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GRADUATE COLLEGE

RELATIONSHIPS BETWEEN T-UNIT MEASURES OF ORAL LANGUAGE MATURITY AND PIAGETIAN STAGE OF MENTAL DEVELOPMENT

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

BY

Robert Powell Abbott

Norman, Oklahoma

1973

RELATIONSHIPS BETWEEN T-UNIT MEASURES OF ORAL LANGUAGE MATURITY AND PIAGETIAN STAGE OF MENTAL DEVELOPMENT

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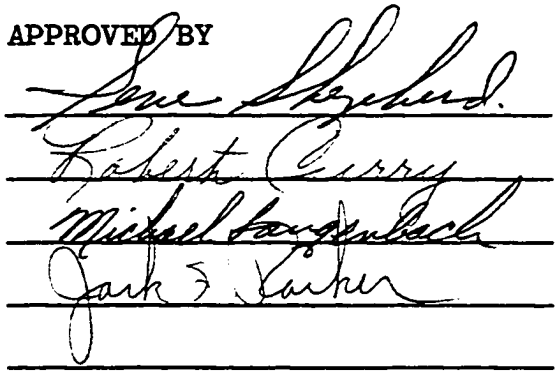

DISSERTATION COMMITTEE

DISSERTATION

RELATIONSHIPS BETWEEN T-UNIT MEASURES OF ORAL LANGUAGE MATURITY AND PIAGETIAN STAGE OF MENTAL DEVELOPMENT

This study investigated relationships between language maturity and Piagetian stage of mental development. Six Piagetian conservation tasks were utilized as an index of stage of mental development. The six tasks were: 1) Conservation of Number, 2) Conservation of Liquid, 3) Conservation of Solid Amount, 4) Conservation of Area, 5) Conservation of Length, and 6) Conservation of Weight. Language was analyzed in terms of Hunt's T-Unit measure of language maturity, comparative adjectives and passive sentences were assumed to be language tasks related to decentering and reversibility.

Eighty first graders, forty boys and forty girls, selected to control for the effects of age, intelligence, and socioeconomic status were administered six Piagetian Conservation Tasks. Subjects viewed silent cartoon films after which each subject told a story about each film. The stories were tape recorded and analyzed in terms of total number of T-units, mean length of T-unit, and ratio of subordinate clauses to all clauses. An instrument consisting of items designed to elicit comparative and passive sentences was also administered.

Total conservation score and scores on each of the five measures of language did not differ significantly by sex. None of the correlation coefficients for conservation with each of the five language tasks were significant for either boys or girls at the .05 level. A multiple regression analysis for total conservation score and composite language score revealed no significant correlation for conservation and language. A reliability coefficient of .59 was computed for the Mean Length of T-unit measure. The relatively low reliability of the T-unit measure for the subjects of this study may have contributed to the low correlation between Conservation and Mean Length of T-unit.

ACKNOWLEDGEMENTS

This writer wishes to express his sincere appreciation to his graduate committee for the invaluable assistance and guidance provided by the committee. A debt of gratitude is expressed to Dr. Gene Shepherd, committee chairman, for his help and guidance while doing this study. Appreciation is expressed to committee members Dr. Robert Curry, Dr. Michael Langenbach, and Dr. Jack Parker for their help and counsel during the study. The writer is indebted to Dr. William Graves for his invaluable assistance during this study.

For their excellent cooperation, appreciation is extended to the administrators, teachers, and pupils of the five elementary schools in Cedar Falls, Iowa, which were a part of this study. To the members of the Department of Curriculum and Instruction, University of Northern Iowa sincere thanks is expressed for the encouragement and assistance given by the various members of that department.

To my wife, Mary Frances, this study is dedicated. Her help and encouragement were steadfast. To daughter, Marilyn, a promise that more time can now be spent doing those things a five year old thinks important.

To Mrs. Sandra Heller sincere appreciation is expressed for her diligent efforts in transcribing the data and assembling the final copy of this study.

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RELATIONSHIPS BETWEEN T-UNIT MEASURES OF ORAL LANGUAGE MATURITY AND PIAGETIAN STAGE OF MENTAL DEVELOPMENT

CHAPTER I

INTRODUCTION

Traditionally, instruction and learning within the elementary school have relied, to a great extent on the use and understanding of language on the part of young children. That language competency is an important area of child development could be seen in studies dealing with first grade reading instruction.[1] Heilman, Betts, and Hildreth indicated that language competency was an important aspect of learning to read.[2] Dykstra suggested that language competency was one factor of possible significance in learning to read.[3] Bougere

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[1]Marguerite B. Bougere, "Selected Factors in Oral Language Related to First-Grade Reading Achievement," Reading Research Quarterly, V (Fall, 1969), 34.

[2]Arthur W. Heilman, Principles and Practices of Teaching Reading (Columbus, Ohio: Charles E. Merrill Publishing Co., 1972), p. 147; Emmett A. Betts, Foundations of Reading Instruction (New York: American Book Co., 1957), p. 128; Gertrude Hildreth, "Reading Achievement and Linguistic Ability," Education, LXIX (May, 1949), 567.

[3]Robert Dykstra, "Auditory Discrimination and Beginning Reading Achievement," Reading Research Quarterly, I (Spring, 1966), 5-34.

pointed out that even though there is currently much interest in verbal language approaches to instruction in the language arts, factors related to maturity in oral language usage have not been completely identified.[1] Smith as well as Blake and Amato indicated the need for studies dealing with the nature of language development to provide evidence regarding how the child uses language as well as to provide a basis for planning curriculum and instructional strategies that will take into account individual differences.[2]

Donoghue and Frost reported that variables thought to be associated with the language maturity of young children have been the focus of numerous studies showing a relationship between these variables and language development.[3] Travis and McCarthy investigated the retarding effects of speech disorders on language development.[4]

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[1]Bougere, "Oral Language," p. 34.

[2]E. Brooks Smith, Kenneth S. Goodman, and Robert Meredith, Language and Thinking in the Elementary School (New York: Holt, Rinehart and Winston, Inc., 1970), p. 17; Howard E. Blake and Anthony J. Amato, "Needed Research in Oral Language: Part II," Elementary English, XLIV (March, 1967), 259-262.

[3]Mildred R. Donoghue, The Child and the English Language Arts (Dubuque, Iowa: William C. Brown Company, 1971), p. 207; Joe L. Frost, Language Development in Children, ed. by Pose Lamb (Dubuque, Iowa: William C. Brown Company, 1971), pp. 1-37.

[4]Dorothea A. McCarthy, "Research in Language Development: Retrospect and Prospect," Child Development Monographs, XXIV (1959), 13-15; L. E. Travis, (Ed.) Handbook of Speech Pathology (New York: Appleton-Century-Crofts, 1957), p. 5.

Bernstein, McCarthy, and Templin reported that larger vocabularies and longer sentences were used by children of higher socioeconomic status than by children of the working class.[1]

Positive relationships between language and intelligence were reported by Sharples and Strickland.[2] During the 1930's Davis and Anderson found that females excelled in language production, however, thirty years later Riling and Loban found no definite sex difference in language.[3] A positive correlation between health and language competency was found by Loban.[4]

One area of child development that has been little studied as it relates to language competency is stages of

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[1]Dorothea A. McCarthy, "Research in Language," British Journal of Sociology, XI (1960), 586-590; Basil B. Bernstein, "Language and Social Class," British Journal of Sociology, XI (1960), 271-276; Mildred C. Templin, Certain Language Skills in Children: Their Development and Interrelationships (Minneapolis: University of Minnesota Press, 1957), p. 147.

[2]Derek Sharples, "Factors Affecting the Composition Performance of Ten Year Old Children," British Journal of Educational Psychology, XXXVII (February, 1967), 406IA; Ruth G. Strickland, The Language of Elementary School Children: Its Relationship to the Reading Textbooks and the Quality of Reading of Selected Children, Bulletin of the School of Education, Indiana University (1962), pp. 1-89.

[3]Mildred E. Riling, Oral and Written Language of Children in Grades 4 and 6 Compared with the Language of Their Textbooks, Project No. 2410 (Washington, D.C.: U.S. Office of Education, 1965), p. 185; Walter D. Loban, The Language of Elementary School Children, NCTE Research Report No. 1 (Champaign, Illinois: National Council of Teachers of English, 1963), p. 89.

