally remarkable achievement in the human species. It too demonstrates remarkable regularity in development. Like the linguistic researchers whose efforts have been spurred by Chomsky, the cognitivists have been renewed by the creative and unique approach of Piaget toward development. Particularly interesting is Piaget's concern with the stages of intellectual development and their unvarying regularity of development across cultures and across individuals with widely varying degrees of intellectual competence. Piaget seeks to explain the overriding mechanisms of growth which might describe the changes the individual undergoes in moving from one stage to another.

Unlike the present psychometric approach to intelligence which has prevailed since the days of Binet, Piaget finds little of interest in the differences between children--the peculiarities of one individual's development. Rather he chooses to look closely at what makes one child like another across developmental stages.

Possibly because both Piaget and Chomsky are interested in competence rather than performance and because both appear to be interested in how underlying structures relate to surface structures, researchers

have again begun to look at the often-asked question of how language and thought are related--how Piagetian stages relate to syntax. However, there is increased recognition that language and grammar cannot be studied in isolation as Chomsky proposes. Rather one must look at the psychological reality of syntax and refer to research what the theorists have proposed. Moreover, some of Piaget's findings provide intriguing possibilities for examining and explaining the regular acquisition of syntax--something which the linguists have been unable to do except in general reference to the rules of grammar--as it relates to the regularities of cognitive development.

An example of this direction in the research is seen in the work of Carol Chomsky (1969, 1972). In her first paper she attempted to explain the older child's ability to deal with increasingly difficult syntactic structures in terms of linguistic rules alone. But her second piece of research extended that of the first and compared the child's invariant syntactic "stages" with intellectual development, socio-economic status, and exposure to written language. Like others, she concluded that language development is closely related to the developmental factors of growth.

Interesting possibilities are raised by the prospect of stages in both the work of C. Chomsky and that of Piaget. One is immediately curious to know how these stages are related, and what is the direction of that relationship. At this time there is no study of this type to which one might refer although there have been studies which attempted to show the relationship between one aspect of linguistic development (passive construction, function words, early language development) and

the stages elicited by Piaget.

One wonders if the relationship between different aspects of Piaget's stages (seriation, conservation, class inclusion) are related in the same way to the structures elicited by Chomsky. Or does the problem of decalage (uneven development of stages) confuse our understanding of the relationship of cognition and language.

Curiosity is also aroused about the cognitive prerequisites which may be necessary for the child to use a particular type of syntactic structure. Is decentered, operational thought a necessary or sufficient prerequisite for the manipulation of the linguistic surface structures? Is it possible to determine the direction of the relationship between language and cognition? Can a model be developed? Or are we hopelessly mired in a chicken or egg argument? Which comes first--thought (as Piaget says), or language (as Vygotsky and Bruner espouse), or are they the same (as the behaviorists have maintained), or are they separate features (as the linguists intimate)?

On a practical level, one finds the measurement of language development a very difficult process. At the present time we find that measures of sentence length and vocabulary are used for the most part to determine linguistic competence. These linguistic measures are necessarily closely tied to our understanding of intelligence. Syntactic development (in terms of complexity) is more difficult to measure and at the present time we find a paucity of standardized scales and an unsureness about how syntax and intelligence are related.

For these reasons (inadequate statistical technique, inappropriate language tasks, psychometric rather than Piagetian tasks in

comparison with syntax), a systematic study of the relationship between language as syntax and cognition as Piagetian stages needs to be completed. The object of such a study is to develop a possible model of the relationship between the two competencies and to investigate the possibility of causality between thought and language.

In the review of the literature which follows, one finds the relationship between language and cognition characterised as:

1. Language and thought are inseparable
2. Language influences and structures thought
3. Thought influences language
4. Thought and language are independently influenced by development.

Much of the research to support any of these four theoretical positions has been, because of inadequate methodological techniques, more speculative than substantive. When research has been carried out to more definitively determine the nature of the relationship, the researcher has summarized his findings by stating that the relationship between language and cognition was complex and difficult with no further answers forthcoming. And for some time research efforts seem to be stymied at this point.

A major purpose of the present investigation will be to attempt to provide a catalyst in dealing with the theoretical language/cognition dilemma through the use of a technique known as path analysis which permits the researcher to trace the implications of a set of causal assumptions. With this method a model is developed by eliminating relationships which the researcher is confident do not exist (for empirical or theoretical reasons) and retaining those models one is not sure about as well as those that are known to be operative.

In evaluating the relationship between thought and language, path analysis will be used to trace out the implications of three of the four possibilities noted above:

1. Language influences thought
2. Thought influences language
3. Thought and language are independently influenced by development.

These three models will be traced for three cognitive (Piagetian) tasks (conservation, seriation and class inclusion). In each instance the cognitive tasks will be compared with the syntactic tasks developed by Carol Chomsky.

Such a study would be useful for two reasons. On a pragmatic level, practitioners in the field of education characteristically find it difficult to determine how much curriculum emphasis should be placed on language lessons. More recently the infusion of special education monies from the federal government has produced a quandary about the employment of additional speech and language personnel as opposed to additional instructional staff. Speech and language pathologists have maintained strong lobbies in both state and federal legislatures to insure the employment of speech and language personnel and the role of speech in the child's total development and has been stressed strongly. On the other hand teachers and psychologists have frequently maintained that such emphasis tends to neglect instruction in cognitive/basic learning activities. Research support is necessary to indicate what is the appropriate balance between the two competing groups.

On another level, path analysis should be evaluated in terms of its usefulness to the field of linguistic and cognitive research. In

the past path analysis has been used primarily by social scientists in the fields of political science, sociology, and economics. It may also be a potentially useful tool within the field of psychology.

If the findings from path analysis can be empirically validated, it will permit us to make some statements about the direction of the relationship between cognition and language and provide a focus for future experimentation.

CHAPTER II

A REVIEW OF THE LITERATURE

In reviewing the literature concerning the relationship between thought and language, the prevailing schools of thought may be characterized in four ways: 1) language influences thought, 2) thought and language are inseparable, 3) thought influences language, and 4) thought and language are independent. Vygotsky, Bruner and Whorf-Sapir are proponents of the first school of thought while the behaviorists are usually associated with the second. Piaget and his Genevan School, on the other hand, have argued that thought develops prior to language. Chomsky and McNeill, the linguists of the language is innate school, have argued the fourth position.

Because the research methodology (path analysis) for the present study is closely tied to the nature of the literature review, the writer will begin immediately to refer to the different schools of thought in terms of competing models:

- Model I: Language influences thought
- Model II: Thought influences language
- Model III: Thought and language are independently influenced by development

The reader should also note that the theory that language and thought are inseparable is not systematically evaluated in the present investigation. However, the implications of the findings of this study for that argument are discussed in the final chapter of this paper.

Language and Thought Are Inseparable

Skinner (1957) and his school of behaviorists have long felt that language and thought are one and the same. Speech, like all other

behavior, is controlled by environmental stimuli, drive stimuli and printed and verbal stimuli. It has been shown that verbal stimuli will elicit physiological and affective responses which in turn have stimulus characteristics that elicit speech responses. Longer, more complex verbal patterns are hypothesized to occur through chaining.

Many of the findings of the Skinnerians have recently been called into question. The most cogent of these criticisms is that the S-R paradigm is too cumbersome to account for the rapidity with which children acquire a relatively sophisticated syntactic system and that children use words like goed and comed (Miller and Ervin, 1964) although these words do not appear in adult speech. In a review of other criticisms of the S-R position, Schlesinger (1975) noted that:

1. Children talk whether or not they are reinforced for their efforts. Their soliloquizing when alone is partial evidence for this. But also in non-Western cultures, there is less concern with children's speech and the child is reinforced less frequently.
2. Researchers have found that grammatically cute, but incorrect phrases are reinforced by parents and others.

Further, R. Brown (1973) reports that parents seem to pay no attention to a child's syntax, nor do parents even appear to be aware of the syntactic errors in the samplings of child speech. Rather the parent approved or disapproved of an utterance on the grounds of the truth value of the proposition which the parents supposed the child intended to assert.

Model I: Language Influences Thought

Vygotsky (1962) has been credited with showing that words direct attention to specific aspects of a situation and that the word is the

primary unit of speech around which thought is organized. He states that the "use of the sign, or word, is the means by which we direct our mental operations, control their course, and channel them toward solution of the problem confronting us (p.58)." Vygotsky also felt that speech and thought spring from separate roots and develop along different lines. But occasionally these separate strands merge and speech is used to help initiate new behaviors. Proof for this perspective was cited in Koehler's apes who were able to use tools but were felt to be incapable of using sign language on a consistent basis.

Luria (1959, 1968) was one of Vygotsky's students and he did a series of experiments which pointed toward the increasing directive role of speech during the preschool years. He found that initially words control orientation toward objects. Later words are synthesized into sentence units and can direct behavior through activation but not inhibition of behavior. In a still later stage, commands or instructions from an external source can control behavior. In a later stage, commands or instructions from an external source can control behavior through both activation and inhibition. Words finally become self-regulatory and a child is capable of starting or stopping a behavior (under the child's own direction), as well as being able to stop an activity in mid-course when asked to do so by an outside agent.

The findings of both Vygotsky and Luria are suspect by today's researchers. Not only have chimpanzees (Linden, 1975) been taught to use American Sign Language, but Luria's studies have been difficult, if not impossible to replicate (Bronckart, 1973).

Bruner (1966) has taken a position similar to Vygotsky's and even refers to primate language in the same way. Bruner also supported his hypothesis in a series of studies (Bruner, et al., 1966) which attempted to show that grammatical concepts are first used and perfected in the sphere of language and are only gradually transferred to thinking in general. The grammatical concepts postulated are those of hierarchy and transformation. And language is felt to lead, direct, and speed cognitive activity. He states that evidence for this position is seen in the language universal of syntax. However, the primacy of syntax is under attack at the present time (Bloom, 1970; Slobin, 1971).

Finally, the Whorf-Sapir Weltanschauung hypothesis builds upon the language before thought premise (Carroll, 1956) which states that one's world view (perceptions, notions of causality and cognitions of a member of a language community) is said to be a direct function of language codes available. Although limited confirmation of this theory was found (Carroll and Casagrande, 1958), the influence of cultural differences in language was found to dissipate with very little additional training.

Model II: Thought Influences Language

Piaget and the Genevan School have been the chief proponents of the thought influences language perspective of development. They propose that language parallels cognition, but always lags behind to become mapped onto experience. The child develops meanings to be expressed in language through prior experience. Within given levels of knowledge about language, a child discovers ways of expressing these

meanings (Sinclair-de-Zwart, 1967; Slobin, 1971). Unlike the linguists of the generative transformation school of thought who posit an innate mechanism for language development, the Genevans assert that the child constructs reality through his actions on the world about him. This particular theory and its ramifications will be dealt with at length below.

Piaget's theory. Before dealing with Piaget's theory as it relates to language development, we shall review the general theoretical framework. One of the most striking aspects of this work is the concern with overall structures in cognition. In contrast with the present American psychometric preoccupation with comparing one child to another and then deriving a normally distributed curve, Piaget confesses he has little interest in such research and prefers instead to discover the regularities of development. He relates that his interest is in schemas -- the total structures of cognitive systems with their own laws. Rather than specifying the dominant characteristics of cognitive development, Piaget looks at whole systems which incorporate all the elements of a structure. The laws he specifies cover the entire set of elements in the system. It is these structures which are hypothesized to become integrated with development (Piaget, 1971).

Piaget's concern with structures leads quite naturally to a concern for stages. The stages he posits (sensory-motor, preoperational, concrete operational, and formal operations) are characterized as insensitive with each preceding stage being a necessary prerequisite for that which follows. Flavell (1975) has noted two salient characteristics of

Piagetian stages. The first is that items do not exist in the child's cognitive repertoire as psychologically isolated and unrelated abilities, but rather interact with one another in specified ways in the course of their being utilized by the child. For this reason it is legitimate to describe them as organized into one or more cognitive structures. Secondly, items and their structural organizations are qualitatively, rather than just quantitatively, different from those defining previous stages of the child's cognitive evolution. They are genuine developmental novelties, not merely more efficient or otherwise improved versions of what has already been achieved. It is this aspect of Piagetian stages that lends itself particularly well to research and allows us to ask detailed questions about the kinds of strategies and cognitive processes children bring to the task of acquiring language.

Much of what is unique in the writing and observations of Piaget was derived from observing his own three children in infancy and childhood. These observations, particularly in the child who has not yet acquired speech, led Piaget to the conclusion that the primary source of knowledge is action (Piaget, 1962, 1969). For the child to know an object or to understand any aspect of his environment he must act upon it. Consequently the first of Piaget's stages is labelled the sensory-motor stage and is usually present from birth to eighteen months. Piaget (Piaget and Inhelder, 1969) has described what is learned during this stage as something resembling a Copernican revolution within the child-- a general decentering process in which the child begins to see himself as an object among others in a universe made up of permanent objects. The intelligence which the child manifests is a practical intelligence,

not at the level of thought and lacking in representation (Piaget, 1970). With this level of competence the child is able to act in space and grasp for objects.

During the next level of cognitive development the child enters the preoperational stage which is characterised by transductive reasoning. Children exhibiting this type of logic assimilate their thoughts from the particular to the particular and are not yet capable of either generalisation across the whole or reciprocity between parts. The child tends to center on particular aspects of a situation or problem. In Piagetian terms the child is assimilating from the particular to the particular. Moreover, transductive thinking is distorted and irreversible in so far as it is centered on one aspect of a problem and will become logical and give rise to a hierarchy of nestings and reciprocities in so far as decentration makes thought reversible. Growth is manifested in the passage from centration of perception to decentration and from egocentrism of thought to logical reciprocity (Piaget, 1962).

An example of reasoning by transduction is seen in the child's judgments about why an object floats on water. The preoperational child says a large boat floats because it is heavy, a small boat floats because it is light, a raft floats because it is flat, while a needle floats because it is thin (Beard, 1972). It is obvious that the child is not capable of mental comparisons, but instead centers on only one feature at a time. The resulting judgments lack stability and reversibility and the thinking pattern lacks direction juxtaposing successive unrelated explanations.

In summarizing the differences between sensory-motor intelligence and conceptual intelligence, Piaget (1962) relates that 1) sensory-motor intelligence links only perceptions and movements without an overall representation dominating the actions. Sensory-motor thinking functions like a slow motion film representing one static image after another instead of achieving a fusion of the images. 2) sensory-motor intelligence aims at success and not at truth. It finds its satisfaction in the achievement of the practical aims pursued and not in recognition or explanation. It is intelligence which is only 'lived' not thought. 3) It acts only on real objects as such, on the perceptual indices and motor signals and not on the signs, symbols and schemas related to them. 4) It is thus essentially individual and lacks the social dimensions resulting from the use of signs. 5) It is not reversible. Reversibility is defined as the permanent ability of returning to the starting points of the operations in question.

In order to move from sensory-motor intelligence to conceptual thought the child's thinking must be accelerated so that successive actions merge into a mobile whole and the child must be able to move in both directions based on graded classification and seriation of relationships. In other words a system of operations transposing exterior actions into mobile, reversible mental actions is necessary. In addition an inter-individual coordination of these operations ensuring both general reciprocity of points of view and correspondence between the detail of the operations and their results is required. Thought must become socialised and integrated into a common, objective reality (Piaget, 1962).

These requirements are met in the stage of cognitive development known as concrete operations. Piaget (1970) defines operations as:

1. Actions that can be internalized--carried out in thought and executed materially.
2. Reversible.
3. Under the presupposition of conservation.
4. Existing within a structure whereby every operation is related to a system of operations.

It is during this period that a child learns about the hierarchy of classes and can tell the examiner if there are more roses or flowers in a bouquet of mixed flowers. The children of this stage can be expected to line up in order of height (order of succession problems). Also symmetrical relations are understood and a child comprehends the meaning of friend, enemy, and/or partner in a game. Two-way classification is now understood by the concrete operational child. Proof for this is seen in the famous Piagetian experiments with clay whereby the child gradually comes to understand that a ball of clay will retain the same mass no matter the type of shape into which it is rolled (Beard, 1972) .

Finally the stage of formal operations is entered by the child. The child capable of formal thought is capable of accepting assumptions for the sake of argument. He can make a succession of hypotheses which are expressed as propositions and test them, e.g., given a set of colorless liquids, he can systematically mix them to find which two may be combined to produce a change in color. He is capable of propositional thinking and can deal with a multiple (as opposed to a 2 x 2) classification system. He looks for general properties to explain causality (unlike the child attempting to explain how an object floats on water

and attends to only one aspect of the problem). He becomes conscious of his own thinking and deals well with a wide variety of complex relations (Beard, 1972). In summary the individual possessing formal operations is capable of hypothesis testing and unlike his counterparts in the concrete operational stage does not depend on a trial and error procedure. He is seeking an all-encompassing law to explain the problems he encounters. He is able to structure relations between relations (Piaget, 1970).

The power of formal thinking has been characterised by Lovell (1971) as the result of combinatorial ability which makes it possible to analyze reality into a set of possible hypotheses. But combinatorial power is, in turn, secondary to the still more fundamental property of formal thought, namely, the subordination of reality to possibility.

Critical evaluation of Piaget. The most searching questions about Piaget's theory have frequently come from within the Geneva School itself (Cellerier, 1976; Inhelder, 1976). The questions appear to be attempts to push the theory in the direction of present psychological research dealing with information-processing.

An excellent case in point is the work of Barbel Inhelder (1976) who has over the years evolved a unique research style combining the sensitivity of the Piagetian methode clinique with an objectivity and precision favored by American experimentalists (Farham-Diggory, 1976). The result is a type of analysis that draws her Piagetian studies into the information-processing framework.

In reviewing the work of Piaget, Inhelder (1976) notes that the Piagetian structures have been formalized in algebraic form as group-like structures and semilattices for the preformal stages of thought and

as lattices and groups for the formal stage. The purpose of Inhelder's recent work has been to locate the formative mechanisms that can explain the transition from one stage to another and to go beyond the present structural model to a more dynamic model which specifies the self-regulatory mechanisms.