[4]Loban, Language of Elementary School Children, p. 87.

mental development as described by Piaget and Vygotsky.[1] Piaget indicated that language was one of several functions arising from the symbiotic function which occurred as the child moved from the sensorimotor stage to the preoperational stage.

Views of the relationships between language and intelligence differ among those who have studied these two aspects of human development. Vygotsky, a Russian psychologist, stated his belief that speech development followed the same course and seemed subject to the same influences as other mental operations. He suggested that complex logical thinking is dependent upon interiorized speech.[2]

Bruner has raised questions concerning the relationships between intelligence and language. He saw language and thought processes being greatly influenced by one's culture. He pointed out that there was a unique relationship between syntax and logical structures of thought. "In order for the child to use language as a vehicle of thought he must begin to match the world of experience with the structural principles of syntax."[3]

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[1]Jean Piaget and Barbel Inhelder, The Psychology of the Child (New York: Basic Books, Inc., 1969), pp. 97-99; Lev. S. Vygotsky, Thought and Language, trans. by E. Haufmann (Cambridge: M.I.T. Press, 1962), pp. 43-47.

[2]Vygotsky, Thought and Language, pp. 43-47.

[3]Jerome S. Bruner, Rose R. Oliver, and Patricia M. Greenfield, et al., Studies in Cognitive Growth (New York: John Wiley and Sons, Inc., 1966), p. 3.

The work of Chomsky has resulted in a nontaxonomic theory of language. Chomsky described an internalized set of language rules as they might have been mastered by an idealized speaker-hearer. Chomsky's system provided a useful device for analyzing what has been learned by a speaker-hearer. The question became one of understanding the nature of what Chomsky refers to as an innate schema of language universals. Chomsky indicated that at the present time there was little on which to base a description of this innate acquisition of the structure of language.[1]

The comparison of language maturity with progress in mental development involved identifying characteristics associated with mental development. Piaget indicated that a useful device for this purpose was the notion of conservation whereby the child maintained an invariance of quantity in the face of change. Important components of conservation include the knowledge that actions could be reversed (reversibility) and the ability to consider more than one dimension of an object (decentering or compensation).[2]

Piaget and Inhelder, as well as Sinclair-de-Zwart have speculated that there is a positive relationship between

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[1]Noam Chomsky, Aspects of a Theory of Syntax (Cambridge: M.I.T. Press, 1965), pp. 27-58.

[2]Piaget and Inhelder, Psychology, pp. 97-99.

children's use of language (as seen in their use of comparatives and passives) and their ability to conserve.[1]

Little if any empirical evidence has been provided by Piaget in support of his view that language acquisition is closely associated with stage of mental development. If the developmentalists were right, it seemed logical to expect that the child's level of language maturity at six years of age would be related to his stage of mental development.

Purpose of the Study

The purpose of this study was to identify relationships between measures of language maturity and stage of mental development in order to investigate the usefulness of the Piagetian Conservation Tasks as a means of predicting oral language maturity. Sex differences were analyzed to determine their association with conservation and measures of language maturity.

Problem of the Study

Are there significant relationships between scores on six Piagetian Conservation Tasks and five measures of oral language maturity: number of T-units, mean length of T-units, ratio of subordinate clauses to all clauses, number of comparatives, and number of passive sentences given; which

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[1]Piaget and Inhelder, Psychology, pp. 89-90; Hermina Sinclair-de-Zwart, "Developmental Psycholinguistics," Research Perspectives, ed. by David Elkind and John H. Flavell (New York: Oxford University Press, 1969), 315-336.

justifies the use of the Piagetian Conservation Tasks as a predictor of oral language maturity for first grade boys and girls?

Hypotheses

The following hypotheses were formulated to test the relationships between measures of oral language maturity and stage of mental development as indicated by six conservation tasks as well as to test the differences between boys and girls. Level of significance was set at $p < .05$.

1. The mean scores for conservation and each language task will not differ significantly by sex.

2. A significantly positive relationship will be found between conservation scores and the scores of the boys on the several measures of language maturity.

3. A significantly positive relationship will be found between conservation scores and the scores of the girls on the several measures of language maturity.

4. The correlation coefficients between conservation score and the various language scores will not differ signif-cantly by sex.

Definition of Terms

Measures of Language Maturity.--Five measures of language maturity were identified:

Number of T-units referred to a unit of language containing one main clause with all the subordinate clauses attached to it.

Mean length of T-unit referred to that index figure arrived at by dividing the total number of words in a subject's oral language sample excluding garbles, edits, repetitions and holders; by his total number of T-units.

Ratio of subordinate clauses to all clauses referred to that figure computed by dividing the number of subordinate clauses by all clauses in the oral language sample of the subject.

Number of comparatives were determined by counting the total number of comparative describing words used by the subject in response to the three comparative items of the Language Tasks--Comparatives. These items were designed to measure a subject's ability to decenter in language by describing more than one dimension of an object as well as to show relative usage between vectors (a lot, a little) and comparatives (more, less).

Number of passive sentences given referred to the number of passive sentence forms produced by the subject in response to the language items of Language Tasks--Passives. These items were designed to measure subject's ability to demonstrate reversibility in language.

Conservation.--Conservation is the ability to determine that a quantity remains invariant in the face of certain superficial changes. Conservation was used by Piaget as an indication that an individual had moved from the preoperational stage to the concrete operational stage of mental development. Conservation was characterized by ability to

decenter (consider more than one dimension of an object) and reversibility (realization that an action can be reversed). In this study six Piagetian Conservation Tasks were used to determine conservation.

Assumptions

A basic assumption to the problem was that comparative markers and passive sentences represent decentering and reversibility respectively.

Procedures of the Study

Population and Sample

The population of this study consisted of first grade pupils from five public elementary schools in Cedar Falls, Iowa. The community, a university town, has a population of 30,000. Rath Packing Company and the John Deere Tractor Works are located some ten miles away.

The sample consisted of eighty first graders from the five elementary schools, forty each of boys and girls. Initially, a total of 214 pupils were screened to eliminate those who were members of minority groups, those who were physically handicapped, and those who were receiving speech therapy. Individuals who scored outside the range of plus or minus one standard deviation from the mean of the S.R.A. Primary Mental Abilities Test were further eliminated. Those individuals who scored outside the range of the middle socioeconomic status (13 to 20) on the socioeconomic status

questionnaire found in Appendix A were also eliminated. Ninety pupils remained as a pool of subjects from which forty boys and girls were randomly selected by reference to a table of random numbers. The design of the study was correlational. Causality cannot be determined from any of the coefficients of this study.

Two sessions were held with each subject. During the first session each subject was administered the six Piagetian Conservation Tasks and the instrument, Language Tasks--Comparatives and Passive Sentences. During the second session each subject was shown two short cartoon films without sound. After each film the subject was individually interviewed by an examiner who asked the child to tell in his own words the story shown in each film. A uniform set of instructions was followed by each examiner. (See Appendix B.)

These stories were recorded on cassette tape recorders and later transcribed. The transciptions were analyzed by the writer in consultation with a graduate student majoring in linguistics at the University of Northern Iowa. The analysis consisted of identifying total number of T-units; subordinate clause ratio, and mean length of T-units.

Instruments

Primary Mental Abilities Test.--The Primary Mental Abilities Test was used as a measure of intelligence. The test measures five components of mental ability. They include verbal meaning, number facility, reasoning, perceptual speed,

and spatial relations. The test, a group test, was administered to the subjects in the Fall of the 1972-73 school year. Buros indicated in The Seventh Mental Measurement Yearbook that the reliability coefficients for the total scores range between .83 and .95 and may be considered satisfactory.[1] The manual accompanying the PMA indicated a mean of 100 and a standard deviation of 16 for this test.

Questionnaire By Which Socio-economic Information Was Secured From Parents.--The Questionnaire By Which Socio-economic Information Was Secured From Parents developed by Eells and others was used to determine the socio-economic status of the subjects.[2] The questionnaire used in this study was an adaptation of the original questionnaire used by Eells. The socio-economic status of each subject was determined by examining four characteristics: (1) Occupation, (2) Education, (3) House type, and (4) Dwelling area. The questionnaire was sent to the parents of each child. The parents supplied information on level of parent education and parent occupation. Ratings were made on house type by the writer's observation of the house in which each subject lived. Ratings on dwelling area were made by both a personal observation and consulting with the County Assessor who provided

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[1]Oscar K. Buros, ed., The Seventh Mental Measurement Yearbook (Highland Park: The Gryphron Press, 1972), p. 1065.

[2]Kenneth Eells, et al., Intelligence and Cultural Differences (Chicago: The University of Chicago Press, 1951), p. 363.

information concerning property values. Each of the four characteristics were rated on a seven point scale ranging from "1" very high status value, to "7" very low status value. The ratings on the four characteristics were combined into a single index. A total score within the range 13 to 20 was used to indicate the middle socio-economic status subjects. (Appendix A provides a copy of the questionnaire.)

T-units.--T-units as described by Hunt were used as a measure of language maturity.[1] He describes the T-unit as a unit of language containing one main clause with all the subordinate clauses attached to it. The number of subordinate clauses can be none. Total number of T-units, mean length of T-units and ratio of subordinate clauses to all clauses were three separate measures of language maturity used in the present study.

The Piagetian Conservation Tasks.--The six Piagetian Conservation Tasks of Number, Solid Amount, Liquid Amount, Area, Length and Weight were individually administered to each subject.[2] Responses were scored "0" indicating no conservation, "1" indicating a transitional stage of conservation or "2" indicating a firm awareness of conservation on

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[1]Kellog W. Hunt, Grammatical Structures Written at Three Grade Levels, NCTE Research Report No. 3 (Champaign, Illinois: National Council of Teachers of English, 1965), p. 20.

[2]John W. Renner, Robert F. Bibens, and Gene D. Shepherd, Guiding Learning in the Secondary Schools (New York: Harper and Row, 1972), pp. 95-100.

the part of the subject.[1] This instrument was used as an indication of stage of mental development. (See Appendix C.)

Language Tasks--Comparatives and Passive Sentences.--The instrument Language Tasks--Comparatives and Passive Sentences was administered in order to measure each subject's ability to decenter and reverse in language.

Both Sinclair-de-Zwart and Bellugi-Klima have identified and described these tasks in the literature. Sinclair-de-Zwart and Piaget have suggested the two language tasks are related to conservation.[2]

Use of comparatives was scored by counting total number of comparatives produced by each subject. Passive sentences were scored by counting the number of passive sentences given. (See Appendix D.)

Treatment of the Data

Hotelling's T^2 test was used to determine whether a significant difference existed between the mean scores for conservation and language tasks by sex as stated in Hypothesis One. Hotelling indicated that the most appropriate procedure for determining whether two or more groups differed significantly in their mean values consisted of methods of multivariate analysis of variance. The multivariate normal

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[1]Millie Almy, Young Children's Thinking (New York: Teachers College Press, 1966), p. 24.

[2]Piaget and Inhelder, Psychology, pp. 89-90; Sinclair-de-Zwart, "Developmental Psycholinguistics," pp. 333-334.

distribution has $p(p+1)/2$ independent parameters, where p equals the six variables in the study. The distribution of a statistic may involve all of them. If p is large, the number of these parameters is large. When none of them was known apart from the observations, the control of error probabilities became difficult. The square root T was a direct generalization of the t of the t test score distribution and for p variates had all the uses that t had for one. Tables are available for conveniently obtaining the critical value of the F statistic having probability of .05 with $n_1=p$ and $n_2=n-p+1$ degrees of freedom from which to compute $T^2=npF/(n-p+1)$ where n equals the number of male subjects minus 1, plus the number of female subjects minus 1.[1]

Hypotheses Two and Three were treated by the use of correlational analysis to determine the relationship between conservation scores and the five language scores for each sex as well as to investigate the use of the conservation tasks as a screening device to determine language maturity.

Ferguson indicated that for bivariate data consisting of pairs of measurements for which one wishes to know the degree of relationship, the correlation is the appropriate statistical procedure.[2] Prediction which is concerned with estimating one variable from the knowledge of another is

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[1]Harold Hotelling, "The Relations of the Newer Multivariate Statistical Methods to Factor Analysis," British Journal of Statistical Psychology, X (November, 1957), 69-79.

[2]George A. Ferguson, Statistical Analysis in Psychology and Education (New York: McGraw-Hill Book Company, 1966), pp. 105-107.

another aspect of bivariate data.

Hypothesis Four was tested with a series of Z tests to determine whether the correlation coefficients between conservation scores and the five language scores differed by sex. Ferguson indicated that the significance of the difference between two correlation coefficients r_1 and r_2 could be tested using Fisher's z transformation.[1] Ferguson further stated that the rationale underlying the application of Fisher's z test was the same as that for arithmetic means. The equation used was as follows:

$$z = \frac{z_r 1 - z_r 2}{\sqrt{1/(N_1-3) + 1/(N_2-3)}}$$

In order to further test the relationship between conservation and language maturity, the score of the six Piagetian Conservation Tasks and the composite scores for the five measures of language maturity for the forty boys and forty girls were analyzed by means of a multiple regression technique.[2]

Limitations

This study is limited to the group identified in the sample. It will not be possible to speculate about other ranges of IQ, other age groups or another socioeconomic status group.

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[1]Ferguson, Statistical Analysis, pp. 187-188.

[2]W. J. Dixon, Biomedical Computer Programs (Berkeley: University of California Press, 1970), p. 309.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter presents a review of the professional literature related to questions of the relationship of theories of language development and theories of mental development. Selection of the studies reviewed here was guided by two criteria. The studies were either fundamental references in the field or they fit within the design of the study in that the studies dealt with relationships between language development and mental development. The studies presented dealt with the areas of (1) language acquisition emphasizing what is acquired, (2) relationships between language maturity and mental development emphasizing how language might be acquired, (3) language measuring techniques, and (4) stages of mental development.

Language Acquisition

McNeil indicated that there were a number of similarities among the languages of the world.[1] All languages

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[1]David McNeil, "Developmental Psycholinguistics," in The Genesis of Language: A Psycholinguistic Approach, ed. by Frank Smith and George Muller (Cambridge: M.I.T. Press, 1966), 21.

appeared to be structured from simple components to more complex structures.

Dale pointed out that language was highly arbitrary and always rule governed.[1] To know a language a person must have intuitively mastered a set of rules which specify how words can be combined into sentences. After mastering these rules a speaker could understand and produce an unlimited number of sentences many of which he had never before heard.

Chomsky indicated that the language learner was able to expand the set of rules (grammar) to include many different kinds of sentences including passives, negatives, and questions.[2] Transformational grammar attempted to explain the knowledge of a language that was possessed by a speaker of that particular language and enabled the speaker-hearer to make predictions about which strings of words were grammatical and which were not as they were encountered.

Miller and Ervin reported their case study investigation of the development of syntax in twenty-five young children.[3] The earliest combinations of words consisted of two word utterances including words in just two classes. One class (operators) contained few members which were used with

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[1]Philip S. Dale, Language Development: Structure and Function (Hinsdale, Illinois: The Dryden Press, Inc., 1972), pp. 3-4.

[2]Chomsky, Aspects of a Theory of Syntax, pp. 25-28.

[3]Wick Miller and Susan Ervin, "The Development of Grammar in Child Language," Monographs of the Society for Research in Child Development, XXIX (1964), 9-34.

high frequency (see, where). The other class contained all other words. Once the children combined one operator with another word, they often began to combine it with many other words (see doggie, see light). An operator was never combined with another operator. As time progressed these two-word expressions gradually became elaborated. Miller and Ervin found similar patterns of progression of the children's language elaboration as was seen in the example of a cat lapping milk. It developed as follows: "Milk," then "kitty drink," then "kitty drink milk," and finally "the kitty is drinking his milk." Consistently omitted in the early speech of the twenty-five subjects were function words, verb and noun inflections, and auxiliary verbs. As the children began to use noun and verb inflections the types of mistakes they made indicated that the rules the children were using were overgeneralized and did not include exceptions to the rules for adding inflections.