In addition, Inhelder (1976) has found that the relationship between the two abstraction processes of assimilation and accommodation have not been sufficiently studied. In order to learn more about this relationship she posits the necessity of designing learning experiments where one may observe or even induce (over time) some of the crucial moments where something (cognitive) happens. She, like the information-processing theorists, notes that it is necessary to know the interaction between the knowing subject and the objects to be known.

In a somewhat different vein Cellerier (1976) speculates that if Piaget were writing today he might have expressed the regularities he observed in behavior in terms of formalized schemes (so familiar to information-processors) and not in terms of the well-known structures. These systems would be more easily simulated with a computer because they would embody the rulelike components of cognition. But even if Piaget were to write in these terms, one would still be left with the problem of relating the subject's output in terms of observed intuitive concepts and representations as well as of the relationship between schemas. And this would mean a structural theory. Cellerier (1976) finds, moreover, that Piaget's central concepts are not sufficiently specified in order to be programmable. In an attempt to coordinate Piaget's structural approach with an information-processing approach,

one must (Cellerier, 1976):

1. First discover regular relations between selected properties.
2. Express these regularities in terms of operations. This is not an explanation, but is simply recoding under the guise of a physical law, a great number of possible situations. This is stronger than (1) above because the rule allows us to compute what the object will do. The rule then, allows the researcher to extend the reconstructions to all possible experiments.

On the other hand, Cellerier takes issue with those who have said that Piaget disregards process while emphasizing the structure and evolution of concepts. Cellerier points to Piaget's insistent characterization of intelligence as an extension of biological adaptation and of schemes as the organs of this adaptation. Inhelder (1976) also points to Piaget's extensive work on the processes of assimilation and accommodation as the explanatory process whereby the child moves from stage to stage in cognitive development. In addition, Piaget's more recent experiments on conceptualization of schemes and on conflicts between schemes shows a significant trend towards a more detailed observation and representation of processes. Cellerier lauds these first efforts and points now to the necessity of specifying how a child moves through a sequence of stages and of specifying what produces these successions of rules and concepts.

As a result of this information-processing approach, the cyclic chaining of external observations and internal coordinations is emphasized in Piaget's more recent work. New learning experiments are now designed so that researchers observe not the coordination process itself, but a close series of snapshots of its effects: how the schemes

are decomposed; what are the successive recombinations that are regenerated and tried out; what are the guiding constraints their generations are subjected to (Cellerier, 1976).

This extension of Piaget's work leads one to believe that we do not store our representations as permanently organized maps. Rather we actively reconstruct the maps from sets of stored cues whenever we have a particular problem to solve. In the process we use relevant cues we may have accumulated since the last reconstruction. By generating the extension of certain rules, a child can discover new properties of the environment. These newly discovered properties serve to invent new rules that can then be used to discover the new properties. The cycle stops when nothing new is generated. Viewed from this perspective, Piaget's stages are only after-the-fact descriptions of the results of an evolving process. It is at this point--at the completion of a stage--that the stages of Piaget and the cognitive map of the information processor come closest to each other.

Cellerier (1976) cautions, however, that the characterization of cognitive growth as a cyclic chain of external observations and internal coordinations gives rise to an over-simplified picture of development as a parallel evolution of cognitive categories, each composed of a neat filiation of progressively stronger structures. This neat picture is complicated by the discovery that many different schemas and concepts may be applied by the child to the same problems, and that the different cognitive categories seem to evolve at slightly different rates.

The net result is that lateral interactions between precursors appear at the decomposition and recombination level. These interactions

take place between elements that are heterogeneous in two ways:

They originate from different categories

Their degrees of completion are not necessarily the same.

Thus a more dynamic picture of Piaget's stages of development now incorporates vertical relations (intracategory filiations), horizontal ones (intercategory lateral interactions), and oblique ones (interactions between elements of different operatory levels). Such interactions make any simple Guttman Scale of cognitive development an impossibility. Rather our impression is of a mosaic, multifaceted cognitive growth pattern which is dynamic and changing at all times.

Piaget and language. Historically, Piaget's first thinking about children and language was encapsulated in a book The Language and Thought of the Child (1926). In it he questioned children of preschool age and distinguished between egocentric and socialized language in young children. His method was to listen to the children talk and to ask them questions about what they said.

But by his own admission (1969), Piaget largely abandoned this language-based form of investigation when he observed that the nature of sensory-motor intelligence developed before the acquisition of language. Piaget concluded that the roots of thought are to be found in actions which become the basis of reflective abstraction (Piaget, 1970). He concluded that as the child acts upon his environment, the symbolic (or semiotic) functions develop. Symbolic functioning is a general process and can be defined as the capacity to represent reality through the intermediary of signifiers. This general symbolic process encompasses representational thought which in turn encompasses gestur-

ing, sign language, deferred imitation, drawing, painting, modeling and mental imagery. But the most important of these symbolic functions is language.

The distinction between language and other forms of representational thought is that language uses signs (words) which are arbitrary and have no resemblance to that which they represent. Gestures, drawing, and mental imagery do bear a resemblance to what they represent and Piaget refers to these representations as symbols (Piaget, 1962). Language, thus, is intimately linked to cognitive structures but also has a place apart. In much symbolic behavior, the subject can invent his own symbols and his own rules, but to communicate verbally, he has to use the language of his community. Language is not only a means of communicating and representing what is known; it is also an object to be known and a highly complex object at that. On the one hand language belongs to a class of typically human behaviors that imply meaningful representation and are therefore dependent on cognitive functioning (representational thought). On the other hand, language is a productive system that combines meaningful symbols according to rules. Rules must be acquired and applied in talking and understanding and this is in itself a cognitive activity (Sinclair, 1975).

Piaget (1969) speaks of a logic more profound than the logic attached to language and which appears well before the logic of propositions. This is the logic of coordination of actions seen in the concrete operations of classes, relations and numbers together with their parallel infra-logical structures. These operations develop

between the ages of seven and twelve years when thinking is closely tied to the manipulation of objects. During this time verbal comprehension appears separate from concrete reasoning. Piaget concedes that language may be a necessary condition for the achievement of logical structures (at the stage of formal thought), but will not concede that it is a sufficient condition of logical operations. Moreover, Piaget believes (Sinclair-de-Zwart, 1967) that operations go beyond language and that language is incapable of expressing aspects of nonverbal thought.

Despite these warnings, however, Sinclair (1970) warns that any study of language acquisition should take into account Piaget's theory of cognitive development. She notes that certain sentence patterns are not understood and cannot be used appropriately before adequate cognitive development has taken place. She also notes that the difficulty in such studies in determining whether a linguistic formation is hard for the child to understand and/or produce because of its surface structure in a particular language or whether it is difficult because it is an expression that is attached to a basic concept that the child has not yet acquired.

Empirical support for Piaget's theory. Piaget's position has been accepted by a number of researchers in the field. Roger Brown (1973^b) reviewed much of the evidence concerning word order in young children's speech and concluded that Piaget's sensory-motor intelligence may be the cornerstone upon which children begin combining words in the first stages of language development. But he reserved final judgment until more evidence from different languages is available.

Bowerman (1974^a) noted that young children do not use indirect objects in their speech and suggest that this could be accounted for in a Piagetian framework. She notes that in order to produce strings including both a verb and indirect object the child should have at least a rudimentary ability to handle two underlying propositions which show a relationship between a causative action and an effect. She postulates that the reason children do not say sentences like "put hat on" or "come eat pabulum" although they are capable of three word utterances, is that they do not have in mind the two halves of the causative paradigm; an act upon a patient and the change of state or location which the patient undergoes. The young child can express agent, action, patient, effect, but are not ready to join these together in this way because they are not yet capable of making transformations from "come eat" and "eat pabulum" to "come eat pabulum."

Bowerman (1974^a) cautions that the child's presumed awareness of a causal relationship between action and effect should not be directly written into the deep structure representation of the child's early utterances. If this is done, developmental processes which may intervene between cognitive awareness and linguistic structures will be missed.

Slobin (1971) came to much the same conclusion but in reference to the notion of space. Piaget found that the concept of topological space (in, on) is acquired before the concept of Euclidean space (in front of, below, beside), while the most complex spatial relations, (along, through) are acquired last. The same pattern was found in children's language acquisition.

Sinclair-de-Zwart (1967) found language followed thought development among older children. She studied the use of dimensional language and relational terms as it related to conservation and seriation among children in the preoperational and concrete operational stage. She found no difference between these two groups in the comprehension of the tasks, but there were striking differences in the children's expression of language. The children with conservation used differentiated terms for different dimensions. For instance, in describing two different pencils, the conserving child would say that "This one is shorter and thicker, but that one is longer and thinner." But the nonconserving child would state that "This one is big. That one is little."

She found that of children with conservation, 70% used relational terms for the description of different numbers whereas of those children without conservation, 90% used absolute terms. Of children with conservation 80% used differentiated terms to describe different dimensions. Children without conservation either described only one dimension or used separate sentences dealing first with length and then with width. She concluded that there was an observed difference in the use of descriptive patterns between the preoperational and concrete operational children which had a strong association with the ability to conserve and seriate.

In this same experiment the children who could not conserve were later taught the expressions of comparison, differentiation and coordinated description of difference in two dimensions of the type used by conservers in the original experiment. The researchers found great

difficulty in teaching the structures of coordinated description and the use of comparatives although it was easy to teach the use of differentiated terms. But when the children were then examined on the Piagetian questions again, very few children (10%) made progress in achieving conservation or seriation.

She concluded that a distinction must be made between lexical acquisition and the ability to manipulate complex syntactical structures. Syntax appears to be more closely related to operational development than does lexical acquisition, and operation and linguistic development parallel one another. In addition operator-like words (more, less, as much as, none) form a class apart whose correct use is also very closely linked to operativity. She suggests that lack of de-centration and the incapacity to coordinate is the basis for the children's problems not only with the conservation problems, but with the language structuring as well. Ghuman and Girling (1974) replicated the findings of Sinclair.

Peisach (1973) conducted a similar study with more stringent statistical controls. She also found significant correlations between the scores on conservation of quantity and the associated use of dimensional language. She too noted that children used less mature dimensional language on the conservation task than on the language task. She found the hypothesis that comprehension of dimensional language is a necessary but not sufficient condition for the development on conservation was supported for receptive language, but not supported for the expressive use of dimensional language. She also found that comprehension of dimensional terms is a necessary, but not sufficient,

condition for the development of conservation of number as well as continuous quantities. She did note, however, that there was a decrease in the correlation between language measures and conservation as a function of age and socioeconomic status and suggested that this might be related to the importance of other factors related to schooling as the child grew older.

Koff (1972) conducted a similar study, but looked at the concept of more, less and middle-size. She too, found suggestive evidence for a contingent relationship between physical concept and the linguistic comparative. Moreover, there was a virtual non-occurrence of the linguistic structure being present in the absence of a demonstration of the concept.

Hanes (1973) looked at the relationship between performance on Piagetian tasks and the use of function words such as now, because, when, and any. He found a significant inverse relationship between children's performance on conservation and the omission of function words when children were asked to repeat sentences containing function words.

McCauley found (1973) that 'don't' commands without cognitive problems were most frequently comprehended by all children and 'placement' commands without cognitive problems were next most frequently understood commands. But performance on both of these types of commands declined significantly when an additional cognitive problem was introduced. Her findings suggest that the children had mastered the linguistic structures of these commands but that this mastery was dependent on the cognitive content of the sentence. Dimensionality

commands were significantly more difficult for all children regardless of the presence of a cognitive problem. She concluded that linguistic and cognitive skills do not develop independently and that cognition is the developmental basis of language comprehension.

Wiig and Semmel (1974) found significant increases in correct responses to comparative, passive, temporal, spatial and familial relationships during the first five grades, but a stabilization of performance between grades five and eight. They noted that improvements occurred in logico-grammatical sentence comprehension throughout the concrete operational level of development and noted the stabilization of performance during the age period of normal transition from concrete to abstract operations. They also noted that their findings closely paralleled those of Piaget and Inhelder.

The comprehension of the passive construction has also received considerable attention. Beilin and Spontak (1969) investigated the relationship between reversibility on seriation and classification tasks and the comprehension of passive sentences. They found that in kindergarten poor performance on reversibility tasks was associated with poor comprehension of passive sentences. In first grade a higher level of reversibility was found, but comprehension of passive sentences was still poor. In second grade, on the other hand, there was a high correlation between the comprehension of passives and reversibility. They suggested that this might indicate a lag in development such that the cognitive structure for reversibility is established before the language structure for passives can be attained.

Sinclair et al. (1970) tested children's comprehension of the

passive in three languages (French, German, and English). They found that all the children had difficulty with the verb follow. The percentages of successes on different verbs was the same in all three languages and for all age-groups and in all languages there was the same hierarchy of difficulty according to the verb used. Break was easiest for the children, followed by knock down, wash, push and finally follow. They concluded that the striking and unexpected similarity of results in three languages lends plausibility to the hypothesis that a general cognitive factor influences the acquisition process.

Without examining the children's performance on Piagetian tasks, Sinclair hypothesized that the ability to transform active into passive sentences was primarily a function of having attained reversible operations. Children between three and five years of age are incapable of decentering in thought and can see action only from the agent's point of view. The younger child is also incapable of understanding how a sentence may be handled in two different ways (active and passive voice). With the beginning of a capacity to consider an event from two different points of view, success in comprehending the passive construction improves. They concluded that success in understanding the reversible passive sentences is possible only when the child's cognitive development has progressed to the level where the child is capable of considering an event from two different points of view. Sinclair (1971^b) notes that the child begins to reflect about language at the beginning of the concrete operations period and also becomes able to conserve the semantic content of an utterance while changing its form.

Hutson (1971) compared the relationship between the comprehension

of active and passive sentences with class inclusion, conservation of substance and weight, and a sorting test. Class inclusion was found not to be strongly related to syntactical comprehension, but conservation was found to be highly correlated. Hutson concluded that logic may be related in different ways to vocabulary, syntax, and verbal fluency. Syntax (the organization of elements in a sentence) was felt to have an appreciable relationship with logic during this period of development. It was suggested that syntactical competence and conservation both involve the ability to keep simultaneously in mind various aspects of a situation and to coordinate them.

Model III: Language and Thought Are Independently Influenced by Development

Noam Chomsky and his students (especially David McNeill) are most influential in this school of thought. They theorize that because language appears to develop with so little outside encouragement and has many common characteristics across linguistic communities, that language must be innate and could be considered apart from a consideration of cognition. But before reviewing this portion of the theory in depth, some additional background is desirable.

The import of much of N. Chomsky's (1965) work resides in his attempts to construct a mathematical theory of language which contains a finite set of rules capable of generating all of the infinite set of grammatically correct utterances possible in a language and none of the incorrect utterances. The adult user of language learns to distinguish the grammatical from the ungrammatical utterance and this ability is referred to as the linguistic competence of the language user. One's

competence with a language allows the speaker to use the language by relating sounds to meaning within a set of rules. The speaker's entire body of knowledge about the grammatical system is referred to as the user's competence. Performance, on the other hand, is the actual behavior which may be affected by a number of other variables.

Chomsky refers to three levels of grammatical knowledge. These are phonology, syntax, and semantics. Phonology is related to the semantic component by syntax. Put another way, syntax is the system of rules which relates the deep structure (semantics) of language to the surface structure (phonology). Chomsky also makes clear that linguistic theory is concerned primarily with an ideal speaker-listener in a completely homogeneous speech community who knows the language perfectly and is unaffected by such grammatically irrelevant conditions as memory limitations, distractions, etc.

Chomsky and some of his students (McNeil, 1970) have posited an innate language acquisition device (LAD) to account for the rapidity with which language is learned by children. Under such a theory a child needs very little exposure to language in order to learn to speak because the mechanisms for language learning are innate. In addition, Chomsky posits that the learning mechanism by which language is acquired is hypothesis testing. The child tests various structures and waits for feedback from the environment to determine if an utterance is grammatically accurate.

Critical evaluation of Chomsky. Chomsky's position has recently come under fire from Brown and Hanlon (1970) who found that parents

rarely correct grammar in their children's speech. Rather they respond to the truthfulness of an utterance. In addition, Lenneberg (1967) cites the case of a disarthric boy (one who understand language, but cannot speak) who was never corrected, but understood language very well and had even learned to read.

Schlesinger (1975) in reviewing the stand of researchers at the present time found a range of opinions. Bloom (1970) made the cautious admission that the question of how grammar is learned remains to be investigated. McNeill (1970) makes a much more far-reaching conclusion that since deep structures cannot be learned, they must be part of the innate equipment of the child requiring only maturation and a suitable environment to become fully operative.

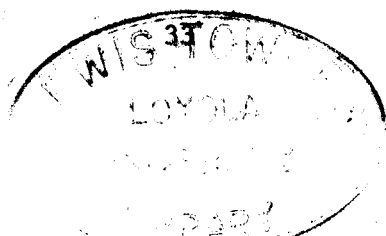
Slobin (1966) was among the first to fault Chomsky's theories. He found that the comprehension of certain sentences could be predicted by taking into account only linguistic factors. But contrary to the thinking of the transformational linguists, syntactically simple negatives took more time to process than the relatively more complex passives. He concluded that psychological factors would have to be included in order to account for the performance of young subjects. Particularly semantic and psychological factors would have to be included with syntax to account for his findings.

Wright (1969) found that passive voice sentences were not as difficult to interpret as the linguists predicted when both sentence and question had the same voice. Wright interpreted this as evidence that listeners do not always transform the sentences after hearing them, and also suggests that people do not normally carry out such

processing as an integral part of understanding all sentences. Moreover, the low error rate in the passive condition (which was expected to be the most difficult condition) shows clearly that the match-mismatch variation has a greater effect on error than does the active-passive variable. It appears clear that people do not necessarily have to transform sentences in order to understand them.

Ivimey (1975) reviewed the research and concluded that contrary to Chomsky's position, children do not approach language acquisition with apriori ideas about what features of language models they hear are important and must be learned. Nor do they know in advance what is locally irrelevant. It appears that they make a set of hypotheses and rules to guide their own utterances. Ivimey objected to Chomsky's assertion that before a sentence can be understood, the listener must first assign to it the correct phrase marker. This is felt to be unnecessary; children initially understand what they have learned. The development of grammatical intuition follows learning.