Brown and Bellugi pointed out influences they had observed in young children's ability to communicate effectively with short sentences.[1] The children were able to extract the most meaningful words from the complex utterances they heard from the adults around them. Brown and Bellugi identified three phenomena at work. Meaningful content words were the type of words the mothers were practicing with the

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[1]Roger Brown and Ursula Bellugi, "Three Processes in the Child's Acquisition of Syntax," Harvard Educational Review, XXXIV (1964), 131-151.

children one at a time. Concrete nouns were often paired with objects such as the mother who picked up an orange and said "orange." Content words also were the words that received the heaviest stress by adult speakers. Finally a number of the mothers were observed to be imitating the speech of their children and elaborating it as they repeated back to the child what he had just said. Brown and Bellugi concluded that the expansion of the children's own utterances by the mothers was a factor in the language development of the children because it provided a close comparison between the child's utterance and the adult form of that same utterance.

Braine explored the usefulness of grammatical structure (specifically word order) as a mean of explaining the acquisition of syntax.[1] Subjects included eight boys and eight girls ranging in age from 9 years 6 months to 10 years 5 months. Subjects were introduced to a simple artificial language made up of two classes of nonsense words, A and P. A words were always presented on the left, and P words on the right of a vacant position. During the testing period which called for subjects to fill in a vacant space with the same class of word as was used in the training period, 78 percent of the vacant spaces were filled appropriately. The tendency to respond correctly was highly significant (χ^2=15.5,df=2, $p < .001$).

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[1]Martin S. Braine, "On Learning the Grammatical Order of Words," Psychological Review, LXX (1963), 323-348.

The results indicated that subjects who had experienced sentences in which words occurred in a certain position and context tended to place these words in the same position in new contexts. Braine indicated that the results of this study seemed to suggest an explanation of the infants acquisition of word order.

> He constantly hears the same expressions recurring in the same positions in his verbal environment; these therefore come to sound familiar and therefore right to him in these positions, and consequently in his own language he reproduces the same positional relationships.[1]

Whipple and Maier investigated perceptual-motor and language development in two groups of children.[2] One group of twenty children had had a year of kindergarten experience while a second group of twenty had just entered a Summer kindergarten with no previous school experience. Each child was given the Bender-Gestalt test and the Peabody Picture Vocabulary Test. The correlation coefficient computed for mean Bender errors and the PPVT MA was -.71 for the kindergarten experienced group and -.43 for the no kindergarten experience group. Whipple and Maier concluded that language development and motor development are related.

Slobin tested the generative and transformational model of grammar offered by Chomsky which suggested the existence of a small set of rules used to generate an infinite

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[1]Braine, "Learning Grammatical Order," p. 327.

[2]Clifford I. Whipple and Louise Maier, "Perceptual-Motor Maturation and Language Development in Young Children," Perceptual and Motor Skills, XXIII (1966), 1208.

number of sentences of a language.[1] Specifically Slobin tested the degree of difficulty of four sentence types including (1) kernal (simple active), (2) negative, (3) passive, and (4) passive negative. Responses were scored in terms of amount of time and number of errors. Subjects included eight boys and eight girls each in kindergarten, second, fourth, and sixth grades; and eight adults. Subjects were presented a spoken sentence and a picture. Subjects were to decide if the sentence was true or false with regard to the picture and press a switch.

Slobin found the same order of difficulty for each type, namely: Kernal < passive < negative < passive negative. Changes in performance with age were significant in terms of time and errors. Ranking of sentence types in terms of difficulty revealed significant agreement among all eighty subjects. Slobin stated that it seemed reasonable to conclude that degree of difficulty was due to the number of transformations involved in each sentence.

Menyuk explored the usefulness of Chomsky's model of transformational grammar to describe the grammar of children.[2] Menyuk described transformational grammar as rules formulated for generating possible sentences in terms of categories of

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[1]Dan I. Slobin, "Grammatical Transformations and Sentence Comprehension in Childhood and Adult," Journal of Verbal Learning and Verbal Behavior, V (1966), 219-227.

[2]Paula Menyuk, "Syntactic Structures in the Language of Children," Child Development, XXXIV (1963), 407-422.

grammatical structure in the language (negative sentences, interrogative sentences). Menyuk stated the hypothesis that the characteristics of a particular class of sentences was memorized by the child who then went on to produce new instances of that class.

Menyuk's sample consisted of 24 boys and 24 girls in nursery school and 25 boys and 23 girls in first grade. There was no significant difference between mean IQ for nursery school children and first grade children or between males and females. Speech was tape recorded in three stimulus situations. Transcriptions were analyzed in terms of mean number of sentences. Nursery school children produced 82.9 sentences while first grade children produced 95.7 sentences. No difference was found between number of sentences produced by boys and girls. Menyuk found that some transformations were used by significantly more first grade children than by the nursery school child. First grade children used significantly more ($p < .05$) of the following constructions: passive sentences, instances of the auxiliary have, instances of conjunction deletion, subordination, and nominalization than did nursery school children.

Menyuk concluded that the basic structures which generated all of the sentences of children could be described by the Chomsky model. All the basic structures used by adults to generate their sentences were found in the grammar of the nursery school group. There were no significant differences in the use of all the structures between males and

females or between children above and below the mean IQ.

Child Language Development and the Growth of Mental Operations

Views of the relationship between language development and mental development differ among those who have studied these two aspects of child development. The chief difference focused on how language was learned. One position held that no linguistic structure was innate, that language was learned entirely through experience. Another position saw the structure of language as being specified biologically.

Beilin and Kagan tested the thesis offered by Piaget which held that the origins of language were to be found in nonlinguistic processes.[1] Beilin and Kagan argued that acquiring and making use of pluralization rules of language required the ability to conceptualize number.

Seventy-eight children ranging in age from 3 years 1 month to 5 years 6 months were tested to determine their understanding of both plural nouns and verbs as well as the number concepts "1" and "2." Most children (81%) attained the number concepts and met the reversal criterion. Only 11 of 63 concept attainers could verbalize the number concepts. There was no difference between verbalizers and

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[1]Harry Beilin and Jacob Kagan, "Pluralization Rules and the Conceptualization of Number," Developmental Psychology, I (November, 1969), 697-706.

nonverbalizers in the mean number of trials to concept criterion (t=1.01, ns). These data suggested that the ability to verbalize the concept led to no faster concept attainment.

Performance in the pluralization tasks fell short of the level of performance in the number concept task. Only 24 of 63 subjects in the number task group obtained a perfect noun score. Correlations between measures of pluralization and measures of number concept were too low to be significant. The low correlations led Beilin and Kagan to conclude that the development of linguistic rules did not appear to be associated with concept attainment. In a training session data showed that pluralization training led to improved performance in pluralization while number concept training given by itself led to no measurable improvement in pluralization performance. Knowing number concepts did not necessarily transfer to a knowledge of plurals.

Beiswenger replicated a study originally done by Luria to investigate the verbal control of behavior.[1] As described by Beiswenger, Luria viewed speech as being formed in ontogenetic development rather than that speech simply grew. The formation of speech involved a series of transformations characterized by substages. Verbal mediation did not appear effective until after age six. The child may have had the words required for mediation but did not

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[1]Hugo Beiswenger, "Luria's Model of the Verbal Control of Behavior," Merrill-Palmer Quarterly, XIV (October, 1968), 267-283.

use them. Luria viewed speech development as an extremely complex inter-action between speech and non-speech cognitive processes dependent on differing functional systems of perception and behavior.

Specifically the study investigated the use of complex verbal commands to organize and guide a sequence of motor behavior. Thirty-two subjects between the ages of 41 and 78 months were individually seated before a device that could blink and make a beep sound.

The subjects were told to listen to the examiner and to do what they were told. Instructions read to each child after a short training period were (1) "When the red light flashes, don't push down. When the green light flashes, push down." and (2) Next, "When the red light flashes, push down; but when the green light flashes don't push down."