Bowerman (1973) also faulted Chomsky's thinking as it relates to child language. From her research of American and Finnish children she concluded that the child first operates with semantic concepts and later learns that these semantic relations are rule-governed. Semantic relations create a syntactic mold and semantic relations are cast into it, but not without a certain amount of reinterpretation. She also questions the wisdom of adopting grammars which force the researcher to postulate that certain concepts are functional in the child's competence from the beginning. In addition, she questioned the hierarchical relationships postulated by the transformational grammar people. Particularly



in the language of young children, Bowerman found no evidence for hierarchies.

Bowerman also called into question the prevailing practice of using one set of rules to describe both the production and comprehension of language. While such practice may be applicable to an 'ideal speaker-listener', it is questionable when there is a large discrepancy between what a person can understand and what he can produce as in true of children. Moreover, important regularities are obscured about the way in which a child learns to comprehend and to produce sentences and how these two abilities are related to each other in various stages of development.

Bloom (1970) criticised the psycholinguist's fascination with syntactic structures at the expense of semantic knowledge. By failing to look at the context in which an utterance is used, the psycholinguists failed to note that many of the early two-word utterances might be used by the child to ask/demand/explain different situations. For instance, "mommy sock" might mean, "Mommy get my sock," "This is Mommy's sock," or "Mommy look at the sock." When the context is analyzed there is every indication that the child has an even greater grasp of grammatical relations than was originally thought. The implication is that language is only a manifestation of what is known and perhaps an expression of a broader cognitive structure. (This has been Piaget's and Sinclair's position for some time.)

F. Smith (1975) reviewed the work of Chomsky and questioned whether any grammar will work independently of meaning. There is reason to believe that grammar cannot be regarded as a closed system, unrelated

to any other aspect of thought. Smith points out in addition, that meaning often takes priority over grammar and the determination about whether or not a sentence is grammatical is determined by its meaningfulness. A more recent approach is that of the generative semanticist who argues that the rules of language must be rooted in meaning and related to meaning in all their operations. The syntax that determines the shape of our language is based not on how words can be put together with grammatical rules at the level of surface structure, but on how concepts are related at the deeper level of thought. The meaning of an utterance involves much more than the words spoken; it depends on the entire situation, verbal and nonverbal, in which the utterance is made.

Parallels Between Linguists and Psychologists

Despite the criticisms of Chomsky's work, there are areas of mutual concern between the linguists and the psychologists. Parallels are particularly evident in the work of Piaget and Noam Chomsky. Especially striking is the concept of transformations for both writers. Piaget finds that the most elementary knowledge is based upon transformations which may proceed in two directions; from surface to deep structure and from deep to surface structure. The transformational grammarians use only the latter type of transformation to explain language. Piaget speaks to the relationship between the 'schema' and the structure of the external act. A parallel may be found in Chomsky's concern for deep and surface structure in language. Deep structures for both gross motor and linguistic acts may be seen as relatively stable and possibly as cognitive and linguistic universals. But transformational rules, the derived surface structures and the external acts differ because they are

subject to culture-specific, act-specific and idiosyncratic variables (Moerk, 1975). Piaget (1970) has commented on the similarity between transformational grammar and the operations of intelligence. But he takes issue with Chomsky's assertion that the kernel of reason on which a grammar of language is constructed is innate. Piaget would insist that such questions must be referred to research.

Sinclair (1971^c) has commented extensively upon the parallels between the two. She notes that Piaget has found the child at the sensori-motor stage can order temporally and spatially; he can classify in action (he can use a category of objects for the same action, or apply a category of action-schemas to one object) and he can relate objects and actions to actions. The linguistic equivalents of these are concatenation (linking whole words together) categorization (the major categories of subject, noun phrase, verb phrase, etc.), and functional grammatical relation (subject of, object of). These are the main operations of the base of the syntactic component which characterizes a highly restricted set of elementary structures from which actual sentences are constructed by transformational rules. Sinclair (1971^c) also notes a convergence between the rules of Chomsky and the sensori-motor coordinations of Piaget. In particular recursiveness as the basic factor that explains the potentiality of producing an infinite number of utterances from a finite set of rules has a parallel in the circular reactions (noted by Piaget) of the infant and the embedding of schemas to which they lead has deep-rooted psychological roots. Both men are also nonempiricists. Both deal in underlying structures that can be formalized. Both deal with competence rather than performance.

But they are dissimilar in an important way. In Piaget's work symbolic play, images and gestures, etc. are linked by a common framework, but they do not form a system. Language, by contrast, is structured into a system and although it is a way of representing what is known, it is itself an object to be known. The child has to infer regularities and rules and arrive at an interiorized grammar that will enable him to construct and understand an unlimited number of sentences in the mother tongue.

The points of convergence between the two theories is presently a subject of much discussion with much of the research centering on the use of dimensional language (Sinclair-de-Zwart, 1967; Ghuman and Girling, 1974; Peisach, 1973; Koff, 1972), function words (Hanes, 1973), early language development (R. Brown, 1973; Bloom, 1970; Bowerman, 1973; Slobin, 1971) and the passive construction (Beilin and Spontak, 1969; Sinclair, 1970, 1971^c; Hutson, 1971). All of these writers hypothesized a relationship between thought and language. The conclusions ranged from the cautious admission by Bloom and Hutson that a relationship is obvious but that the direction is still unclear, to the declarations of Sinclair (1975) that language and cognition can be clearly separated in only one sense and that is that intelligence can develop without language, but the reverse is never true.

Carol Chomsky's Linguistic Research

The present fascination with the relationship between thought and language has not always been the case. After the publication of N. Chomsky's Aspects of the Theory of Syntax (1965) the emphasis was on describing language development in children without reference to a

child's environment or his cognitive development which were felt to be extraneous factors unrelated to the ideal speaker-listener of N. Chomsky's theory and the competence/performance distinction he established.

An important example of research carried out within this framework is that of Carol Chomsky (1969, 1972) which investigated the language development of children between the ages of five and ten. Her purpose was to determine the syntactic difficulty of certain utterances and the nature of the language acquisition process by ascertaining which sentences were acquired first and which are acquired later by the child and in this way to determine the syntactic complexity of the structures in question (1969). C. Chomsky also wished to show that unlike popular theory of the time (Menyuk, 1963, 1969), syntactic development was not completed by the time the child reached five years of age. C. Chomsky's research did overturn much of this thinking because she showed that there were a number of structures which were very difficult for children even up to the age of ten years. Today's writers assure us that sentences which involve transformation of the subject-verb-object order, passive, promise and easy to see, and causative and conjunctive elements continue to be difficult for children through adolescence (Sanders, 1971; Menyuk, 1971; Noval, 1974).

In her research C. Chomsky postulated (1969) that structures which would be acquired late were those which:

1. Deviate from widely established patterns in the language.
2. Have a surface structure that is relatively inexplicit with respect to grammatical relationships.

3. The linguist finds it difficult to incorporate into a thorough description.

Difficulty in interpreting grammatical relationships is determined by the presence of certain conditions. These are:

- A. The true grammatical relations which hold among the words in a sentence are not expressed directly in the surface structure.
- B. The syntactic structure associated with a particular word is at variance with a general pattern in the language.
- C. A conflict exists between two of the potential syntactic structures associated with a particular verb.
- D. Restrictions on a grammatical operation apply under certain limited conditions only (p. 6-8).

An example where true grammatical relations are not expressed in the surface structure (A) is seen in the juxtaposition of:

- a. John is easy to see.
- b. John is eager to see.

The listener needs more complex syntactic knowledge to interpret (a) above. The easy to see sentence may be interpreted that it is easy to see John or that John is easily seen. Unlike eager to see which follows a recognized pattern (John is happy to see, John is quick to see, John is trying to see, etc.) the listener must resolve the surface structure ambiguity by a more thorough analysis of the intended deep structure (meaning) of the sentence.

- B. The syntactic structure associated with a particular word is at variance with a general pattern in the language.

If one looks at the sentence:

John told Bill to leave

one finds it to be a command verb which is consistent with the general

pattern in the English language and the complement verb told relates to the main clause object (Bill).

But in a sentence using a request verb such as:

John ^{asked}_{begged} Bill to leave

the complement verb may be interpreted as relating to the main clause subject or object. Thus John may be seen as begging to leave or as trying to persuade Bill to leave. Because of the possible conflicting interpretations, request verbs should be more difficult to interpret than command verbs.

Finally the verb promise is in a different class. In the sentence: "John promised Bill to leave", only John can be interpreted as leaving. In this sentence the complement verb relates only to the main clause subject.

C. Chomsky hypothesized that all of the sentences (told, asked, promised) could be explained by what she termed the Minimal Distance Principle (MDP) which states that the implicit subject of the complement verb is the noun phrase most closely preceding it. Verbs like tell (as well as persuade, encourage, order, permit, allow, urge, etc.) follow the rule consistently and should be acquired first. A sentence using promise consistently violates the principle and so should be acquired next. But request verbs like asked and begged, when used in violation of the MDP should be acquired later because they are an inconsistent exception to the rule.

Such inconsistent exceptions to the rule (ask, beg) are examples of (C) above which states that:

A conflict exists between two of the potential syntactic structures associated with a particular verb.

She noted that to interpret this type sentence, the listener must consider the lexical character of the main verb and the greater the variety of structural configurations which may be associated with the main verb, the more complicated the sentences should be.

Chomsky's study gave support for her hypothesis. Easy to see tended to be acquired after promise and the hypothesized increase in ability to deal with the Minimal Distance Principal was confirmed. But from this early work it was not possible to show a consistent developmental hierarchy. Rather, it appeared more likely that a child who succeeded on one construction tended to succeed with all of the others as well (C. Chomsky, 1969, p. 117).

Carol Chomsky's original research generated a great deal of additional research and much questioning about technique. Sanders (1971) found that 21 of 40 adults had difficulty with the ask-tell comprehension problems like those posed by Chomsky and concluded that terms like adult English, adult language, or adult grammar were misleading because syntactic forms attributed to adults are not always understood by the adult population. She also found that the errors were not random, but that 80% of the errors were in incorrect construction of the verb ask.

Cromer (1970) looked in a more detailed fashion at the easy to see construction. His findings generally upheld those of C. Chomsky, but he asked if the problem of a subject/object interpretation of a sentence in "John is easy to see" could be more accurately characterized in Piagetian terms as a difficulty in moving from egocentric thought to decentration in thinking. A child might partly decenter to the doll's viewpoint and find the doll hard to see since others are believed by children to be

unable to see when the object's eyes are covered. Or a young child might believe that it is necessary to see the eyes of another person in order to feel that it is easy to see them. He asked that if progressively less and less of the doll were covered by a cloth, at what point would one change to saying that the doll is "easy to see".

In his research he varied the nature of the adjective and considered them to be of three types:

1. Adjectives like 'glad' (John is glad to see) in which the surface and deep subjects coincide and the subject is doing the seeing.
2. Adjectives like easy and hard (John is easy to see, John is hard to see) which indicate that someone other than the surface subject is the actor. In this case the adjective relates to the object.
3. Adjectives like nice or bad (John is nice to see, John is bad to see) in which the adjective is ambiguous and can be interpreted as relating to either the subject or object.

Cromer found a developmental hierarchy whereby the child first interpreted the sentences on the basis of a primitive rule which identified the deep subject as being the surface subject. An intermediate group of children gave mixed answers, with some sentences correctly interpreted and others incorrectly interpreted. The most advanced group answered correctly on a consistent basis and knew when to abandon the subject adjective and give the object adjective interpretation instead.

Cromer also found that a very inconsistent picture of the results was obtained when answers were compared only with the child's chronological age. But a clearer picture emerged using the Peabody Picture Vocabulary Test to divide the children. All children below a mental age

of 5:7 were either primitive rule users or in the intermediate stage, but predominantly the former. All children with a mental age between 5:9 and 6:6 were in the intermediate stage. Almost all children above 6:8 answered the questions in a consistently correct fashion. Cromer found that individual words were not troublesome to the children. But rather the difficulty was in learning to break the old rule which consistently matched surface structure to deep structure. In addition, Cromer posed the interesting (and at that time unique) question of "why" and "how" children move from one rule to another.

In a different study Kessel (1970), unlike Chomsky, studied the eager to see structure in which deep and surface structures are the same. Using a simulated hide-and-seek game, he asked the child to respond to eight declarative sentences. Half were of the form "Lucy was sure to see," and half were of the form "Lucy was impossible to see." Like Cromer (above) he also characterized the children as having little difficulty with sentences in which the deep and surface structure subjects are the same. But he found that children did have problems when surface and deep structure subjects were not congruent. He found errors made in this type of sentence to be manifested in the assignment of the incorrect subject to the infinitive verb. He also argued that the blindfold utilized in C. Chomsky's study was an unnecessarily distracting cue and the poor performance of the children on this task may be attributed to the fact that younger children did not recognize the blindfold as irrelevant to the question, "Is the doll easy to see?"

Kessel's results correlated highly with those of Chomsky (1969). The major difference was that Kessel's subjects tended to achieve

various stages at somewhat earlier ages. Kessel, like Carol Chomsky, found an invariant and non-transitive sequence in the children's acquisition of ask and tell.

Cambon and Sinclair (1973) also reviewed and extended the easy to see research using a Piagetian framework. They hypothesized and found support for their assumption that there is a qualitative difference in the reasons given by an eight year old child who says a doll is easy to see and those reasons given by a six or seven year old child. The younger child has difficulty decentering. He supposes that the agent of the verb "to see" can only be himself. A later regression occurs when the child is learning the grammatical relationships necessary to interpret a question on both a semantic and syntactic level. At one moment the child puts himself in place of the doll who is blindfolded and considers the difficulty of the action of seeing while one's eyes are shut. At another moment he focuses on the contrast between visible and invisible parts of the doll without being able to coordinate the two different points of view. Cognitive conflict erupts between seeing somebody who can be seen but cannot see and this is a step forward from the attitude of the younger child who simply considers that if there is seeing to be done, it is he himself who does it. The oscillation between the two viewpoints gives rise to conflicting subject-object answers. For the oldest subjects there is a cognitive resolution of the conflict and a linguistic resolution. Older children understand that meanings can be expressed in different ways.

And, indeed, Cambon and Sinclair did find an irregular increase in the number of correct responses with age. There was a decrease in the

number of correct responses between five and six years, followed by an increase in correct responses at seven and eight years. They concluded that, in line with Piaget's studies, the child is first capable of applying a specific thought pattern to a limited area of problems and as the cognitive processes develop, the child's thought patterns are encompassing ever-widening contents. This creates a conflict between the new and old ways of structuring language, and a temporary regression in syntactic competence is the result. But Cambon and Sinclair stopped short of comparing the children on Piagetian tasks. Although they found an interesting curvilinear pattern in language development, there was no attempt to correlate this with the acquisition of conservation, seriation, etc.

Possibly as a result of the discussion which followed the publication of her study in 1969, Carol Chomsky enlarged upon her original study (1972). In this later study she initially tested the children on nine different sentence structures and found that five* of these were acquired by the children in an invariant sequence and formed a nearly perfect Guttman Scale with only five responses of 100 not falling into the intransitive pattern.

Unlike the first study (1969) when C. Chomsky explained the structures to be tested in terms of linguistic rules, this study (1972) notes that there is no experimental work available to determine why easy to see has been such a stable indicator of grammatical development. Rather it was included as the first structure simply because it is such a stable measure of linguistic growth. In addition, no blindfold was used to

*Of the other four discarded, some were too easy (known by all the children), others were too difficult (known by only a few of the children) and others elicited only scattered responses irrelevant to the study.

distract the children.

On the other hand, promise and ask are included on theoretical grounds (discussed earlier) and were felt to demonstrate the MDP.

Finally, two other sentences which asked the child to determine the missing verb referent were added. These are:

- a. Mother scolded Gloria for answering the phone,
and I would have done the same.
- b. Mother scolded Gloria for answering the phone,
although I would have done the same.

Chomsky notes that she was happily surprised that these two sentences turned out to be stable indicators. During the planning stage, the although sentences were anticipated to be the difficult ones, and and had been included only for contrast. But both sentences were difficult for children to interpret and were scored as follows. In the although sentences, the child had to choose the referent of done the same, while at the same time choosing the far candidate verb for and. In other words sentence (a) would be scored correct if interpreted without error. But sentence (b) would be scored as correct only if both (a) and (b) were interpreted without errors.

Chomsky also extended her study by comparing the children's responses with scores on intelligence tests (WISC and WPPSI), socioeconomic status, and reading exposure. Not surprisingly she found a strong correlation between syntax and all these measures, and the relationship between linguistic and intelligence measures was significant at the .001 level.

Unlike her earlier research (1969), Chomsky found the children able to interpret "John is easy to see," before any of the other structures. Chomsky attributed this finding to the change in experimental

technique--the removal of the blindfold.

Promise was acquired next, followed by ask. This was in line with the findings of the earlier study and was felt to support the MDP hypothesis. Last to be acquired was and, followed by although. Chomsky's findings are unique because she found a perfect Guttman Scale with only five deviations per 100 responses (see below)

Developmental Stages in Children's Acquisition in
Five Test Structures

	easy to see	promise	ask	and	although
STAGE 1: 5:9-7:1	—	—	—	—	—
STAGE 2: 5:9-9:5	+	—	—	—	—
STAGE 3: 6:1-9:9	+	+	—	—	—
STAGE 4: 7:4-10	+	+	+	+	—
STAGE 5: 7:6-9:9	+	+	+	+	+

+ Success
— Failure

Chomsky, 1972, p. 19.

Chomsky notes that all of the sentences require the listener to fill in a missing item in order to understand the sentence. All of the surface forms lack a noun phrase or a verb phrase and the listener must know what to fill in to make a correct interpretation. The listener is given only the surface form and must recreate the base structures. In addition all five sentences require the subject to abandon the rule which says choose the nearest preceding candidate. So the child must be freed from this entrenched constraint to successfully complete the task.