The results showed that with age there was increased ability to perform correctly in response to a single verbal command. Beiswenger concluded that the results of his study supported the claim of Luria that verbal learning provided greater flexibility over conditioned behavior than did non-verbal learning. Luria believed that speech as a cognitive system always worked in close mutual relationship with non-verbal cognitive processes.

Wittrock studied the effect of giving rules on the development of concepts related to transposition codes.[1]

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[1]M. C. Wittrock, "Verbal Stimuli in Concept Formation," Journal of Educational Psychology, LIV (August, 1963), 33-41.

The 292 subjects were taught by one of four treatments involving differing degrees of verbal stimuli. Wittrock found that when retention and transfer were considered, giving rules was more effective than not giving rules. The study implied that verbal direction could supply cues which increased the probability that the learner responded in the directed fashion.

Brown and Lenneberg studied the effects of culture on language.[1] Naming (or coding) of the various divisions of the color spectrum indicated that while the English language distinguished many different hues between the colors orange and yellow, other languages made no distinctions between those two colors. The experimental task involved determining which colors were easiest for subjects to name (code). After codability scores had been computed the subjects were asked to look at four closely related colors and then to identify the four from a chart containing 120 different colors. The subjects reported they were able to name the colors on the chart by silently giving each color a name as they first saw it during the stimulus experience and then remembering those names as they went to the chart. Correlation scores were high between codability and recognition.

The same experimental tasks were given to a group of Zuni Indians with the result that orange and yellow were

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[1]Roger W. Brown and Eric H. Lenneberg, "A Study in Language and Cognition," The Journal of Abnormal and Social Psychology, XLIX (July, 1954), 454-462.

frequently confused. This was due to the high codability in Zuni. Bilingual Zunis were able to code both orange and yellow but not as well as subjects who spoke only English.

Brown and Lenneberg concluded that speech was likely to be a molder of thought due to the fact that speech could be viewed as a patterned response that was learned only after the governing cognitive patterns had been grasped. Simple exposure to speech would not shape an individual's mind, but to the degree that one was motivated to learn the language of a community, he used its structure as a guide to reality. In this sense language could play an important role.[1]

Levenstein investigated the effects of helping low-income families promote verbal-cognitive activities characteristic of many middle-income families.[2] The study, a before-after design, consisted of fifty-four children, aged 20 to 43 months, and their mothers. There was an experimental group (N=33) and two comparison groups (C_1, N=9 and C_2, N=12). Socioeconomic status, parental background and physical condition were assessed and controlled. The Stanford-Binet Intelligence Scale and the Peabody Picture Vocabulary Test were used to measure the verbal and cognitive status of all children before and after seven months of verbally stimulating intervention for the experimental

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[1]Brown and Lenneberg, "Language and Cognition," p. 461.

[2]Phyllis Levenstein, "Cognitive Growth in Preschoolers Through Verbal Interaction with Mothers," American Journal of Orthopsychiatry, XL (April, 1970), 426-432.

group. The treatment consisted of an average of 32.4 home sessions by a research worker who in the presence of mother and child presented toys and verbally interacted with the child. The mothers were encouraged to model after the Toy Demonstrator and take over the dominant role using certain verbalizations including (1) labelling, (2) questioning, (3) inviting, (4) giving verbal encouragement, and (5) encouraging divergence (curiosity).

Levenstein found a mean gain of 17 IQ points for the children of the experimental group as well as positive and enthusiastic attitudes on the part of almost all of the mothers. It was concluded that significant cognitive gains could be achieved through early verbal intervention within the home and that this intervention likely had the effect of strengthening family ties as well as promoting more positive self-concepts on the part of the mothers.

Kingsley investigated the involvement of linguistic processes in cognitive functions.[1] Thirty-seven children, five to eight years of age were administered a short term memory task and a transpositional task. Labelling and rehearsing were recorded as a measure of simple linguistic production. Additionally, a Piagetian conservation of liquids task and a communication task were administered.

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[1]Phillip R. Kingsley, "Developmental Changes in Children's Use of Language: Relationships with Certain Aspects of Cognitive Development," Dissertation Abstracts International, Vol. 31 (2), August, 1970, p. 931-B.

Correlations among performances on all tasks were analyzed. Performance in verbal mediation tasks (transposition and short-term memory) intercorrelated moderately with simple linguistic production (labelling and rehearsing) defining a symbolic mediation factor. Conservation performance, measures of communication skills, and indices of non-egocentric speech intercorrelated moderately defining a logical operations factor.

Kingsley's study also compared the Piagetian testing procedures with the Bruner procedure based on verbalizing. While the Bruner procedure produced a larger proportion of conservers there was no evidence for greater improvement on conservation after the Bruner screening method had been used to train for conservation. Scores from both methods of measuring conservation correlated with the other factors in a similar pattern.

Giebink, Neville, and Davidson studied the performance of middle class children and lower class children in their ability to apply morphological rules to both nonsense words and meaningful words.[1] The subjects were 30 children enrolled in Project Head Start and 30 children enrolled in two private nursery schools. Measures of intelligence were obtained after two language tests designed to measure

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[1]John W. Giebink, Annette R. Neville, and Robert E. Davidson, "Acquisition of Morphological Rules and Usage as a Function of Social Experience," Psychology in the Schools, VII (3), 1970, pp. 217-221.

performance on the use of morphological rules were given. Scores on the language tests indicated that the middle class children performed at a significantly higher level than did the lower class children ($F=37.92$, $df=1/56$, $p < .001$). When the results of the morphological test were reanalyzed to covary for IQ it was found that, although reduced, the difference between the two social classes were still significant ($F=10.40$, $df=1/56$, $p < .005$). Giebink, Neville, and Davidson concluded that the middle class child had apparently internalized his cultural group's set of rules for applying morphological inflections while the lower class child appeared to be operating with memorized inflections of known words.

Guthrie and Baldwin studied the effect of verbalizing grammatical rules on concept formation.[1] Ninety children from four fifth-grade classes were randomly assigned to two treatment groups. Treatment I consisted of verbalizing the rule and applying the rule. Treatment II consisted of verbalizing the rule but no application of the rule. Results of comparisons of the treatment means showed that Treatment I was superior to Treatment II ($p < .05$). It appeared that rule application was the instructional procedure which produced the largest effect on the concept formation task. Learning to verbalize a rule alone did not facilitate the acquisition of a grammatical concept.

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[1]John T. Guthrie and Thelma Baldwin, "Effects of Discrimination, Grammatical Rule, and Application of Rules on the Acquisition of Grammatical Concepts," Journal of Educational Psychology, XLI (October, 1970), 358-364.

Bernstein investigated the effect of instruction in the cognitive uses of language on kindergarten children's ability to succeed in a double classification task.[1] Equal numbers of boys and girls who failed a pretest were randomly assigned to training or control groups. Results were reported on a total of eighty children remaining at the conclusion of the study.

The training program consisted of six twenty minute lessons designed to teach an understanding of the vocabulary involved in the classification tasks. Practice was provided in the use of language to explain, describe, and compare.

Bernstein found (at the .01 level) that children who had received training in the use of language scored higher on the classification task than did those children who had not received language training. There was no significant difference between scores of boys and girls. It was also found that on the classification task learning was well retained after a period of two weeks.

Stones reviewed a number of studies which showed that level of verbal ability correlated significantly with level of cognitive operations.[2] Stones expressed doubt that verbal

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[1]D. E. Bernstein, "The Effect of Training in the Cognitive Uses of Language on the Attainment and Retention of Double Classification Concepts by Kindergarten Children," Dissertation Abstracts International, Vol. 31 (3), September, 1970, pp. 1065-A-1066-A.

[2]E. Stones, "Verbal Labelling and Concept Formation in Primary School Children," The British Journal of Educational Psychology, XL (November, 1970), 245-252.

language was a crucial factor in the formation of concepts. Stones investigated the effect of the use of nonsense syllables on success in the Vygotsky block sorting concept task by testing 60 children, 20 each of 7 year olds, 9 year olds, and 11 year olds. Half of the subjects in each age group were given nonsense syllables in an effort to facilitate learning the sorting concept. On a series of extension tests there was a striking superiority in the performance of the group that sorted using the labels.