Much of Chomsky's discussion of the need for transformation between base and surface structures was not seen in her earlier studies but may well be a response to the criticism of Kessel (1970) and Cromer (1970) cited earlier. In addition Chomsky has compared her findings with other factors--particularly intelligence. This may reflect Cromer's findings that the easy to see structure was closely tied to performance on the vocabulary test. Chomsky also makes it clear that she feels that her present findings "reflect an underlying developmental sequence (p. 25)." But she leaves untouched Cromer's (1970) question about the why and how of movement from one level of syntactic complexity to the next.

However, there is also support in the research (Cambon and Sinclair, 1973; Sinclair et al., 1970; Cromer, 1970; Kessel, 1970) for a Piagetian interpretation to this problem. A particular example is the conservation task in which the child understands that the amount of a substance is unchanged even though the shape changes. In a similar way the child learns that meaning may be preserved while the surface structure is manipulated to derive the deep structure (meaning). If the C. Chomsky structures are viewed in this light, there appears to be a progression from the preoperational egocentric thought to the decentred thought characteristic of the concrete operational stage. Cognitive difficulty increases as a function of sentence length, dissimilarity between surface structures used by the examiner and those expected of the child, and/or the number of concepts which the child must hold constant while manipulating the linguistic structure.

C. Chomsky's (1972) studies show that each of these sentences is

very closely tied to intelligence as interpreted on the Wechsler Scales. It may also be true that despite Piaget's assertion that there is little relation between the two domains of verbal comprehension and concrete reasoning at this stage (1969), that certain levels of cognitive development (especially conservation) are indeed necessary for the comprehension of some syntactic structures. This position has engendered increased support (Slobin, 1971; Koff, 1972; McCauley, 1973; Wiig and Semmel, 1974; Sinclair-de-Zwart, 1967; Sinclair-de-Zwart, 1970; Beilin, 1975; Bloom, 1970; Bowerman, 1974^b; Wright, 1969; Peisach, 1973).

Carol Chomsky's (1972) work offers a unique opportunity to further our understanding of the relationship between cognition and language. She has found a close correlation between linguistic structures and the established concept of psychometric intelligence. But it is still unclear how this acquisition process relates to the Piagetian stages.

Need For Further Study

Given that characteristics similar to those found in syntactic development also describe the development of cognitive structures in Piagetian theory, and that the "active, transformational aspect of thinking within the context of a structure, increasing in scope and internal complexity is the unifying link between the earliest manifestations of intelligent thinking (preoperational action-schemas) and mature logical thinking (formal operations) (Furth, 1967, p. 820)," it is reasonable to assume that cognitive structures do not develop in isolation, one from the other. Rather the relationships develop between structures; and the nature of these relationships between cognitive structures and linguistic structures needs to be investigated.

It is also clear that research which has attempted to evaluate the language/cognition relationship has foundered in the ambiguity of the question of which comes first (language or cognition) or whether the abilities develop independently under the influence of age because of methodological difficulties. There has been much speculation as noted above about the relationship between cognition as defined by Piaget and syntax. But aside from the work of Hutson (1971) and Sinclair-de-Zwart (1967). It is apparent that a newer statistical approach is needed.

Summary

In summary the schools of thought regarding the interrelationship of the development of language and thought may be characterised as:

Language influences thought
Thought influences language
Language and thought are independently influenced
by development

The first school, language influences thought, has been associated with Vygotsky and Bruner. Bruner, especially, has felt that the syntax utilized by a child helps to structure and direct thought in a hierarchical way. He substantiated his theorizing with a number of studies (1966) which compared the relationship of language to cognitive development.

The second theoretical school, thought influences language, has been associated with Piaget. A large body of literature and research is also associated with and appears to substantiate the Piagetian approach. But much of this research appears to be more concerned with the semantic aspects of language rather than the syntactic aspects which were the focus

of much of Bruner's work. Particularly forceful in supporting the Genevan School has been Hermine Sinclair's work. Much of the research which substantiates the Piagetian position is the outgrowth and replication of the original work of Sinclair.

Noam Chomsky's theories about generative grammar are the basis for the theory that language and thought are independent. Chomsky's interest in the speaker's syntactic competence without regard to the meaning of an utterance is interpreted here to mean that syntax may develop without extensive consideration given to the psychological realities encountered by the child. Criticism has related to attempts to study syntax apart from a study of the psychological coordinations of development and the semantic considerations involved in understanding language.

Because much of the research in these areas utilized simplistic statistical tools, there appears to be a need for a study which could compare the areas of cognitive and syntactic development in terms of these theoretical schools. In addition, the majority of the research in this area has centered on preschool children. It would be advantageous to carry on the research to children older than the age of five and to empirically measure the development in the two areas of cognition and language.

METHOD

Models

Model I. Language influences thought ($\text{Age} \rightarrow \text{Syntax} \rightarrow \text{Thought}$)
 Model II. Thought influences language ($\text{Age} \rightarrow \text{Thought} \rightarrow \text{Syntax}$)
 Model III. Language and thought are independently influenced
 by development ($\text{Age} \begin{matrix} \nearrow \text{Thought} \\ \searrow \text{Syntax} \end{matrix}$)

1. Conservation
2. Seriation
3. Class inclusion

In each instance the Piagetian task was compared with performance on the syntactic tasks as derived from the work of Carol Chomsky (1972).

Subjects

The children who were evaluated were student volunteers selected from Infant Jesus School in Flossmoor, Illinois. This is a parochial school with an enrollment of 600 children in grades one through eight. The community in which the school is located is affluent* and most of the children were from the white upper middle class. Eight boys and eight girls were randomly selected at each of five age levels: 6, 7, 8, 9, and 10. When more than the required number of subjects were available as subjects at a particular age level, names were randomly drawn to determine participation.

Procedure

Materials. Because C. Chomsky (1972) indicated that when children answered one syntax question correctly, all like questions were also answered correctly, the syntax tasks for promise and ask constructions were condensed versions of those developed and refined in the original study (C. Chomsky, 1972). The condensed version used here differed only in the number of sentences included. For all of the other syntax tasks, the questions are the same as those used in the 1972 study. A total of nineteen sentences were used to evaluate the children and five different structures were under consideration (easy to see (3), promise (5), ask (7), and (2), although (2). In addition nine demonstration and sample questions were used to familiarize the

*Initially socioeconomic status was expected to be included in the analysis. But when socioeconomic status was found to be uncorrelated with any of the variables, it was excluded from further statistical manipulation. The researcher suspects that in this instance, the population was too homogeneous for SES to be a differentiating variable.

children with vocabulary involved in the syntactic constructions. The sentences used are presented in Appendix A. Scoring criteria appear in Appendix C.

Prior to collecting the data for the study, a pilot study of ten children was made. This was done to determine the appropriateness of the syntax questions and their relative difficulty for the children.

Cognitive development was assessed in terms of conservation, seriation, and class inclusion. The format for the Piagetian tasks used to evaluate conservation were chosen because the questions were phrased in terms of very simple linguistic rules. They were taken largely from the work of Cahoon (1974), Elkind (1969), and Uzgiris (1969), and evaluated four conservation levels (number, 16 questions; substance, 16 questions; weight, 12 questions; and volume, 12 questions). Appendix B presents the test in its entirety.

Although the children were asked to justify their answers for each of the conservation tasks, the justification data was not used in the statistical analysis. It was felt that inclusion of such material loaded the cognitive task with a heavy verbal component and would make the interpretation of the results difficult. In order to determine the criteria for the conservation tasks, a child had to make 2 of 3 correct yes/no responses to the questions at each of the conservation (number, substance, weight, volume) levels. One point was given for each criterion response and the range of scores was thus 0 to 4. See Appendix D for further scoring detail.

Seriation questions and procedures were taken largely from the works of Wohlwill (1966) and Inhelder and Piaget (1964) and were

evaluated on the basis of how long it took the child to complete the task (see Appendix B). The children were evaluated in two ways:

1. Time taken to correctly order 8 straws.
2. Time taken to insert 2 additional straws into the existing series.

Because virtually all of the children were able to complete the task if given enough time, the criteria in this test was speed of response. A frequency distribution was made of the number of seconds it took for the children to complete the tasks and on the basis of this information the subjects were scored 0, 1 or 2 on each task where natural breaks occurred in the frequency distribution. These two scores were then summed to derive a total score. Appendix D contains the specific timing criteria.

Ten class inclusion questions were used (Cahoon, 1974). Again, however, the verbal justification questions were disregarded in the statistical manipulations because it was felt that the overlap with the language questions would produce ambiguous results. For this reason, this task was evaluated on only one level which was a simple yes/no answer to the first of the class inclusion questions in each of the categories (see Appendix B). The items were presented as line drawings pasted on 18" x 30" sheets of cardboard and included the following categories: ball players, baseball and football; things that fly, butterflies and airplanes; flowers, roses and daisies; fruits, strawberries and bananas; animals, dogs and horses. Initially it was felt that some of the categories might prove more difficult than others. But this was not the case. The criteria was how many questions were answered correctly by each child and further detail is in Appendix D.

stimulus questions were presented orally by the examiner and the children's responses were recorded on score sheets. In addition, the children's responses to the linguistic questions were recorded on a cassette tape player. In every instance the examiner was the author. The response tapes for syntax were scored independently by a trained assistant and in the rare instance where the author's scores differed from those of the assistant, a third opinion was attained from a certified speech and language pathologist familiar with children of this age.

Design and Analysis

Preliminary analysis. Because Carol Chomsky had found a Guttman Scale in her 1972 study, the first analytic attempts were made in the hope of replicating those findings. This was not the case in the present study. I found non-significant evidence for a Guttman Scale. Consequently it was necessary to eliminate the and syntactic structure from the analysis of the language portion of the study.

Rationale for use of path analysis. It has been difficult to compare stages of cognitive development with stages of linguistic development. Methodological (statistical) problems seem to predominate in these attempts. That few concrete results have been produced is evidenced by the discussion in Chapter II of the differences of opinion about whether thought influences language or whether the reverse is true or whether the two are separately related to development. In reviewing the recent research, one finds that the statistics which have been used are primarily a comparison of percentages and means (Elkind, 1961; Uzgiris, 1964; Hutson, 1971; Tenezakis, 1975) or simple correlations,

t-tests, or analyses of variance (Hutson, 1971; Peisach, 1973). None of these more conventional statistical methods appear to shed light on the controversy. A method of analysis which proved valuable to these kinds of questions was path analysis.

Path analysis is primarily a method of decomposing and interpreting linear relationships among a set of variables. In this way one may look at underlying relationships and paths of influences (Asher, 1976) and estimate the relative importance of alternate paths of influence.

One must be cautioned, however, that path analysis is not a procedure for demonstrating causality (Nie, et. al., 1975). Rather it is a method for tracing out the implications of a set of causal assumptions. With this method, a model is developed by eliminating relationships which the researcher is confident do not exist (for empirical or theoretical reasons) and retaining those models which could not be eliminated (Heise, 1975). In this manner a weak causal order may be established.

Weak causal order is not to be understood as causality in the layman's terms. Rather it may be defined as: X_1 is a cause of X_0 if and only if X_0 can be changed by manipulating X_1 and X_1 alone. The notion of causation here implies prediction of a particular kind. It implies the notion of possible manipulation. Purely statistical or mathematical predictions do not imply the notion of producing changes and are excluded by this definition. In addition, the manipulation of X_1 alone does not imply that all the other causes of X_0 are controlled or held constant. If X_1 is alone manipulated or changed, it will bring about changes in many other variables that are affected by X_1 . Changes

induced by X_1 may in turn affect X_0 (Nie, et. al., 1975). Finally it is assumed that the reverse causal system will not hold true. That is, that X_0 is not changed by X_1 (Heise, 1975).

Stated in mathematical terms, estimates of the main path coefficients are obtained when one regresses (using linear regression analysis) each endogenous variable on those variables that directly impinge on it (Asher, 1976). The assumptions in path analysis are:

1. A weak causal order among the variables is known or hypothesized. For example, age is known to influence language and cognition.
2. The relationship among the variables are causally closed. This assumption is valid because age cannot be influenced by either language or cognition.
3. An exogenous* variable (such as age) is unaffected by other variables.
4. The residual variables--the unaccounted for variation in the variable--are uncorrelated with the endogenous* variable.
5. The residual variables are correlated with the exogenous* variable.

Researchers using path analysis have not in the past used age as an exogenous variable, nor have they used this technique with cross-sectional data as was the case in the present study. However, none of the assumptions would be violated with the present approach using cross-sectional data or by using age as an exogeneous variable. Thus it appears appropriate to utilize path analysis in the present study.

However, it is vitally important in using path analysis that one have a good model (Nie, et. al., 1975; Duncan, 1975) against which the

*Exogenous variables are those unaffected by any of the dependent variables. An example of exogenous variables would be age and sex. An endogenous variable is one which is affected by situational factors. Examples are language and cognition.

statistics may be matched. This is true in the present study. The three much discussed models have been presented in the foregoing discussion. They are:

- Model I Language influences thought
- Model II Thought influences language
- Model III Language and thought are independently
 influenced by development.

Analysis. Utilizing path analysis, the above models were tested with the Piagetian tasks of conservation, seriation and class inclusion and compared with syntactic development using the five structures proposed by Chomsky (1972).

Analyses were based upon two basic equations:

$$P = b_{ps}S + b_{pa}A$$

$$S = b_{sp}P + b_{sa}A$$

where:
 S=syntax score in standardized form
 P=piagetian task score in standardized form
 A=age score in standardized form
 b=the beta weights in the corresponding equation

These models may be presented schematically as follows:

Model I: Language influences thought leads to a schematic representation as follows: Age \longrightarrow Syntax \longrightarrow Piagetian task. In this case the following regression equation would hold true: $P = b_{ps}S$. In effect this means that using the equation $P = b_{ps}S + b_{pa}A$, the model would be rejected if either $b_{pa} = 0$ or $b_{ps} \neq 0$.

Model II Thought influences language leads to a schematic representation which is: Age \longrightarrow Piagetian task \longrightarrow Syntax where the following regression equation should hold true: $S = b_{sp}P$. In effect this means that using the equation $S = b_{sp}P + b_{sa}A$, this model would be rejected if $b_{sa} = 0$ or $b_{sp} \neq 0$.

Model III: Language and thought are separately influenced by development was schematically represented by Age ^{Piagetian task} ^{Syntax} where the following regression equation should hold true: $P = b_{sa}A$ and $S = b_{pa}A$. In effect this means that using the equations $P = b_{ps}S + b_{pa}A$ and $S = b_{sp}P + b_{sa}A$, this model would be rejected if $b_{ps} \neq 0$ or $b_{sp} \neq 0$ or $b_{ca} = 0$ or $b_{sa} = 0$.

Each of these basic models described above was separately tested for each of the three Piagetian tasks (conservation, seriation, and class inclusion). By taking into account these partial results, a global model was then derived which incorporated the exogenous variables and endogenous variables. The global model was further restricted by the following assumptions:

- a. Only recursive models were considered. In other words the arrows are assumed to go in only one direction. Language and cognition might be separately influenced by age or one might influence the other, but the possibility of their being mutually influential upon each other was excluded as a possibility.
- b. Exogenous and residual (the unaccounted-for variation in the variable) variables were assumed to be uncorrelated.
- c. A weak causal order among the variables was hypothesized. Age was postulated as the primary influence on both language and cognition.
- d. The exogenous variables (age and sex) were known to be unaffected by other variables.

Variables. The variables in this study are described as either endogenous variables or exogenous variables. The exogenous variables are defined as those which are known to be unaffected by other variables. Age is the major exogenous variable and was used to develop the basic

three models. The second exogenous variable is sex. It was taken into account in developing a global model in the latter stages of the statistical manipulation. The endogenous variables, defined as those which are influenced by the situation were the Piagetian tasks of conservation, seriation, and class inclusion, and syntax as developed by Chomsky.

In distinguishing between cognitive and syntactic skills, the present study adhered closely to definitions developed in previous research about syntax (C. Chomsky, 1969, 1972; N. Chomsky, 1965) and cognition (Cahoon, 1974; Elkind, 1969; Uzgiris, 1969; Inhelder and Piaget, 1964; Wohlwill, 1966). The exception to this practice as noted earlier was the elimination of a verbal justification in the conservation and class inclusion section. Rather only a correct yes/no response was required to meet the passing criteria. In other words, the important Piagetian question, "Why do you think so?" was eliminated in determining whether a subject's response met criteria. It was felt that this was necessary to avoid unduly intermingling the areas of language and cognition. Inclusion of questions in the cognition portions of the tests was based upon the simplicity of the questions in terms of the linguistic code.

CHAPTER IV

RESULTS

The basic model of language and thought development was developed using the following variables: seriation, conservation and class inclusion for the Piagetian tasks; the sentences derived from the work of C. Chomsky (1972) for the syntactic tasks; and age and sex. The Pearson product-moment correlation coefficient was calculated for each pair of variables forming the following inter-correlation matrix.

Table I

Pearson Product Moment and Point Biserial Correlation Coefficients for each pair of variables

	<u>Age</u>	<u>Sex</u>	<u>Verb</u>	<u>Conservation</u>	<u>Seriation</u>
Sex	.0358 <u>s=.377</u>				
Verb	.5561 <u>s=.001</u>	.2321 <u>s=.020</u>			
Conser- vation	.1746 <u>s=.062</u>	-.0405 <u>s=.361</u>	.2991 <u>s=.004</u>		
Seriation	.5020 <u>s=.001</u>	.0879 <u>s=.220</u>	.4029 <u>s=.001</u>	.0956 <u>s=.201</u>	
Class Inclusion	.5198 <u>s=.001</u>	-.0295 <u>s=.398</u>	.3647 <u>s=.001</u>	.2891 <u>s=.005</u>	.1236 <u>s=.139</u>

From the computation of these correlational statistics, it was then possible to test the three models for each of the three Piagetian measures (conservation, class inclusion, and seriation.) The three models are:

1. Model I Language influences thought
2. Model II Thought influences language
3. Model III Thought and language are independently influenced by development.

The two regression equations necessary to test the three competing models for each of the Piagetian tasks were: (Duncan 1975)

$$P = b_{ps}S + b_{pa}A$$

$$S = b_{sp}P + b_{sa}A$$

where A = age

P = Piagetian task

S = Syntax

The reader should also note that each of the beta weights used on the following pages was derived using a multiple regression analysis and tested for significance using an F-ratio statistic. These beta coefficients presuppose expression of all variables as standard scores.

Conservation

The first Piagetian task to be compared with language was conservation. When the two regression equations (above) were calculated for the conservation (P_1) tasks, the following beta coefficients were derived in a multiple regression analysis:

$b_{p_1s} = .29$	$b_{sp_1} = .21$	$b_{p_1a} = .01$	$b_{sa} = .52$
$F = 4.93$	$F = 4.93$	$F = .008$	$F = 30.676$
$p < .05$	N.S.	N.S.	$p < .01$

Thus the two regression equations which were derived were:

$$P_1 = .29S + .01A$$

$$S = .29P_1 + .52A$$

Model I. For Model I, represented schematically as Age \longrightarrow Syntax \longrightarrow Conservation, the following regression equation would hold

true: $P_1 = b_{p1s}S$. This means that using the equation: $P_1 = b_{p1s}S + b_{p1a}A$, Model I would be rejected if $b_{p1a} \neq 0$ or $b_{p1s} = 0$. When the beta coefficients were tested against the F-ratio statistic, it was found that b_{p1a} was not significantly different from zero and b_{p1s} was significantly different from zero so it was not possible to reject Model I.

Model II. The next test for significance was made for Model II (conservation influences thought) which may be represented schematically as Age \longrightarrow Conservation \longrightarrow Syntax. For Model II the appropriate regression equation is $S = b_{sp1}P_1$ which implies that using the equation $S = b_{sp1}P_1 + b_{sa}A$, the model would be rejected if $b_{sa} \neq 0$ or $b_{sp1} = 0$. When tested for significance, it was found that b_{sa} was significantly different from zero and b_{sp1} was not. Therefore Model II was rejected.

Model III. Model III was one which hypothesized that development independently influences conservation and syntax (Age $\begin{matrix} \nearrow \text{Conservation} \\ \searrow \text{Syntax} \end{matrix}$) where the following regression equations should hold true: $P_1 = b_{p1s}S + b_{p1a}A$ and $S = b_{sa}A$, which means that in the equations, $P_1 = b_{p1s}S + b_{p1a}A$ and $S = b_{sp1}P_1 + b_{sa}A$, Model III would be rejected if $b_{p1s} \neq 0$ or $b_{sp1} \neq 0$ or $b_{p1a} = 0$ or $b_{sa} = 0$. When beta coefficients were measured using the F-ratio statistic, it was found that b_{p1s} and b_{sa} were significantly different from zero while b_{sp1} and b_{p1a} were not, so the model was rejected.

Seriation

The second Piagetian task, seriation, (P)₂ made use of the same procedures and models to evaluate the relationship between seriation (P)₂ and language. Again the four beta coefficients necessary to

calculate the regression equations were computed in a multiple regression analysis. They were:

$b_{p_2s} = .18$	$b_{sp_2} = .17$	$b_{p_2a} = .40$	$b_{sa} = .47$
$F = 2.321$	$F = 2.321$	$F = 11.714$	$F = 18.974$
N.S.	N.S.	$p < .01$	$p < .01$

Thus the two regression equations derived were:

$$P = .18S + .40A$$

$$S = .17P + .47A$$

Model I. Model I, language influences seriation, may be represented schematically as Age \longrightarrow Syntax \longrightarrow Seriation where the regression equation $P = b_{p_2s} S$ should hold true if the model is appropriate. In effect this means that using the equation $P = b_{p_2s} S = b_{p_2a} A$, Model I would be rejected if $b_{p_2a} \neq 0$ or $b_{p_2s} = 0$. In a test of significance using the F-ratio statistic, it was found that b_{p_2a} was significantly greater than zero and b_{p_2s} was not. So Model I was rejected.

Model II. When Model II, seriation influences language was tested, a similar pattern was found. The schematic representation of Model II, Age \longrightarrow Seriation \longrightarrow Syntax was denoted by the regression equation $S = b_{sp_2} P$ which implies that using the equation $S = b_{sp_2} P + b_{sa} A$, the model would be rejected if $b_{sa} \neq 0$ or $b_{sp_2} = 0$. When Model II was tested, it was rejected because b_{sa} was significantly greater than zero while b_{sp_2} was not.

Model III. The only model which could not be rejected was Model III, which postulated that language and seriation are independently influenced by development. The schematic representation of this model, Age $\begin{matrix} \nearrow \text{Seriation} \\ \searrow \text{Syntax} \end{matrix}$ implies the two regression equations which are: $P = b_{p_2a} A$ and $S = b_{p_2a} A$. In turn these regression equations mean that using the

equations $P = \frac{b}{2} \frac{P_2}{P_2^s} S + \frac{b}{P_2^a} A$ and $S = \frac{b}{sp_2} P_2 + \frac{b}{sa} A$, Model III would be rejected if $\frac{b}{P_2^s} \neq 0$ or $\frac{b}{sp_2} \neq 0$ or $\frac{b}{P_2^a} = 0$ or $\frac{b}{sa} = 0$. When beta coefficients were measured using the F-ratio statistic, it was found that $\frac{b}{P_2^s}$ and $\frac{b}{sp_2}$ were not significantly different from zero and $\frac{b}{P_2^a}$ and $\frac{b}{sa}$ were significantly different from zero so the model was not rejected.

Class Inclusion

Class inclusion (P) and language were compared using the same procedures, notations and models, where the beta coefficients for the equations which were used were:

$\frac{b}{P_3^s} = .11$	$\frac{b}{sp_3} = .10$	$\frac{b}{P_3^a} = .46$	$\frac{b}{sa} = .50$
$\underline{F} = .873$	$\underline{F} = .873$	$\underline{F} = 15.327$	$\underline{F} = 20.479$
N.S.	N.S.	$p \leq .01$	$p \leq .01$

Thus the two regression equations which were derived were:

$$P = .46 A + .11 S$$

$$S = .11 P + .50 A$$

Model I. Model I, language influences class inclusion, was represented schematically as Age \longrightarrow Syntax \longrightarrow Class inclusion.

The regression equation implied by this model $P = \frac{b}{P_3^s} S = \frac{b}{P_3^s} S$ would mean that using the equation $P = \frac{b}{P_3^s} S + \frac{b}{P_3^a} A$, the model would be rejected if $\frac{b}{P_3^a} \neq 0$ or $\frac{b}{P_3^s} = 0$. When the beta coefficients were tested using the F-ratio statistic, it was found that $\frac{b}{P_3^a}$ was significantly greater than zero and $\frac{b}{P_3^s}$ was not, so Model I was rejected.

Model II. Model II (class inclusion influences syntax) was represented schematically as Age \longrightarrow Class inclusion \longrightarrow Syntax. When written in terms of a regression equation, the representation is $S =$

$$\frac{b}{sp_3} P$$

which means that using the regression equation $S = \frac{b}{sp_3} P +$

$\underline{b}_{sa}A$, this model would be rejected if $\underline{b}_{sa} \neq 0$ or $\underline{b}_{sp_3} = 0$. When tested using the F-ratio statistic, the model was rejected because \underline{b}_{sa} was significantly different from zero and \underline{b}_{sp_3} was not.

Model III. Model III was also tested (development independently influences class inclusion and language development). This may be represented schematically as Age $\begin{cases} \nearrow \text{Class inclusion} \\ \searrow \text{Syntax} \end{cases}$ where the regression equations would be $P_3 = \underline{b}_{sa}A$ and $S = \underline{b}_{p_3a}A$. In effect this means that using the equations $P_3 = \underline{b}_{p_3s}S + \underline{b}_{p_3a}A$ and $S = \underline{b}_{sp_3}P_3 + \underline{b}_{sa}A$, the model would be rejected if $\underline{b}_{p_3s} \neq 0$ or $\underline{b}_{sp_3} \neq 0$ or $\underline{b}_{p_3a} = 0$ or $\underline{b}_{sa} = 0$. When measured using the F-ratio statistic it was found that \underline{b}_{p_3s} and \underline{b}_{sp_3} were not significantly different from zero, while \underline{b}_{p_3a} and \underline{b}_{sa} were so Model III was not rejected.

Preliminary Summary

In summary, the models which were not rejected were:

Age \longrightarrow Syntax \longrightarrow Conservation

Age $\begin{cases} \nearrow \text{Syntax} \\ \searrow \text{Seriation} \end{cases}$

Age $\begin{cases} \nearrow \text{Class inclusion} \\ \searrow \text{Syntax} \end{cases}$

Formulation of a global model. In combining these basic models with the significant correlations between sex and syntax ($\underline{r} = .23$), a more comprehensive model suggests itself. That is:

Age $\begin{cases} \nearrow \text{Seriation} \\ \nearrow \text{Class inclusion} \\ \searrow \text{Syntax} \end{cases}$
 Sex \longrightarrow Syntax \longrightarrow Conservation

In order to take the model a step further, the partial correlations

between the remaining endogenous variables, controlling for age and sex, were examined. Only two of these correlations were significant at the .05 level: the partial correlation between syntactic development and conservation ($r = .27$; $p \leq .01$) which is accounted for by this model and the partial correlation between class inclusion and conservation ($r = .23$; $p \leq .05$) which is not. This suggests a relationship between class inclusion and conservation which is not due to their mutual relationship with age. Thus either conservation directly influences class inclusion or class inclusion directly influences conservation. In order to clarify the relationship, the two models were then tested.

The two regression equations necessary to test the two competing models were:

$$P_3 = b_{P_3P_1}P_1 + b_{P_3A}A$$

$$P_1 = b_{P_1P_3}P_3 + b_{P_1A}A$$

where A = Age
 P₁ = Conservation
 P₃ = Class inclusion

When regression equations were calculated for these Piagetian tasks, the following beta coefficients were derived in a multiple regression analysis:

$b_{P_3P_1} = .20$	$b_{P_1P_3} = .27$	$b_{P_1A} = .03$	$b_{P_3A} = .48$
$F = 4.47$	$F = 4.47$	$F = .067$	$F = 25.058$
$p \leq .05$	$p \leq .05$	N.S.	$p \leq .01$

Thus the two regression equations which were derived were:

$$P_3 = .20P_1 + .48A$$

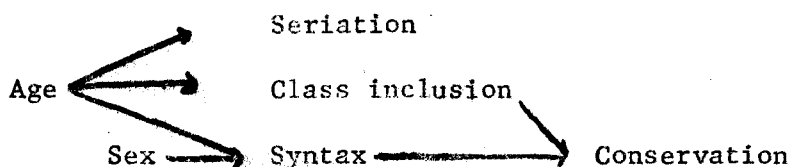
$$P_1 = .27P_3 + .03A$$

For the model class inclusion influences conservation, represented schematically as Age \longrightarrow Class inclusion \longrightarrow Conservation, the following regression would hold true if the model were appropriate:

$P_1 = b_{p_1 p_3} P_3$. This means that using the equation: $P_1 = b_{p_1 p_3} P_3 + b_{p_1 a} A$, the model would be rejected if $b_{p_1 a} = 0$ or $b_{p_1 p_3} \neq 0$. When the beta coefficients were tested against the F-ratio statistic, it was found that $b_{p_1 a}$ was not significantly different from zero and $b_{p_1 p_3}$ was so the model was not rejected.

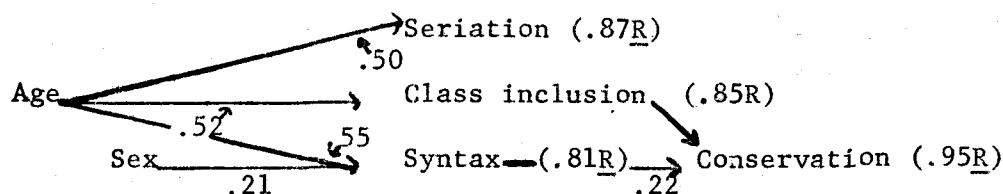
The model conservation influences class inclusion, represented schematically as Age \longrightarrow Conservation \longrightarrow Class inclusion, would imply the following regression equation: $P_3 = b_{p_3 p_1} P_1$. This means that using the equation $P_3 = b_{p_3 p_1} P_1 + b_{p_3 a} A$, the model would be rejected if $b_{p_3 a} = 0$ or $b_{p_3 p_1} \neq 0$. When beta coefficients were tested using the F-ratio statistic, it was found that $b_{p_3 a}$ was significantly different from zero, while $b_{p_3 p_1}$ was not. Thus the model was rejected.

In view of these findings, the global model was modified to reflect the additional path (Conservation \longrightarrow Class inclusion). This may be seen below:



At this point all partial correlations had been accounted for and it was now necessary to investigate the magnitude of the path coefficients. This was done by regressing each variable on the variables that had arrows leading directly to it. The following pattern presented

itself (residuals are presented by the numerals in parentheses):



Final Summary

Model I, language influences thought, was supported by the data for only one of the cognitive tasks and that was conservation. However, Model II (thought influences language) was not supported by the data in any of the cognitive tasks which were used in this study. Rather it was found that age independently influences language and thought when one considers either class inclusion or seriation tasks. This finding supports Model III. In addition, it appears that there may be a causal relationship between class inclusion and conservation (Age → Class inclusion → Conservation). A large residual factor was found to be associated with the Model I relationship between conservation and syntax. It should also be noted that girls performed significantly better than boys on the syntax measures.

CHAPTER V

DISCUSSION

Results Supporting Model I:

The use of path analysis in this project presents to the researcher some interesting patterns in the development of language and thought. Among these are limited support for Model I. In this instance, only conservation (of the three cognitive tasks) was found to be influenced by syntactic development.

Results Supporting Model II:

A most intriguing and unexpected finding was that Model II (thought influences language) was not supported for any of the cognitive tasks. In view of the present fascination of American (and global) academia with the work of Piaget, one is most surprised to discover so little empirical support for his position in the present study.

Results Supporting Model III:

Equally surprising is the empirical support for Model III which was formulated from the linguistic theories of the N. Chomsky (1965) and McNeill (1970) school. Model III is supported in that when compared with the cognitive tasks of class inclusion and seriation, syntax appears to be independently influenced by development. This might be interpreted to mean that some cognitive skills (seriation and class inclusion) develop in a separate way from syntax.

It is doubtful of an innate language acquisition device, however. Moreover, the findings (Development ^{Language} Cognition) appear to be true to only a limited degree because another cognitive skill, conservation, does

appear to be influenced by syntax. The generalizability of a global statement is thus curtailed.

Language and Thought Are Inseparable

The possibility also presents itself that language and thought may not be inseparable to the researcher as some have thought. Path analysis appears to give the researcher the means of isolating variables and directions of influence which were once considered hopelessly intermingled. Obviously the present study is only a tentative first step, but it does present a methodology which has seldom, if ever, been tried in attempts to disentangle the thought/language questions.

Integration and Extension of the Model:

In reviewing the global model presented at the end of Chapter IV, one should also attend to the path of influence from class inclusion to conservation. It was found that class inclusion is more age-dependent than conservation. In addition, it appears that when what is acquired in learning the class inclusion and syntax skills are combined, the child's skills in conservation are enhanced.

Another finding of this study is that the female subjects performed better on the syntactic questions than did the male subjects. Although this finding is not entirely unique (Slobin, 1966; Haney and Hooper, 1973; and Farmer, Nixon and White, 1976), the remainder of the studies cited in this paper do not note performance differences related to gender.

It was also found that socioeconomic status was unrelated to performance on either the syntactic or cognitive tasks. It is felt that this reflected the very homogeneous population which was examined.

As noted earlier, the children were students in a small parochial elementary school and in reviewing the fathers' occupations, one was struck by the homogeneous upper and upper middle-class nature of the population.

Another finding which was not expected was the wide variability in the age of acquisition of conservation skills. This finding contrasts with the more uniform acquisition process for class inclusion and seriation tasks. This may be a reflection of the instructions given to the students or the wording of the questions which were asked to ascertain the children's understanding of conservation. One also notes the large residual factor (see page 70) associated with conservation and there is a suspicion that a number of random reasons may be associated with the large variability in age of acquisition. It may also be true that language entered into the conservation findings. Syntax was already believed to play a role, but there may be other aspects of language not measured in this study which have played a part in the children's conservation responses. But even with large error factors, conservation and syntax are still significantly related. This points to a strong relationship between the two.

Limitations and Cautions About the Study:

It is appropriate to note at this point that the findings of the study are limited by the "state of the art" in the field of psychology and education. It is difficult, if not impossible, to clearly define, differentiate, and measure independently the hypothetical constructs of language and cognition. Because language was used to instruct the students in all of the cognitive tasks (even seriation which necessitated only a non-verbal, performance response) one cannot assume that a

language component was not a factor in those cognitive tasks. At the same time the syntactic measures required the subjects to manipulate the sentences mentally and this manipulation necessarily involves a cognitive component.

Menyuk (1972) has suggested that in order to minimize ambiguity in the relationship between linguistic rules and cognitive tasks, it is necessary to:

1. Evaluate the difficulty of the linguistic rules involved in the cognitive tasks.
2. Determine the concreteness of the relationships expressed in the syntactic measures in order to eliminate cognitive problems.

In devising the measures used in the present study, this was done to the maximum extent possible. However, the goal became increasingly difficult as the tasks--both cognitive and linguistic--became more complex. It may be that this type of research is only possible with younger children and/or simpler tasks. Abstraction for both linguistic and cognitive tasks makes the problem of measuring these hypothetical constructs independently very difficult.

However, the fact that class inclusion and syntax appear independent when age is controlled, while conservation and syntax showed considerable overlap, makes it clear that regardless of the difficulty in measuring language and cognition independently, the two cannot be assumed to be the same. Moreover, the different relationship between these two cognitive tasks when compared with syntax indicates that path analysis is useful in differentiating between different aspects of cognition and syntax.