Stones concluded that the syllables were of key importance in the concept formation task. Age of child and verbal ability seemed to have little effect on attaining the particular concept studied. Stones' study indicated that the use of verbal labels facilitated the learning of concepts and demonstrated an important function of language.

Furth studied the relation between conceptual behavior and three variables: age, intelligence, and verbal language.[1] Some investigators had assumed that verbal language was an indispensable ingredient of general cognitive development. The assumption by some writers was that inferior performance of deaf people on some tasks was a reflection of their language deficiency. The hearing and deaf children were given the part-whole conceptual task in the

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[1]Hans G. Furth, "Conceptual Discovery and Control on a Pictorial Part-Whole Task as a Function of Age, Intelligence, and Language," Journal of Educational Psychology, LIV (1963), 191-196.

form of sets of pictures two of which were to be correctly matched on each try.

Furth found no significant differences by sex on the concept development task. Highly significant F ratios were found for age variance with learning. The performance of the deaf children was very similar to that of the hearing children. None of the eighteen comparisons approached significance by a t test. IQ accounted for significant variance in learning. The lower IQ group made significantly more errors than did the higher IQ groups. The similarity of results for hearing and deaf children indicated that for their sample, language had not played a major role in concept formation.

Sinclair-de-Zwart investigated the relationship between the child's thinking as he first entered the concrete operational stage and his linguistic development.[1] A number of children were first given the conservation of liquid task and the seriation task and later were asked to describe simple situations related to the distribution of objects to two figures. The subjects were divided into three groups according to the results of the conservation tasks. No difference was found among the three groups on comprehension however, differences were found ($p < .05$) between non-conservers and conservers regarding the description tasks.

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[1]Sinclair-de-Zwart, "Developmental Psycholinguistics," pp. 315-336.

Seventy percent of the conserver children used comparatives for the description of different quantities. Ninety percent of the children without conservation used absolute terms (a lot, a little) to describe the quantities. Sinclair-de-Zwart concluded on the basis of these experiments that operational structuring and linguistic structuring parallelled each other.

Assessing Language Maturity

McCarthy has pointed out that the earlier studies of language development charted the growth of such language characteristics as vocabulary, parts of speech as classified by traditional school grammar, various ratios of different kinds of words, and measures of sentence complexity such as sentence length, number and type of clauses, and number of prepositional phrases.[1] Starting in the 1890's most of the studies of child language development were mainly concerned with the acquisition of vocabulary from the time of the appearance of the first word up to the fourth or fifth year. At that time the amount of vocabulary was so large that the data tended to become unwieldy.

Anderson studied the reliability of a number of measures for determining language development.[2] These

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[1]McCarthy, "Language Development," p. 478.

[2]John E. Anderson, "An Evaluation of Various Indices of Linguistic Development," Child Development, VIII (March, 1937), 62-68.

measures included (1) length of sentence, (2) index of subordination, and (3) pronoun index. The written compositions of 111 college students were analyzed. A correlation of r=.49 was found between length of sentence and index of subordination. The correlation for high school rank and pronoun index was r=.01. Anderson determined that written passages of 150 words were too short for an adequate sample of written language. Length of sentence, standard deviation of sentence length, and index subordination were positively related. No significant relationship between sex and the linguistic indices were found.

Templin studied the language growth patterns of 480 children ranging in age from 3 to 8 years.[1] Four aspects of language were examined: (1) articulation of speech sounds, (2) speech sound discrimination, (3) sentence structure, and (4) vocabulary. An attempt was made to control the factors of age, sex, intelligence, family status, and impaired hearing.

Templin found few significant differences in the length of sentences of boys and girls. Upper socioeconomic status groups used longer sentences at nearly every level. There was a steady increase with age in the use of more complex and elaborated forms of the sentence. For both sexes and both socioeconomic status groups the simple declarative sentence was the most common one used. At all

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[1]Templin, Certain Language Skills in Children, pp. 1-183.

ages, and for both sexes and both socioeconomic status groups adverbial clauses were most frequent, the nominal next, and the adjectival clauses least frequent. Vocabulary measures showed an increase throughout the age ranges. For vocabulary, no sex differences were found, but the upper socioeconomic status group knew more words than the lower socioeconomic status groups. High correlations were found between sound discrimination and sound discrimination vocabulary. No significant sex differences were found by Templin.

Strickland analyzed the structure of children's language in the first through the sixth grade comparing it with the structure of the language in the textbooks used by the subjects. The extent to which language structure of the children was related to the variables of age, sex, intelligence, and socioeconomic status was also analyzed by Strickland.[1] The analysis of language structures was done in terms of certain measures of structural linguistics. The language structures included parts of speech described as slots (subjects, verbs, conjunctions) and movables (adjectives and adverbs). Slots and movables included either single words, phrases or clauses. The language structures were identified in terms of various combinations of elements. Strickland found that while children used a large number of

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[1]Strickland, The Language of Elementary School Children, pp. 1-89.

language structures, some patterns appeared with high frequency at all grade levels.

Strickland found significant differences between the use of movables and the variables of intelligence, mental age, and socioeconomic status. There were at grades 1, 4, and 6 also significant differences between the use of subordination patterns and the variables of mental age, intelligence, and socioeconomic status at grades 1, 4, and 6. In the textbooks examined patterns of sentence structure appeared to be introduced at random. A pattern of structure, once introduced, seemed not to be followed up with elements of the same sort.

Riling studied the language structures of 200 children in grade 4 and 100 children in grade 6.[1] Samples of both oral and written language were analyzed in terms of basic sentence elements.

Riling found that children in grade 4 produced 713 different oral language patterns while children in grade 6 produced 845 different oral language patterns. It was also observed that in speech children whose scores on verbal and total intelligence were in the lowest quartile never used some of the structures other children used. Children with higher intelligence scores used more phrases and clauses as adverbs of time. Riling further found length of sentence related to higher intelligence scores. Boys in the higher

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[1]Riling, Oral and Written Language of Children, pp. 1-178.

intelligence range used longer sentences than girls while in the lowest intelligence score range girls used longer sentences than did the boys of that group.

Hunt investigated a method for studying language (syntax) which was a refinement of previous techniques.[1] Additionally, Hunt explored developmental trends in the occurrence of various grammatical structures written by students of average IQ in the fourth, eighth, and twelfth grades. Nine boys and nine girls were selected from each of the three grades. Only children scoring within the average range of IQ (90-110) were included. Teachers were asked to collect normal class related writing of the students amounting to 1000 words per child. In addition to analyzing each child's writing in terms of the mean length of T-units, structures within the clauses were analyzed in terms of coordinated structures, nominals, verb auxiliary, modifiers of verbs, and predicate adjectives.

Hunt has described the T-unit as a unit of language containing one main clause with all the subordinate clauses attached to it. The number of subordinate clauses can be none. A main clause was described as a structure with a subject and a finite verb (a verb with a tense marker). He pointed out that if subjects were coordinated, they merely lengthened the clause, and if any part of the verb phrase was coordinated, that also merely lengthened the clause.

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[1]Hunt, Grammatical Structures, pp. 1-159.

The entire construction was counted as one clause.[1]

Hunt suggested that specimens of language production could be sliced into units. He indicated that there should be no trouble deciding whether an expression, if it was intelligible at all, went with the preceding main clause or the following. An and between two main clauses would always go with the second clause, beginning it just as coordinating conjunctions so often begin the sentence of mature writers.

The following was an example of a sample of language produced by an elementary school child.

> I like the movie we saw about Moby Dick the white whale the captain said if you can kill the white whale Moby Dick I will give this gold to the one that can do it and it is worth sixteen dollars they killed a whale and used the oil for the lamps they almost caught the white whale.

Arranged into T-units the same sample looked like the following:

1. I like the movie / we saw about Moby Dick, the white whale.
2. The captain said / if you kill the white whale, Moby Dick,/
3. And it is worth sixteen dollars.
4. They tried and tried.
5. But / while they were trying / they killed a whale and used the oil for the lamps.
6. They almost caught the white whale.