When evaluating the residuals associated with the different paths of influence, there is a clear-cut relationship with age for class inclusion and syntax, but not for conservation. This indicates that path analysis is differentiating between the two cognitive tasks in a reliable way. Such high residual factors should work against finding the significant relationships which were apparent in the research.

However, if the differing paths of influence for class inclusion and conservation had not presented themselves, additional cautions would be necessary in interpreting these findings. Moreover, this study presented a picture parallel to that of Hutson (1971) in her work with the passive sentence construction in comparison with conservation, class inclusion and seriation. This tends to support the contention that learning the linguistic code requires different skills from those needed in solving the Piagetian tasks.

Because of the newness of path analysis to cross-sectional psychological studies, it is appropriate to review again the causal model implications of these findings. Most importantly, this research does not suggest that one skill is a necessary prerequisite for learning or acquiring another. Rather it may be that if one could manipulate what makes a child achieve skill X, one may indirectly help the child in the acquisition of skill Y. One assumes that the skills acquired in learning one task are similar and useful in learning another task. Moreover, the causal model posits that the reverse would not be true: acquiring skill Y will do little or nothing to help a child learn skill X.

Questions also remain. The most perplexing finding is that conservation is more closely bound to verbal behavior than either class

inclusion or seriation. Because the seriation task included a manipulative model for the subject of what was required and asked the subject for only a performance response, one can more easily accept the finding that seriation and syntax have a very limited correlation.

But a similar explanation is not available for the low level of relationship between class inclusion and syntax tasks. In reviewing the literature, one finds that others (Sinclair, 1967; Peisach, 1973; and Hanes, 1973) have also found a close relationship between syntax and conservation. But only Hutson (1971) found a similar close relationship between passive sentences and conservation coupled with the similar weak relationships between class inclusion and the passive construction. Hutson hypothesized that logic may be related in different ways to vocabulary, syntax and verbal fluency. Syntax, the organization of elements in a sentence, was felt to have an appreciable relationship with logic during this period of development. She suggested that syntactical competence and conservation both involve the ability to keep various aspects of a situation simultaneously in mind and to coordinate them.

In view of the relative novelty of the area of research and the introduction of path analysis as a statistical technique, this data should be analyzed with caution. Although one may say that the acquisition of one task facilitates the acquisition of another, these findings may simply reflect task difficulty. In other words the relative difficulty of each of these tasks is open to dispute and because path analysis assumes an interval scale, the findings may reflect unequal intervals.

One should also be reminded that the model presented in this investigation is a causal one, not a developmental model. No assumption is made about the order in which skills are acquired: This is information which would be gained in a longitudinal study. One must always keep in mind that the data on which this study is based are cross-sectional, not longitudinal data.

Implications for Further Research:

It follows from the cautions of the preceding section that further research using path analysis would be appropriate in a developmental study which used age as an exogenous variable. Such research should be preceded by preliminary data-gathering using the approach of the information-processing theorists to look more closely at changes in syntactic and cognitive skills over time. (Inhelder, 1976, provides the prototype for this type of study.) Although time-consuming and difficult, this would be extremely useful data in determining the steps a child takes in moving from one level of operational thought to the next.

Replication of the study with less verbally sophisticated subjects, or with a more heterogeneous socioeconomic group would be desirable. In a conversation with Carol Chomsky (personal communication, June 16, 1977), it was obvious that the syntactic measures have been used with verbally adept children from upper middle class families. In order to generalize the present findings it would be very helpful to

find how a wider sampling of the population would respond.

Another type of replication which would be very useful would be a non-verbal assessment of the cognitive skills. Measures of this type have already been designed by Furth (1973) for class inclusion tasks and have been used to evaluate deaf populations. There do not appear to be non-verbal assessments of conservation at the present time, but if they could be developed using demonstration and extension rather than verbal instruction and question, a more clear-cut picture of cognitive and linguistic development would be available. Replication of this sort would definitely enhance the viability and strength of the present study.

It would also be appropriate to undertake similar studies with presently available "language" tests which are used widely in the schools and use the raw scores to compare the findings with these (seriation, conservation, and class inclusion) and other Piagetian tasks. In this way the language skills which are considered necessary for school success might be compared with the Piagetian tasks. It would appear that until these types of data are available, the generalizability of these findings to a school population would be quite limited.

Perhaps the most important research which is now needed is an applied research study which seeks to find if an increase of one task actually incurs an increase on another task as the path analysis suggests. Although others have suggested this is true (Hamel, VanderVeer and Westerhof, 1972), an experimental study is necessary to validate these findings. One might suggest that children who cannot conserve be

randomly assigned to four treatment groups, such as:

Group I. Train in class inclusion

Group II. Train in syntax

Group III. Train in both syntax and class inclusion

Group IV. No training

Conservation would be the dependent variable. A schematic presentation of the analytic paradigm is as follows:

	Class inclusion Training	No Training
Syntax Training	III	II
No Training	I	IV

In this way, empirical data would be available to determine if a growth in syntax influences a child's performance on a conservation task or if class inclusion successes have a positive effect on conservation. Until such information is available the findings of this study will remain only interesting, but only potentially useful.

Implications for Education:

There is the implication in the present study that those speech therapists and communication disorders teachers who labor in the field are providing a useful service to children with language disabilities. For certain cognitive tasks such as conservation, language classes may be appropriate, while the reverse does not appear to be the case. In other words, one cannot simplistically assume that syntax will improve if cognitive skills are developing or present. Again this remains to be verified by missing studies, but those who would assume with

Sinclair-de-Zwart (1967) and Sinclair (1971) that cognitive growth assumes linguistic growth while the reverse is not true, may be in error.

CHAPTER VI

SUMMARY

Children's comprehension of selected syntactic structures was compared with their performance on three Piagetian tasks. The syntactic structures were taken from the work of C. Chomsky (1971) and included easy to see, ask, promise, and and. The Piagetian tasks included conservation, seriation, and class inclusion. Included in the study were 79 boys and girls between the ages of six and ten.

The comparisons were made on the basis of three competing models derived from a review of the literature. These were: Model I, language influences cognition, based on the writings of Vygotsky and Bruner; Model II, cognition influences language, developed from the research of Piaget and his Genevan School; and Model III, language and cognition are independently influenced by development, taken from the writings of N. Chomsky. In order to compare the three models, path analysis was used to isolate possible paths of influence between language and cognition skills.

It was found that class inclusion and syntax are independently influenced by development and the same thing is true for seriation and syntax. Conservation, however, appears to be influenced by syntax. Thus Models I and III were supported by the study, but Model II (that derived from the writings of Piaget) was not. In further investigations using path analysis, an additional path of influence was found which suggested that class inclusion may influence conservation.

Syntax appeared to be influenced by sex differences. Girls performed significantly better than boys on the syntactic tasks. This was not true for the Piagetian tasks.

Socioeconomic status was found to be unrelated to performance on either the cognitive or language tasks. It was felt that this reflected the homogeneous upper-middle class population which was used in the study.

Discussion followed on the need for further study to validate these findings using path analysis. Empirical support which would confirm or disconfirm the use of path analysis in a study such as this is needed before these statistical techniques can be generalized to other areas of psychological or educational inquiry.

BIBLIOGRAPHY

- Abbott, R. Relationships between T-unit measures of oral language maturity and Piagetian stage of mental development. Unpublished doctoral dissertation. University of Oklahoma, 1973.
- Amidon, A. & Carey, P. Why five-year-olds cannot understand before and after. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 417-423.
- Anderson, R.C. The notion of schemata and the educational enterprise: General discussion of the conference. In R.C. Anderson, R.J. Spiro & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers, 1977.
- Anglin, J. The growth of word meaning. Cambridge, Mass.: M.I.T. Press, 1970.
- Antinucci, P. & Parisi, D. Early semantic development in child language. In E. Lenneberg and E. Lenneberg (Eds.), Foundations of language development. New York: Academic Press, 1975.
- Asch, S. & Nerlove, H. The development of double function terms in children: An exploratory investigation. In B. Kaplan and S. Wagner (Eds.), Perspectives in psychological theory: Essays in honor of Heinz Werner. New York: International Universities Press, 1960.
- Asher, H.R. Causal modeling. Beverly Hills, CA: Sage Publications, 1976.

- Barclay, J.R., Bransford, J.D., Franks, J.J., McCarrell, N.S. & Nitsch, K. Comprehension and semantic flexibility. Journal of Verbal Learning and Verbal Behavior, 1974, 13, 471-481.
- Beard, R. Piaget's developmental psychology. New York: Mentor, 1972.
- Begg, I. & Paivio, A. Concreteness and imagery in sentence meaning. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 821-827.
- Beilin, H. Developmental stages and developmental processes. In D.R. Green, M.P. Ford, and G.B. Flamer (Eds.), Measurement and Piaget. New York: McGraw-Hill, Inc., 1971. (a)
- The training and acquisition of logical operations. In M.F. Roszkopf, L.P. Steffe, and S. Taback (Eds.), Piagetian cognitive-development research and mathematical education. Washington, D.C.: National Council of Teachers of Mathematics, 1971b.
- Studies in the cognitive basis of language development. New York: Academic Press, 1975.
- Bellugi, U. Roots of language in the sign talk of the deaf. Psychology Today, 1972, 6, 60-64
- Bergling, K. The development of hypothetico-deductive thinking in children. New York: John Wiley & Sons, 1974.
- Bever, T. The comprehension and memory of sentences with temporal relations. In G.B. Flores d'Arcais and W.M. Levelt (Eds.), Advances in psycholinguistics. Amsterdam, Netherlands: North Holland Press, 1970. (a)
- The influence of speech performance on linguistic structures. In G.B. Flores d'Arcais and W.J.M. Levelt (Eds.), Advances in psycholinguistics. Amsterdam, Netherlands: North Holland Press, 1970. (b)

- Bleich, D. New considerations of the infantile acquisition of language and symbolic thought. Psychoanalytic Review, 1976, 63, 49-71.
- Bloom, L. Language development: Form and function in emerging grammars. Cambridge, Mass.: M.I.T. Press, 1970.
- Talking, understanding and thinking. In R.L. Schiefelbusch and L.L. Lloyd (Eds.), Language perspectives: Acquisition, retardation and intervention. Baltimore, Maryland: University Park Press, 1974.
- Bormuth, J.R., Manning, J., Carr, J., & Pearson, D. Children's comprehension of between and within-sentence syntactic structures. Journal of Educational Psychology, 1970, 61, 349-357.
- Bowerman, M.F. Early syntactic development: A cross-linguistic study with special reference to Finnish. Cambridge, England: Cambridge University Press, 1973.
- Development of concepts underlying language. In R.L. Schiefelbusch and L.L. Lloyd (Eds.), Language perspectives: Acquisition, retardation, and intervention. Baltimore, Maryland: University Park Press, 1974. (a)
- Learning the structure of causative verbs: A study in the relationship of cognitive, semantic, and syntactic development. Papers and reports on child language development, No. 8. Stanford University, California: Committee on Linguistics, June, 1974. (b)
- Braine, M. The ontogeny of English phrase structure: The first phase. Language, 1963, 39, 1-13.

Bransford, J.D. & Franks, J.J. The abstraction of linguistic ideas.

Cognitive Psychology, 1971, 2, 331-350.

Brekke, B. & Clark, A. Observation of a Piagetian clinical interview on language acquisition. Elementary English, February 1974, 51, 291-294.

Bronckart, J.P. The regulating role of speech: A cognitive approach.

Human Development, 1973, 16, 417-439.

Brown, A.L. The development of memory: Knowing, knowing about knowing, & knowing how to know. In H.W. Reese (Ed.), Advances in child development and behavior (Vol. 10). New York: Academic Press, 1975, 103-152.

----- Development, schooling, and the acquisition of knowledge about knowledge. In R.C. Anderson, R.J. Spiro & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers, 1977, 241-253.

Brown, R. How shall a thing be called? In R.C. Oldfield and J.C. Marshall (Eds.), Language. Baltimore, MD: Penguin Books, 1968.

----- Psycholinguistics. New York: Free Press, 1970.

----- A first language: The early stages. Cambridge, Mass.: Harvard University Press, 1973.(a)

----- Language acquisition in the human species. American Psychologist, 1973 (b), 28, 27-38.

Brown, R. & Fraser, C. The acquisition of syntax. In U. Bellugi and R. Brown (Eds.), The acquisition of language: Monographs of the society for research in child development, 1964, 29, 43-79.

- Brown, R. & Hanlon, C. Derivational complexity and order of acquisition in child speech. In J. Hayes (Ed.), Cognition and the development of language. New York: John Wiley & Sons, 1970.
- Bruner, J. An overview. In J.S. Bruner, R.R. Olver, and P.M. Greenfield (Eds.), Studies in cognitive growth. New York: John Wiley & Sons, 1966. (a)
- On cognitive growth--I and II. In J.S. Bruner, R.R. Olver, and P.M. Greenfield (Eds.), Studies in cognitive growth. New York: John Wiley & Sons, 1966. (b)
- On the conservation of liquids. In J.S. Bruner, R.R. Olver, and P.M. Greenfield (Eds.), Studies in cognitive growth. New York: John Wiley & Sons, 1966. (c)
- Process of cognitive growth: Infancy. Worcester, Mass.: Clark University with Barre Publishers, 1968.
- Bruner, J.S. & Kenney, H.J. On relational concepts. In J.S. Bruner, R.R. Olver, and P.M. Greenfield (Eds.), Studies in cognitive growth. New York: John Wiley & Sons, 1966.
- Cambon, J. & Sinclair, H. Relations between syntax and semantics: Are they "easy to see"? British Journal of Psychology, 1974, 65, 133-140.
- Campione, J.C. & Brown, A.L. The effects of contextual changes and degree of component mastery on transfer of training. In H.W. Reese (Ed.), Advances in child development and behavior (Vol. 9). New York: Academic Press, 1974, 69-114.
- Memory in the retarded child. In R.V. Kail, Jr. & J.W. Hagen (Eds.), Perspectives on the development of memory and cognition. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers, 1977.

- Carroll, J.B. (Ed.) Language, thought, and reality: Selected writings of Benhamin Lee Whorf. Cambridge, Mass: M.I.T. Press, 1966.
- Learning from verbal discourse in educational media: A review of the literature. (Research Bulletin RB 71-61) Princeton, NJ: Educational Testing Service, October, 1971.
- Carroll, J.B. & Cassagrande, J.B. The function of language classification in behavior. In E.E. Maccoby, T.M. Newcomb, and E.L. Hartley (Eds.), Readings in social psychology. (3rd ed.) New York: Holt, Rinehart & Winston, 1958.
- Cazden, C. The situation: A neglected source of social class differences in language use. Journal of Social Issues, 1970, 26, 35-60.
- Cellerier, G. Information processing tendencies in recent experiments in cognitive learning--theoretical implications. In B. Inhelder & H.H. Chipman (eds.), Piaget and his school. New York: Springer-Verlag, 1976, 36-45.
- Chomsky, C. The acquisition of syntax in children from 5 to 10. Cambridge, Mass.: M.I.T. Press, 1969.
- Stages in language development and reading exposure. Harvard Review of Education, 1972, 42, 1-33.
- Chomsky, N. Aspects of the theory of syntax. Cambridge, Mass.: M.I.T. Press, 1965.
- Clark E. On the acquisition of the meaning of before and after. Journal of Verbal Learning and Verbal Behavior, 1971, 10, 266-275.

- Some aspects of the conceptual basis for first language acquisition. In R.L. Schiefelbusch and L.L. Lloyd (Eds.), Language perspectives: Acquisition, retardation and intervention. Baltimore, MD: University Park Press, 1974.
- Clark, H. The language-as-fixed-effect fallacy: A critique of language statistics in psychological research. Journal of Verbal Learning and Verbal Behavior, 1973, 12, 335-359.
- Clark, H. & Clark, E. Semantic distinctions and memory for complex sentences. Quarterly Journal of Experimental Psychology, 1968, 20, 129-138.
- Clay, M. Reading: The patterning of complex behavior. New Zealand: Heinemann Educational Books, 1972.
- Collins, A., Warnock, E., Aiello, N. & Miller, M. Reasoning from incomplete knowledge. In D.G. Bobrow & A. Collins (Eds.), Representation and understanding: Studies in cognitive science. New York: Academic Press, 1975, 383-415.
- Cromer, R. Children are nice to understand: Surface structure clues for the recovery of deep structure. British Journal of Psychology, 1971, 61, 397-408.
- The development of the ability to decenter in time. British Journal of Psychology, 1971, 62, 353-365.
- Conservation by the congenitally blind. British Journal of Psychology, 1973, 64, 241-250.
- Receptive language in the mentally retarded: Processes and diagnostic distinctions. In R.L. Schiefelbusch and L.L. Lloyd (Eds.), Language perspectives: Acquisition, retardation and

- intervention. Baltimore, MD: University Park Press, 1974.
- Dale, P. Language development: Structure and function. Hinsdale, IL: Dryden Press, 1972.
- Divesta, F.J. & Palermo, D.S. Language development. In F.N. Kerlinger and J.B. Carroll (Eds.), Review of research in education--II. Itasca, IL: F.E. Peacock Publishers, Inc., 1974.
- Donachy, W. Parent participation in preschool education. British Journal of Educational Psychology, 1976, 46, 31-39.
- Donaldson, M. & Balfour, G. Less is more: A study of language comprehension in children. British Journal of Psychology, 1968, 59, 461-472.
- Donaldson, M. & Wales, R. On the acquisition of some relational terms. In J.R. Hayes (ed.), Cognition and the development of language. New York: John Wiley & Sons, 1970.
- Duncan, O.D. Introduction to structural equation models. New York: Academic Press, 1975.
- Dupreez, P. Units of information in the acquisition of language. Language and Speech, 1974, 17, 369-376.
- Elkind, D. Children's discovery of the conservation of mass, weight, and volume. Piaget replication study II. In D. Elkind and J.H. Flavell (Eds.), Studies on cognitive development: Essays in honor of Jean Piaget. New York: Oxford University Press, 1969.
- Two approaches to intelligence: Piagetian and psychometric. In D.R. Green, M.P. Ford, and G.B. Flamer (Eds.), Measurement and Piaget. New York: McGraw-Hill, Inc., 1971.