Hunt found significant differences between the mean length of T-units for each of the three age groups. The greatest growth in T-unit length occurred in the nominal structures. Older students extended their nominals by using more noun clauses. Number of subordinate clauses per T-unit

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[1]Hunt, Grammatical Structures, p. 20.

was found to increase with age. Hunt concluded that T-unit length was tied closely to maturity. The average twelfth grade student was able to write T-units nearly 60 percent longer than the fourth grader.

Bougere investigated the predictive role of language competency on success in beginning reading.[1] The factors of (1) mean length of T-unit, (2) ratio of subordinate clauses to all clauses, (3) percent of words at selected Thorndike-Lorge frequency levels, and (4) scores on standardized tests of oral and silent reading achievement were identified and measured. Subjects were sixty pupils attending six neighborhood schools in South Chicago. Bougere found moderate coefficients between reading achievement scores and mean length of T-units (r=.63) and number of different words (r=.60).

Bougere concluded that the finding that mean length of T-unit to ratio of subordinate clauses and ratio of sentence combining transformations lent support to the idea that average length of communication unit was a useful index of maturity in language.

O'Donnell, Griffin and Norris studied the grammatical structures used in speech and writing by eighteen boys and girls at six age levels. The validity of the T-unit and other related measures of language maturity were also investigated.[2]

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[1]Bougere, "Oral Language," pp. 31-58.

[2]Roy C. O'Donnell, William J. Griffin and Raymond C. Norris, Syntax of Kindergarten and Elementary School Children (Champaign, Illinois: National Council of Teachers of English, 1967), pp. 1-115.

Oral and written language samples were collected and analyzed in terms of T-units and sentence combining transformations including nominal constructions, adverbial constructions and coordinate-constructions. The findings in their study supported the use of mean T-unit length as a sensitive measure of maturity in children's language development. Positive correlations were found between advances in age and increasing word length of total responses. The fastest progress in development of oral expression occurred between kindergarten and the end of first grade. No significant differences were found between boys and girls.

Stages of Mental Development

Stage of mental development has been described by Vygotsky and Piaget. Vygotsky identified four stages in the development of speech and mental development.[1] The first stage was described as the primitive stage, corresponding to preintellectual speech and preverbal thought. Vygotsky believed the operations were initiated at the primitive level of behavior.

The second stage, "naive psychology," involved the child's experience with the physical properties of his body and objects and the application of this experience to the use of tools. It was at this stage that practical intelligence first emerged. The child used grammatical forms before

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[1]Vygotsky, Thought and Language, pp. 43-47.

he understood the logical operations for which they stood.

The third stage involved the use of external signs and operations that were used to solve internal problems. Vygotsky suggested that complex logical thinking was dependent upon interiorized speech.

The fourth stage was that point at which external operations turned inward. Thought was described as an inner, soundless speech. There was a continual interaction between outer and inner operations, one form frequently changing into the other and back again. Speech was the basis of logical operations.

Piaget observed that the growth of intelligence became apparent soon after birth and progressed through well defined stages of development.[1]

The first stage of mental development, the sensorimotor stage (birth to approximately 18 months of age), was that period in which the child lacked the symbolic function. He did not have representations by which he could evoke persons or objects in their absence. It was during this time that the child constructed all the cognitive substructures that would provide a foundation for his later intellectual development.

The second stage of mental development described by Piaget was the preoperational stage. At this stage (2 to 7 years of age) the child was beginning to use representations

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[1]Piaget and Inhelder, Psychology, p. 3.

for objects and events no longer present. At this stage there was an absence of conservation whereby the child could maintain invariance of quantity in the face of change. With the development of conservation the child moved into the concrete operational stage (7 to 11 years of age). At this point the child was able to operate upon objects and events with the use and/or memory of the real objects.[1]

Piaget indicated that a useful index for determining stage of mental development was the notion of conservation.[2] Important components of conservation included the knowledge that actions could be reversed (reversibility) and the ability to consider more than one dimension of an object (decentering or compensation).

Summary

Considerable support was given to the concept that language acquisition is a developmental process. The language learner possessed an ever expanding set of linguistic rules which enabled him to generate new sentences. The acquisition of different language structures was largely complete by the time the child entered school.

Thinking was described as a function initially separate from language. Children without language have been

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[1]Jean Piaget, The Origins of Intelligence in Children (New York: International Universities Press, Inc., 1952), pp. 359-363.

[2]Piaget and Inhelder, Psychology, pp. 97-99.

found to operate as well cognitively as children with language. Findings concerning the effects of verbal mediators on concept learning were not always consistent in the studies reviewed. Verbal intervention was found to raise the IQ scores of a group of children profoundly.

The development of the T-unit measure of language maturity has been used considerably in language development research. Many research studies have consistently found few significant differences in the language production of boys and girls. Age, socioeconomic status, and IQ have very often been found to be significantly correlated with language production. Nowhere was there reported any information related to the association of stage of mental development with language production. The Piagetian Conservation Tasks were identified as a measure of stage of mental development. Conservation was characterized by reversibility of action and compensation.

CHAPTER III

PRESENTATION AND ANALYSIS OF THE DATA

Presentation of the Analysis

The problem of this study asked the question--Are there significant relationships between scores on six Piagetian Conservation Tasks and five measures of oral language maturity: number of T-units, mean length of T-units, ratio of subordinate clauses to all clauses, number of comparatives, and number of passive sentences given; which justify the use of the Piagetian Conservation Tasks as a predictor of oral language maturity for first grade boys and girls? The required level of statistical significance was set at the .05 level.

The comparison of language maturity and stage of mental development involved identifying both the T-unit as a measure of language maturity and six Piagetian Conservation Tasks as a measure of stage of mental development. The use of comparatives and passive sentences were identified as measures of language maturity, also.

In addition to the data obtained in testing the hypotheses of the present study a number of measures were used in selecting the sample. To control for the effects of ethnic background, physical handicap, and speech disorder on

oral language production; pupils of minority ethnic groups, pupils with physical handicaps, and pupils receiving speech therapy were screened from the sample population. The purpose of this study was to investigate the relationship of measures of language maturity with Piagetian stage of mental development, therefore, in order to control the effects of age, intelligence, and socioeconomic status on oral language production the design of the study specified an age range of one year, a socioeconomic status range of 13 to 21 on the Eells Questionnaire By Which Socioeconomic Information Was Secured From Parents,[1] and an IQ score range including plus or minus one standard deviation from the mean of the Primary Mental Abilities Test. Table 1 indicates the results of the various screening procedures. From an initial population of 214 first graders in a total of five elementary schools a pool of ninety youngsters was identified. From the remaining ninety, forty boys and forty girls were randomly selected for the sample using a table of random numbers.

Table 2 indicates the mean scores and standard deviations for age, PMA IQ score, socioeconomic status, the five measures of language maturity, and conservation. Mean PMA IQ score for the eighty subjects was 107.5 with a standard deviation of 5.7.

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[1]Eells, et al., Intelligence and Cultural Difference, p. 363.

TABLE 1

TOTAL NUMBER OF SUBJECTS SCREENED
FROM THE POPULATION
BY VARIABLE

Physically Handicapped	1
Minority Group Members	0
Receiving Speech Therapy	18
Outside IQ Range	63
Outside SES Range	19
Overaged	23
Total	124

The norms for the Primary Mental Abilities Test indicate a mean score of 100 and a standard deviation of 16.[1] The differences between the mean and standard deviation of the sample and the mean and standard deviation of the population on which the norms of the Primary Mental Abilities Test were based indicated that the sample was not a normal population in terms of PMA IQ scores. The small variance seen in the standard deviation of the PMA IQ measures indicated that the subjects were relatively homogeneous in intelligence. The range of the measure of socioeconomic status

[1]Thelma G. Thurstone, Examiner's Manual: Primary Mental Abilities K-1 (Chicago: Science Research Associates, Inc., 1962), p. 30.