- Ernst, G.W. & Newell, A. GPS: A case study in generality and problem solving. New York: Academic Press, 1969.
- Farmer, A.R., Nixon, M. & White, R. Sound blending and learning to read: An experimental investigation. British Journal of Educational Psychology, 1976, 46, 155.
- Farnham-Diggory, S. Information-processing in children. New York: Academic Press, 1972.
- Fillion, B., Smith, F. & Swain, M. Language basics for language teachers: Towards a set of universal considerations. Language Arts, 1976, 53, 740-745.
- Flavell, J. Stage-related properties of cognitive development. In P.H. Mussen, J.J. Conger, & J. Kagan (Eds.), Basic contemporary issues in developmental psychology, New York: Harper & Row, 1975.
- Flavell, J.H. & Wellman, H.M. Metamemory. In R.V. Kail, Jr. & J.W. Hagen (Eds.), Perspectives on the development and cognition. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers, 1977.
- Fraser, C., Bellugi, U. & Brown, R. Control of grammar in imitation, comprehension and production. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 121-135.
- Furth, H. Thinking without language. New York: Free Press, 1966.
- Concerning Piaget's view on thinking and symbol formation. Child Development, 1967, 38, 819-826.
- On language and knowing in Piaget's developmental theory. Human Development, 1970, 13, 241-257.

- Linguistic deficiency and thinking: Research with deaf subjects, 1964-1969. Psychological Bulletin, 1971, 76, 58-72.
- Deafness and learning. Belmont, CA: Wadsworth Publishing Co., 1973.
- Furth, H. & Youniss, J. The influence of language and experience on discovery and use of logical symbols. In N. Ender, L. Boulter, and H. Osser (Eds.), Contemporary issues in developmental psychology. New York: Holt Rinehart & Winston, 1968.
- Gaer, E. Children's understanding and production of sentences. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 289-294.
- Gagne, R.M. Schooling and the relevance of research. In R.C. Anderson, R.J. Spiro & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, NJ: Lawrence Erlbaum Associates, Publisher, 1977.
- Ghuman, A.S. & Girling, L.A. A study of children's cognitive operations in relationship to their language. Indian Journal of Psychology, 1974, 49, 149-157.
- Ginsburg, H. & Oppen, S. Piaget's theory of intellectual development: An introduction. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1969.
- Godman-Eisler, F. & Cohen, M. Is N, P, and NP difficulty a valid criterion of transformational operations? Journal of Verbal Learning and Verbal Behavior, 1970, 9, 161-166.
- Goodglass, H., Gleason, J.B. & Hyde, M.R. Some dimensions of auditory language comprehension in aphasia. Journal of Speech and Hearing Research, 1970, 13, 595-606.

- Goodman, A. & Burke, C. Reading Miscue inventory. New York: Macmillan Publishing Co., Inc., 1972.
- Goodnow, J. Rules and repertoires, rituals and tricks of the trade: Social and informational aspects to cognitive and representational development. In S. Farnham-Diggory (Ed.), Information processing in children. New York: Academic Press, 1972.
- Greenfield, P.M., Nelson, K. & Saltzman, E. The development of rulebound strategies for manipulating seriated cups: A parallel between action and grammar. Cognitive Psychology, 1972, 3, 291-310.
- Halliday, M. Learning how to mean. In E. Lenneberg and E. Lenneberg (Eds.), Foundations of language development. New York: Academic Press, 1975.
- Hallós, M. Logical operations and role-taking abilities in two cultures: Norway and Hungary. Child Development. 1975, 46, 638-649.
- Hamel, B., VanderVeer, M. & Westerhof, R. Identity, language activation training, and conservation. British Journal of Educational Psychology, 1972, 42, 186-191.
- Hanes, J. Cognition and the acquisition of selected function words in poverty children. Unpublished doctoral dissertation. Indiana University, 1973.
- Haney, J.H. & Hooper, F.H. A developmental comparison of social class and verbal ability influences on Piagetian tasks. Journal of Genetic Psychology, 1973, 122, 235-245.
- Hargis, C., Mercaldo, D. & Johnson, H. A linguistic and cognitive perspective on retardation. Journal of Genetic Psychology,

1975, 126, 145-154.

Harris, R. Children's comprehension of complex sentences. Journal of Experimental Psychology, 1975, 19, 420-433.

Hayhurst, H. Some errors of young children in producing passive sentences. Journal of Verbal Learning and Verbal Behavior, 1967, 6, 634-639.

Heise, D.R. Causal analysis. New York: John Wiley & Sons, 1975.

Holland, V. & Palermo, D. On learning 'less': Language-cognitive development. Child Development, 1975, 46, 437-443.

Hunt, K. Grammatical structures written at three grade levels. (Research Report No. 3) Champaign, IL: National Council of Teachers of English, 1965.

Hutson, B. A study of the relationship of cognitive development and syntactical comprehension. Paper presented at the annual meeting of the American Educational Research Association, New York, 1971.

Huttenlocher, J. Language and intelligence. In L.B. Resnick (Ed.), The nature of intelligence. Hillsdale, NJ: Lawrence Erlbaum Associates, Publisher, 1976.

Inhelder, B. Information processing tendencies in recent experiments in cognitive learning--empirical studies. In B. Inhelder & H.H. Chipman (Eds.), Piaget and his school. New York: Springer-Verlag, 1976. (a)

----- Memory and intelligence in the child. In B. Inhelder & H.H. Chipman (eds.), Piaget and his school. New York: Springer-Verlag, 1976. (b)

- Operational thought and symbolic imagery. In B. Inhelder & H.H. Chipman (Eds.), Piaget and his school. New York: Springer-Verlag, 1976. (c)
- Inhelder, B. & Piaget, J. The early growth of logic in the child. New York: Humanities Press, 1964.
- Ivimey, G. The development of English morphology: An acquisition model. Language and Speech, 1975, 18, 120-144.
- Jenkins, J. & Palermo, D. Mediation processes and the acquisition of linguistic structure. In U. Bellugi and R. Brown (Eds.), The acquisition of language. Monographs of the Society for Research in Child Development, 1964, 29, 141-169.
- Katz, E. & Brent, S. Understanding connectives. Journal of Verbal Learning and Verbal Behavior, 1968, 7, 501-509.
- Kessel, F. Role of syntax in children's comprehension from ages 6 to 12. Monographs of the Society for Research in Child Development, September 1970, 35.
- Klima, E. & Bellugi-Klima, U. Syntactic regularities in the speech of children. In J. Lyons and R. Wales (Eds.), Psycholinguistic papers. Edinburgh, Scotland: Edinburgh University, 1966.
- Koff, E. Concept and language: The comparative relation. Unpublished doctoral dissertation. Tufts University, 1972.
- Leech, G.N. Towards a semantic description of English. Bloomington, IN: Indiana University Press, 1970.
- Lenneberg, E. Biological foundations of language. New York: John Wiley & Sons, 1967.
- A biological perspective of language. In R.C. Oldfield and

J.C. Marshall (Eds.), Language. Baltimore, MD: Penguin Books, 1968.

Lesser, H. & Drouin, C. Training in the use of double-function terms. Journal of Psycholinguistic Research, 1975, 4, 285-302.

Linden, E. Apes, men and language. New York: Saturday Review Press, 1975.

Loban, W. The language of elementary school children. (Research Report No. 1) Champaign, IL: National Council of Teachers of English, 1963.

----- Problems in oral English. (Research Report No. 5) Champaign, IL: National Council of Teachers of English, 1966.

Lovell, K. Some problems associated with formal thought and its assessment. In D.R. Green, M.P. Ford, and G.B. Flamer (Eds.), Measurement and Piaget. New York: McGraw-Hill, Inc., 1971.

Lovell, K. & Dixon, E.M. The growth of the control of grammar in imitation, comprehension and production. Journal of Child Psychology and Psychiatry, 1967, 8, 31-39.

Luria, A. The directive function of speech in development and dissolution. Word, 1959, 15, 341-352.

----- The neuropsychology of memory. Washington, D.C.: V.H. Winston & Sons, 1976.

Maratsos, M. How preschool children understand missing complement subjects. Child Development, 1974, 45, 700-706.

Mayer, R.E. Thinking and problem solving. Glenview, IL: Scott, Foresman and Co., 1977.

McCabe, A., Levin, J. & Wolff, P. The role of overt activity in

- children's sentence production. Journal of Experimental Child Psychology, 1974, 17, 107-114.
- McCauley, M.E. The role of cognition in the language comprehension of three, four and five year old children. Unpublished doctoral dissertation. State University of New York at Buffalo, 1973.
- McNeill, D. The creation of language. In R.C. Oldfield & J.C. Marshall (Eds.), Language. Baltimore, MD: Penguin Books, 1968.
- The acquisition of language: The study of developmental psycholinguistics. New York: Harper & Row, 1970.
- Mehler, J. Some effects of grammatical transformation on the recall of English sentences. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 346-351.
- Mehler, J. & Bever, T. Cognitive capacity of very young children. Science, 1967, 158, 141-142.
- Menyuk, P. A preliminary evaluation of grammatical capacity in children. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 429-439.
- Sentences children use. (Research Monograph, No. 52) Cambridge, MA: M.I.T. Press, 1969.
- The acquisition and development of language. Englewood Cliffs, NJ: Prentice-Hall, 1971.
- Miller, G.A. The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 1956, 63, 81-97.
- Some preliminaries to psycholinguistics. In R.C. Oldfield & J.C. Marshall (Eds.), Language. Baltimore, MD: Penguin Books, 1968.

- Miller, G.C. Handbook of research design and social measurement, (3rd ed.). New York: David McKay Co., Inc., 1977.
- Miller, G. & Isard S. Some perceptual consequences of linguistic rules. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 217-228.
- Miller, G. & Smith, F. The genesis of language: A psycholinguistic approach. Cambridge, MA: M.I.T. Press, 1966.
- Miller, W. & Ervin, S.M. The development of grammar in child language. In U. Bellugi & R. Brown (Eds.), The acquisition of language. Monographs of the Society for Research in Child Development, 1964, 29.
- Moerk, E. Piaget's research as applied to the explanation of language development. Merrill-Palmer Quarterly, 1975, 21, 152-169.
- Moore, T. Linguistic intuitions of twelve year olds. Language and Speech, 1975, 18, 213-218.
- Morehead, D.M. & Morehead, A. From signal to sign: A Piagetian view of thought and language during the first two years. In R.L. Schiefelbusch & L.L. Loyd (Eds.), Language perspectives--acquisition, retardation, and intervention. Baltimore, MD: University Park Press, 1974.
- Neimark, E. Development of comprehension of logical connectives: Understanding of "or". Psychonomic Science, 1970, 21, 217-219.
- Neimark, E. & Slotnick, N. Development of the understanding of logical connectives. Journal of Educational Psychology, 1970, 61, 451-460.
- Nelson, K. Concept, word and sentence: Interrelations in acquisition and development. Psychological Review, 1974, 81, 267-285.

- Newell, A. A note on process-structure distinction in developmental psychology. In S. Franham-Diggory (Ed.), Information processing in children. New York: Academic Press, 1972.
- Nie, N., Hull, C., Jenkins, J., Steinbrenner, K., & Bent, D. Statistical package for the social sciences. New York: McGraw-Hill, 1975.
- Norman, D. A. Memory and attention: An introduction to human information processing. New York: John Wiley & Sons, 1969.
- Noval, L. Language and cognition in the concrete operations period. Paper presented at the 82nd annual convention of the Psychological Association, New Orleans, August, 1974.
- O'Donnell, R.C., Griffin, W.J. & Norris, R.C. Syntax of kindergarten and elementary school children: A transformational analysis (Research Report, No. 8) Champaign, IL: National Council of Teachers of English, 1967.
- Oldfield, R.C. & Marshall, J.C. Language. Baltimore, MD: Penguin Books, 1968.
- Osherson, D.N. & Markman, E. Language and the ability to evaluate contradictions and tautologies. Cognition, 1975, 3, 213-226.
- Osler, S.F. & Kofsky, E. Stimulus uncertainty as a variable in the development of conceptual ability. In N. Endler, L. Boulton, & H. Osler (Eds.), Contemporary issues in developmental psychology. New York: Holt Rinehart & Winston, 1968.
- Palermo, D.S. More about less. Journal of Verbal Learning and Verbal Behavior, 1973, 12, 211-221.
- Palermo, D.S. & Molfese, D.L. Language acquisition from age 5 onward. Psychological Bulletin, 1972, 78, 409-427.

- Papandropoulou, I. & Sinclair, H. What is a word? Human Development, 1974, 17, 241-258.
- Parisi, D. & Antinucci, F. Lexical competence. In G.B. Flores d'Arcais & W.J.M. Levelt (Eds.), Advances in psycholinguistics. Amsterdam, Netherlands: North-Holland, 1970.
- Peisach, E. Relationship between knowledge and use of dimensional language and achievement of conservation. Developmental Psychology, 1973, 9, 89-197.
- Pelfrey, M.C. The influence of language in the acquisition of concrete operations. Unpublished doctoral dissertation. University of Texas at Austin, 1972.
- Phillips, J.L. The origins of intellect: Piaget's theory, (2nd ed.). San Francisco: W.H. Freeman & Co., 1975.
- Piaget, J. The language and thought of the child. New York: Harcourt, Brace & World, Inc., 1926.
- The origins of intelligence in children. New York: International Universities Press, 1952.
- The construction of reality in the child. New York: Basic Books, 1954.
- Plays, dreams and imitation. New York: Norton, 1962.
- Six psychological studies. New York: Random House, 1968.
- Language and intellectual operations. In H.G. Furth (Ed.), Piaget and knowledge. Englewood Cliffs, NJ: Prentice-Hall, Inc., 1969.

- Genetic epistemology. New York: Columbia Universities Press, 1970.
- The theory of stages in cognitive development. In D.R. Green, M.P. Ford, & G.B. Flamer (Eds.), Measurement and Piaget. New York: McGraw-Hill, Inc., 1971.
- Biology and cognition. In B. Inhelder & H.H. Chipman (Eds.), Piaget and his school. New York: Springer-Verlag, 1976. (a)
- Identify and conservation. In B. Inhelder & H.H. Chipman (Eds.), Piaget and his school. New York: Springer-Verlag, 1976. (b)
- Need and significance of cross-cultural research in genetic psychology. In B. Inhelder & H.H. Chipman (Eds.), Piaget and his school. New York: Springer-Verlag, 1976. (c)
- Piaget's theory. In B. Inhelder & H.H. Chipman (Eds.), Piaget and his school. New York: Springer-Verlag, 1976. (d)
- Piaget, J. & Inhelder, B. The psychology of the child. New York: Basic Books, 1969.
- The gaps in empiricism. In B. Inhelder & H.H. Chipman (Eds.), Piaget and his school. New York: Springer-Verlag, 1976.
- Pinard, A. & Sharp, E. IQ: A point of view. Psychology Today, 1972, 6, 65-68.
- Przetacznikowa, M. & Kielar, N. Development of skill in analysis and synthesis of verbal elements in children from 4 to 15 years. Polish Psychological Bulletin, 1975, 6, 3-11.
- Rubin, C. Children's comprehension of comparative sentences. Unpublished doctoral dissertation. University of North Carolina at Chapel Hill, 1973.

- Rumelhart, D.E. & Ortony, A. The representation of knowledge in memory. In R.C. Anderson, R.J. Spiro, & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers, 1977.
- Russell, J. The interpretation of conservation instructions by five-year old children. Journal of Child Psychology, 1973, 16, 233-244.
- Sanders, L.J. The comprehension of certain syntactic structures by adults. Journal of Speech and Hearing Research, 1971, 14, 739-745.
- Savin, H.B. & Perchonock, E. Grammatical structure and immediate recall of English sentences. Journal of Verbal Learning and Verbal Behavior, 1965, 4, 348-353.
- Schlesinger, I. Relational concepts underlying language. In R.L. Schiefelbusch & L.L. Lloyd (Eds.), Language perspectives: Acquisition, retardation and intervention. Baltimore, MD: University Park Press, 1974.
- Grammatical development: The first steps. In E. Lenneberg & E. Lenneberg (Eds.), Foundations of language development I. New York: Academic Press, 1975.
- Schultz, T.R. & Pilon, R. Development of the ability to detect linguistic ambiguity. Child Development, 1973, 44, 728-733.
- Sinclair, A., Sinclair, H. & DeMarcellus, O. Young children's comprehension and production of passive sentences. Archives de psychologie, 1970, 41, 121-129.
- Sinclair, H. Piaget's theory of development: The main stages. In M.F. Roskopf, L.P. Steffe, & S. Taback (Eds.), Piagetian cognitive development research and mathematical education. Washington, D.C.: National Council of Teachers of Mathematics, 1971.

- Piaget's theory and language acquisition. In M.F. Roszkopf, L.P. Steffe, & S. Taback (Eds.), Piagetian cognitive development research and mathematical education. Washington, D.C.: National Council of Teachers of Mathematics, 1971. (b)
- Sensorimotor action patterns as a condition for the acquisition of syntax. In R. Huxley & E. Ingram (Eds.), Language acquisition: Models and methods. New York: Academic Press, 1971. (c)
- The role of cognitive structures in language acquisition. In E. Lenneberg & E. Lenneberg (Eds.), Foundations of Language Development. New York: Academic Press, 1975.
- Epistemology and the study of language. In B. Inhelder & H.H. Chipman (Eds.), Piaget and his school. New York: Springer-Verlag, 1976.
- Sinclair-de-Zwart, H. Developmental psycholinguistics. In D. Elkind and J. Flavell (Eds.), Studies on cognitive development: Essays in honor of Jean Piaget. New York: Oxford University Press, 1967.
- Skinner, B.F. Verbal behavior. New York: Appleton, Century-Crofts, 1957.
- On having a poem. Cumulative record: A selection of papers, 3rd edition, New York: Appleton Century-Crofts, 1972.
- About behaviorism. New York: Alfred A. Knopf, 1974.
- Slobin, D.I. Grammatical transformations and sentence comprehension in childhood and adulthood. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 219-227.

- Imitation and grammatical development in children. In N. Endler, L. Boulter, and H. Osler (Eds.), Contemporary issues in developmental psychology. New York: Holt Rinehart & Winston, 1968.
- Developmental psycholinguistics. In W.O. Dingwall (Ed.), A survey of linguistic science. College Park, MD: University of Maryland, 1971.
- Cognitive prerequisites for the development of grammar. In C.A. Ferguson and D.I. Slobin (Eds.), Studies in child language development. New York: Holt Rinehart & Winston, 1973.
- On the nature of talk to children. In E. Lenneberg and E. Lenneberg (Eds.), Foundations of language development, I, New York: Academic Press, 1975.
- Smith, C. An experimental approach to children's linguistic competence. In J. Hayes (Ed.), Cognition and the development of language. New York: John Wiley & Sons, 1970.
- Smith, F. Understanding reading: A psycholinguistic analysis of reading and learning to read. New York: Holt Rinehart & Winston, 1971.
- Comprehension and learning. New York: Holt Rinehart & Winston, 1975.
- Smith, K. & McMahon, L. Understanding order information in sentences. In G.B. Flores d'Arcais and W.J.M. Levelt (Eds.), Advances in psycholinguistics. Amsterdam, Netherlands: North Holland, 1970.
- Sonstroem, A.M. On the conservation of solids. In J.S. Bruner, R.R. Olver, and P.M. Greenfield (Eds.), Studies in cognitive growth. New York: John Wiley & Sons, 1968.

- Staats, A. Behaviorism and cognitive theory in the study of language. In R.L. Schiefelbusch & L.L. Lloyd (Eds.), Language perspectives: Acquisition, retardation and intervention. Baltimore, MD: University Park Press, 1974.
- Steiner, G. On the psychological reality of cognitive structures: A tentative synthesis of Piaget's and Bruner's theories. Child Development. 1974, 45, 891-899.
- Sternberg, R.J. Intelligence, information processing, and analogical reasoning. Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers, 1977.
- Tenezakis, M.D. Lingusitic subsystems and concrete operations. Child Development, 1975, 46, 433-436.
- Thomas, O. & Kintgen, G. Transformational grammar and the teacher of English. New York: Holt Rinehart & Winston, 1974.
- Townsend, D.J. The relations between operational thought and children's use of comparative sentences. Unpublished doctoral dissertation. Wayne State University, 1972.
- Travers, R.W. Essentials of learning. New York: MacMillan Co., 1972.
- Tuddenham, R.D. Theoretical regularities and individual idiosyncrasies. In D.R. Green, M.P. Ford, & G.B. Flamer (Eds.), Measurement and Piaget. New York: McGraw-Hill, Inc., 1971.
- Turner, E.A. & Rommetveit, R. The acquisition of sentence voice and reversibility. Child Development, 1967, 38, 649-660. (a)
- Experimental manipulation of the production of active and passive voice in children. Language and Speech, 1967, 10, 169-180. (b)

- Uziris, I. Situational generality of conservation. In D. Elkind & J. Flavell (Eds.), Studies in cognitive development: Essays in honor of Jean Piaget. New York: Oxford University Press, 1969.
- Vygotsky, L. Thought and language. Cambridge, MA: M.I.T. Press, 1962.
- Wadsworth, B. Piaget's theory of cognitive development. New York: David McKay Co., Inc., 1974.
- White, S. Evidence for a hierarchical arrangement of learning processes. In ..P. Lipsitt & C.C. Spiker (Eds.), Advances in child development and behavior, (Vol. 2). New York: Academic Press, 1965.
- Wiig, E.H. & Semel, E. Development of comprehension of logico-grammatical sentences by grade school children. Perceptual and Motor Skills, 1974, 38, 171-176.
- Wohlwill, J. Piaget's theory of the development of intelligence in the concrete operations period. American Journal of Mental Deficiency (Monograph supplement), 1966, 70.
- Wolman, R.N. & Baker, E.N. A developmental study of word definitions. Journal of Genetic Psychology, 1965, 107, 159-166.
- Wright, P. Transformation and the understanding of sentences. Language and Speech, 1969, 12, 156-166.
- Wright, R.J. & Gallagher, J.M. The relationship between children's performance of concept attainment and Piagetian conservation problem. Journal of Genetic Psychology, 1976, 128, 41-67.

APPENDIX A

APPENDIX A

SYNTAX TASKS

Easy to see

A doll with movable eyes is placed on the table with its eyes closed. The doll is lying down, faced up.

- | | | |
|--|-----|----|
| 1. Is the doll easy to see or hard to see? | yes | no |
| 2. Why is the doll easy/hard to see? | yes | no |
| 3. Make the doll easy/hard to see? (Use opposite question of that used in question 2.) | yes | no |

Promise

First determine if the child knows the meaning of promise by asking:

- | | | |
|--|-----|----|
| 1. Can you tell me what you would say to your friend if you promise you will call him up this afternoon? | yes | no |
| 2. What do you mean if you make someone a promise? | yes | no |
| 3. What is special about a promise? | yes | no |

Ask the child to name two figures--Bozo the clown and Mickey Mouse. Then give the following practice sentences:

- | | | |
|--|-----|----|
| 1. Bozo wants to do a somersault. Make him do it. | yes | no |
| 2. Bozo wants Mickey to do a somersault. Have him do it. | yes | no |
| 3. Mickey decides to stand on a book. Make him do it. | yes | no |

Test sentences:

- | | | |
|--|-----|----|
| 1. Mickey promises Bozo to hop up and down.
Make him hop. | yes | no |
| 2. Bozo promised Mickey to stand on the
book. Make him do it. | yes | no |
| 3. Bozo promised Mickey to do a somer-
sault. Make him do it. | yes | no |
| 4. Mickey promised Bozo to lie down. Make
him do it. | yes | no |
| 5. Mickey promised Bozo to stand on his
head. Make him do it. | yes | no |

Sentences may be repeated freely as the child's needs dictate.

Ask

Two children who know each other well are to carry out the task according to instructions. Only one of the children is tested, however. The second child is a conversational partner only. The children are to be seated at a table on which are placed toy food, Donald Duck, Mickey Mouse and Bozo. Children are to be told they will be playing games with the things on the table. Correct responses are noted in parentheses.

1. I'll tell you what we are going to do here. We're going to play some games with the things on the table. (Pick up Donald Duck) For instance, you'll make him do some things. Can you tell me who he is? yes no
And later we'll do some things with Mickey Mouse and Bozo.

But first I want you to ask (partner's name) some things like:

- | | | |
|--|-----|----|
| 1. Will you ask _____ what time it is?
(What time is it?) | yes | no |
| 2. And will you ask _____ his last name?
(What is your last name?) | yes | no |
| 3. Tell _____ how many pencils there are
here. (Two) | yes | no |
| 4. Okay, now tell _____ who this is. And
would you ask _____ what is in this
box? (What's in the box?) | yes | no |

Now we're going to do some more asking and telling, connected with feeding Bozo. Listen and I'll tell you how.

- | | | |
|---|-----|----|
| 1. Would you first ask _____ what to feed the doll? (What shall I feed the doll?) | yes | no |
| 2. Now would you tell _____ what to feed the doll? (Variable responses) | yes | no |
| 3. And ask _____ what to give him next. (What shall I feed him next?) | yes | no |
| 4. Ask _____ what to feed Bozo. (What shall I feed Bozo?) | yes | no |
| 5. Would you tell _____ what to feed him? (Variable response) | yes | no |

Now we're going to do a few more asking and telling questions.

- | | | |
|---|-----|----|
| 6. Ask _____ to stand up. (Will you stand up?) | yes | no |
| 7. Tell _____ to walk over to the door. (Walk over there.) | yes | no |
| 8. Ask _____ to go back to class. (Will you go back to class?) Partner leaves | yes | no |

Line up three figures on the table. Now all the toys are standing in line. Suppose Donald Duck asks to go first in line.

- | | | |
|---|-----|----|
| 9. What does he say? How does he ask to go first in line. (May I be first?) | yes | no |
| 10. Okay, yes he may. Put him there. Now suppose Mickey Mouse asks Bozo to go first. What does Mickey say? (Bozo, will you go first?) | yes | no |

And, although (evaluated simultaneously)

The examiner reads aloud the following statements to evaluate the youngster's comprehension of although:

- | | | |
|---|-----|----|
| 1. Although my favorite TV program was on, I..... | yes | no |
| 2. I wore a heavy jacket, although..... | yes | no |

If the subject demonstrates correct usage of the sample questions, the examiner reads aloud the following statements in alternating order:

- | | | | |
|----|--|-----|----|
| 1. | The cowboy scolded the horse for running away, <u>although</u> I would have done the same. What would I have done? (Run away.) | yes | no |
| 2. | The cowboy scolded the horse for running away, <u>and</u> I would have done the same. What would I have done? (Scolded the horse.) | yes | no |
| 3. | Mother scolded Gloria for running away <u>and</u> I would have done the same. What would I have done? (Scolded Gloria.) | yes | no |
| 4. | Mother scolded Gloria for answering the phone, <u>although</u> I would have done the same. What would I have done? (Answered the phone.) | yes | no |

Those who can read will be given sentences typed on cards to follow as they are read aloud. Repetitions will be made as necessary.

APPENDIX B

APPENDIX B

COGNITIVE TASKS

Conservation

Number

- A. Use two rows of poker chips, seven black and seven red, each placed opposite until rows are identical in length and number.

1. Count the number of chips in each row. yes no
Extend the row of red chips in both directions to twice the length of the row of black chips. Do you think there are more black chips in this row?

2. Do you think there are more red chips yes no
in this row?

3. Do you think there are the same number yes no
of black and red chips?

4. Why do you think so? yes no

- B. Subdivide the red chip row into a row of four chips and a row of three chips. Place the rows parallel to the row of seven black chips.

1. Do you think there are more black yes no
chips in this row?

2. Do you think there are the same number yes no
of black chips and red chips?

3. Pointing to both rows of red chips, yes no
ask: Do you think there are more red chips in this row or this row?

4. Why do you think so? yes no

- C. Place red chips in a vertical pile in front of the other row.

1. Do you think there are more black yes no
chips in this row?

- | | | | |
|----|--|-----|----|
| 2. | Do you think there are the same number of black chips and red chips? | yes | no |
| 3. | Do you think there are more red chips in this row? | yes | no |
| 4. | Why do you think so? | yes | no |
- D. Extend the black chips in both directions to twice the length of the white row.
- | | | | |
|----|--|-----|----|
| 1. | Do you think there are more red chips in this row? | yes | no |
| 2. | Do you think there are the same number of red chips and black chips? | yes | no |
| 3. | Do you think there are more black chips in this row? | yes | no |
| 4. | Why do you think so? | yes | no |

Substance

Two balls of plasticine of equal size and weight are placed in front of the child. Are the two balls of clay the same? (Satisfy the child by allowing him to make changes if he does not agree the two balls are the same.) Deform only one of the balls as you ask the questions.

A. Now I change this one into a sausage.

- | | | | |
|----|---|-----|----|
| 1. | Do you think there is more clay in the ball? | yes | no |
| 2. | Do you think there is more clay in the sausage? | yes | no |
| 3. | Do you think they are the same? | yes | no |
| 4. | Why do you think so? | yes | no |

B. After restoring the sausage to the original ball form: Now I change this one into a ring.

- | | | | |
|----|--|-----|----|
| 1. | Do you think there is more clay in the ball? | yes | no |
| 2. | Do you think there is more clay in the ring? | yes | no |

3. Do you think they are the same? yes no

4. Why do you think so? yes no

C. Now I change this one into a cross.

1. Do you think there is more clay in the ball? yes no

2. Do you think there is more clay in the cross? yes no

3. Do you think they are the same? yes no

4. Why do you think so? yes no

Weight

Use two balls of plasticine of each of the following colors, equal in weight and volume: green, blue, red and yellow.

A. Two green balls of plasticine are presented. Now I change this one into a cup.

1. Do you think the cup weighs more than the ball? yes no

2. Do you think the cup weighs the same as the ball? yes no

3. Do you think the cup weighs less than the ball? yes no

4. Why do you think so? yes no

B. Two balls (blue) of plasticine are presented. Now I change this one into a ring.

1. Do you think the ring weighs more than the ball? yes no

2. Do you think the ring weighs same as the ball? yes no

3. Do you think the ring weighs less than the ball? yes no

4. Why do you think so? yes no

C. Two red balls of plasticine are presented. Now I change this one into a cross.

- | | | | |
|----|---|-----|----|
| 1. | Do you think the cross weighs more than the ball? | yes | no |
| 2. | Do you think the cross weighs the same as the ball? | yes | no |
| 3. | Do you think the cross weighs less than the ball? | yes | no |
| 4. | Why do you think so? | yes | no |

Volume

Three water glasses are placed on the table in front of the child. Two of the glasses are identical (long and thin) and an equal amount of water is contained in each. The third water glass is short and wide and is empty. (Satisfy the child that the amount of water in each of the glasses is the same by allowing him to make changes if he does not agree that the amount is the same.) Empty only one of the glasses into the short, wide glass and ask the questions.

A. Now I pour the water that is in this glass into the other glass.

- | | | | |
|----|---|-----|----|
| 1. | Do you think there is more water in this glass? | yes | no |
| 2. | Do you think there is more water in this glass? | yes | no |
| 3. | Do you think they are the same? | yes | no |
| 4. | Why do you think so? | yes | no |

Present two glasses filled with water and two balls of plasticine to the child. Satisfy the child that the two balls and the two glasses of water are equal by allowing him to make changes if he does not agree that the two balls are equal. Deform one of the balls leaving the other in a ball.

B. Now I change this one into a sausage.

- | | | | |
|----|--|-----|----|
| 1. | Do you think this sausage will make the water rise (go up) more? | yes | no |
| 2. | Do you think this ball will make the water rise (go up) more? | yes | no |
| 3. | Do you think they will both make the rise (go up) the same? | yes | no |

- | | | | |
|---------------------------------------|--|-----|----|
| 4. | Why do you think so? | yes | no |
| C. Now I change this one into a ring. | | | |
| 1. | Do you think this ring will make
the water rise (go up) more? | yes | no |
| 2. | Do you think this ball will make
the water rise (go up) more? | yes | no |
| 3. | Do you think they will both make
the water rise (go up) the same? | yes | no |
| 4. | Why do you think so? | yes | no |

Seriation

Present ten straws of various sizes to the child in a random order. Show him the shortest straw and the longest straw.

1. This is the shortest straw and this is the longest straw. I want you to put them in order for me.

If the child is unable to complete the task, order the straws for him.
Then ask:

2. Now I want you to put these two yes no
straws in line where they belong.
Just put them where they go with
the others.
- seconds

Class Inclusion

A. Present four baseball players and two football players:

- | | | |
|--|-----|----|
| 1. Are there more <u>people</u> or more
baseball players? | yes | no |
| 2. Why do you think so? | yes | no |

B. Four butterflies and two airplanes:

- | | | | |
|----|---|-----|----|
| 1. | Are there more butterflies or more
<u>things that fly?</u> | yes | no |
| 2. | Why do you think so? | yes | no |

C. Six roses and two daisies.

1. Are there more flowers or more daisies? yes no

- | | | |
|---|-----|----|
| 2. Why do you think so? | yes | no |
| D. Five strawberries and two bananas. | | |
| 1. Are there more strawberries or more
more <u>things to eat</u> ? | yes | no |
| 2. Why do you think so? | yes | no |
| E. Seven dogs and three horses. | | |
| 1. Are there more animals or more dogs? | yes | no |
| 2. Why do you think so? | yes | no |

APPENDIX C

APPENDIX C

SCORING RULES FOR SYNTACTIC TASKS

Easy to see

Scored correct if:

1. States doll is easy to see
2. States doll is easy to see because she is in sight
3. Makes doll hard to see by hiding it or covering subject's own eyes

Scored error if:

1. Fails to do any of the three above

Criteria:

1. All three criteria are met.

Promise

Scored correct if subject makes:

1. Mickey hop
2. Bozo stand on a book
3. Bozo do a somersault
4. Mickey lie down
5. Mickey stand on his head

Scored error if:

1. Subject picks up wrong figure

Criteria:

1. 5 of 5 correct

Ask (Note only starred items are to be scored for evaluation purposes)

Scored correct if:

1. Response in parentheses (See Appendix A) is given.

Scored error if:

1. Statement is not put in interrogative form.

Criteria:

1. 7 of 9 sentences answered correctly.

Although

Scored correct if:

1. Both although questions are answered correctly.

Scored error if:

1. Either of the two questions are answered incorrectly

Criteria:

1. 2 of 2 correct

APPENDIX D

APPENDIX D

SCORING RULES FOR COGNITIVE TASKS

Conservation

Number, substance, weight and volume:

Scored correct if subject answered two of three yes/no questions correctly at each level.

Final score was determined by how many of the four levels were correctly answered. Score could be 0 to 4.

Seriation

First seriation task:

Order the straws correctly
and

0 = More than 60 seconds necessary to complete the task

1 = 17 to 60 seconds necessary to complete the task

2 = 7 to 16 seconds necessary to complete the task

Second seriation task:

Insert two additional straws into the existing series
and

0 = Unable to complete the task or took more than 45 seconds
to complete the task

1 = 13 to 45 seconds to complete the task

2 = Less than 13 seconds necessary to complete the task

Class inclusion

Answer first question of each category correctly (see Appendix B; underlined word is the correct response)

Score determined by how many of the five questions were correctly answered.

APPROVAL SHEET

The dissertation submitted by Linda Jones has been read and approved by the following committee:

Dr. Joy J. Rogers, Director
Associate Professor, Educational Foundations,
Loyola

Dr. Pedro J. Saavedra
Assistant Professor, Educational Foundations,
Loyola

Dr. Ronald Morgan
Assistant Professor, Educational Foundations,
Loyola

Dr. Jack A. Kavanaugh
Association Professor and Chairman of the Department
of Educational Foundations
Loyola

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

April 20, 1979
Date

Joy Rogers
Director's Signature