TABLE 2

MEAN SCORES AND STANDARD DEVIATIONS FOR NINE MEASURES

	Boys		Girls		Total	
	Mean	s.d.	Mean	s.d.	Mean	s.d.
Age (Months)	86.55	3.23	86.63	3.60	86.59	3.40
Socioeconomic Status	14.70	1.24	14.28	1.34	14.49	1.30
Primary Mental Abilities	107.18	6.25	107.88	5.13	107.53	5.69
Total T-units	51.58	16.96	48.88	13.48	50.23	15.28
Mean Length of T-unit	7.03	.91	7.09	1.28	7.06	1.10
Ratio of Subordinate Clauses to All Clauses	10.83	5.27	12.65	7.63	11.74	6.58
Comparatives	3.73	1.85	3.45	1.91	3.59	1.87
Passives	.90	1.08	.48	.82	.69	.98
Conservation	7.30	3.98	6.25	4.55	6.78	4.28

ranged from a score of 13 to 18. A low numerical score indicated a higher status than a high numerical score. The mean SES score of 14.5 indicated relatively high middle-class status for the boys and girls of the sample. The small variance (s.d. 1.3) indicated a relatively homogeneous group in terms of socioeconomic status. In the case of both PMA IQ scores and socioeconomic status scores the mean scores indicating high measures and the small variances were due to an effort to control within the design of the study, the effects of intelligence and socioeconomic status on the oral language production of the subjects.

Results of Testing Hypothesis One

Hypothesis One stated that there would be no significant difference by sex in mean scores for conservation and the five language tasks. In order to test this hypothesis Hotelling's T^2 test, a multivariate generalization of Student's t test, was used.[1] The analysis was done by using Program X69, U.C.L.A. Biomedical Computer Program.[2] The results for each of the six variables are given in Table 3. The calculated value of T^2 for this hypothesis was less than the criterion value of 3.96. This was not statistically significant. Therefore, Hypothesis One cannot be rejected.

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[1]Hotelling, "Relations of Multivariate Statistical Methods to Factor Analysis," pp. 69-79.

[2]W. J. Dixon, Biomedical Computer Programs (Berkeley: University of California Press, 1970), pp. 60-65.

TABLE 3

HOTELLING'S T^2 AND t TEST RESULTS FOR MEAN DIFFERENCES BY SEX FOR CONSERVATION AND FIVE MEASURES OF LANGUAGE MATURITY

$F(6,73)=1.36....NS$

Hotelling T^2--Approximate $F=1.36....NS$ $(6,73)$

Tasks	Source of Variation	Mean Square	t(.05,78)	
	t tests			
Total T-units	Between	145.80		
	Within	234.67	.79	NS
Mean Length of T-unit	Between	0.08		
	Within	1.23	.26	NS
Ratio of Subordinate Clauses to All Clauses	Between	66.61		
	Within	43.01	1.24	NS
Comparatives	Between	1.51		
	Within	3.54	.68	NS
Passives	Between	3.61		
	Within	0.92	1.98	NS
Conservation	Between	22.05		
	Within	18.28	1.10	NS

Results of Testing Hypothesis Two

Hypothesis Two stated that there would be a significant positive relationship between conservation scores and each of the five language scores for boys. The correlation results are given in Table 4. None of the coefficients was statistically significant at the .05 level. Hypothesis Two cannot be accepted.

Results of Testing Hypothesis Three

Hypothesis Three stated that there would be a significant positive relationship between conservation scores and each of the five language scores for girls. The results of the correlations are given in Table 4. None of the coefficients was significant at the .05 level. Hypothesis Three cannot be accepted.

Results of Testing Hypothesis Four

Hypothesis Four stated that the correlation coefficients between conservation score and each of the five language scores would not differ significantly by sex. Two pairs of coefficients exhibited enough difference to warrant being tested by a Z test.[1] The two coefficients tested were those for Conservation and Ratio; and Conservation and Passives. The computations for the two pairs of coefficients

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[1]Ferguson, Statistical Analysis, pp. 187-188.

are found in Appendix E. In neither case did the statistic reach the .05 level. Hypothesis Four cannot be rejected.

TABLE 4

CORRELATION COEFFICIENTS FOR CONSERVATION WITH LANGUAGE MATURITY BY SEX

	Total T-units	Mean Length of T-units	Ratio of Subordinate Clauses to All Clauses	Compara-tives	Passives
Boys	-0.044	0.122	-0.021	0.126	0.013
Girls	-0.114	0.072	0.180	0.113	-0.198

$r_{(.95,38)=0.265}$

Conservation Tasks as a Predictor of Oral Language Maturity

Tables 5 and 6 show the correlation coefficients for conservation and the five language measures for boys and girls respectively. The coefficient for Mean Length of T-unit and Ratio of Subordinate Clauses reached a correlation of .49 for boys and .84 for girls. The coefficient for Passives and Mean Length of T-unit was .36 for the boys and -.32 for the girls. The highest coefficient for conservation with any of the measures of language was the coefficient for Conservation and Ratio which reached a correlation of .18.

TABLE 5

CORRELATION MATRIX CONSERVATION AND FIVE LANGUAGE MEASURES--BOYS

	Total T-units	Mean Length of T-units	Ratio of Subordinate Clauses to All Clauses	Comparatives	Passives	Conservation
Total T-units	1.00	-0.02	-0.07	0.13	-0.06	-0.04
Mean Length of T-units		1.00	0.49	0.09	0.36	0.12
Ratio of Subordinate Clauses to All Clauses			1.00	-0.19	0.20	-0.02
Comparatives				1.00	-0.07	0.13
Passives					1.00	0.01
Conservation						1.00

TABLE 6

CORRELATION MATRIX CONSERVATION AND FIVE LANGUAGE MEASURES--GIRLS

	Total T-units	Mean Length of T-units	Ratio of Subordinate Clauses to All Clauses	Compara-tives	Passives	Conserva-tion
Total T-units	1.00	0.16	0.24	0.20	0.01	-0.11
Mean Length of T-units		1.00	0.84	-0.06	-0.32	0.07
Ratio of Subordinate Clauses to All Clauses			1.00	-0.09	-0.35	0.18
Comparatives				1.00	0.37	0.11
Passives					1.00	-0.20
Conservation						1.00

The low correlations between conservation and the five measures of language maturity indicated that the Piagetian Conservation Tasks used in this study were poor predictors of language maturity as defined herein.

A correlation coefficient was computed as a test of the reliability of the Mean Length of T-unit measure of oral language maturity. This calculation, corrected for the length of the test, yielded a reliability coefficient of .59.[1] Thus, the reliability of the T-unit measure was not high. This relatively low T-unit reliability may account, in part, for the low correlation between conservation and T-unit measures of language found in this study. The calculation of the reliability test for the T-unit is show in Appendix F.

Analysis of Conservation Score and Composite Language Score

In an effort to determine the relationship of conservation and language, the score of the six Piagetian Conservation Tasks and the composite score for the five measures of language maturity were analyzed by means of a multiple regression correlation technique.[2] A multiple r of .40 was found for girls while the multiple r for the boys was .19.

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[1]William A. Mehrens and Irvin J. Lehmann, Measurement and Evaluation in Education and Psychology (New York: Holt, Rinehart and Winston, Inc., 1973), p. 115.

[2]Dixon, Biomedical Computer Programs, p. 309.

Neither multiple r was significant. Thus, it could be determined that for both boys and girls, composite language scores were no more highly correlated with conservation than the single language scores.

CHAPTER IV

SUMMARY, FINDINGS, AND RECOMMENDATIONS

Summary

The purpose of this study was to identify relationships between measures of language maturity and stage of mental development in order to investigate the usefulness of the Piagetian Conservation Tasks as a means of predicting oral language maturity. Sex differences were analyzed to determine their association with conservation and measures of language maturity.

The importance of oral language in the instructional approaches of the primary school was noted. Factors related to maturity in oral language have not been completely identified. Little research had been reported which focused upon the relationship of conservation with measures of language maturity. The usefulness of the Piagetian Conservation Tasks as a predictor of oral language had not been reported.

Eighty first graders, forty boys and forty girls, were identified as the subjects of this study. In order to control for the effects of a number of factors known to influence oral language, the sample population of this study was screened in terms of ethnic background, physical handicap, speech, age, PMA IQ score, and socioeconomic status. Thus,

the forty boys and forty girls of this study did not represent a normal population. On all screening indices variances were small indicating a homogeneous sample on all measures.

Each subject was administered six Piagetian Conservation Tasks as well as the language instruments. Tape recorded oral protocols were analyzed using the T-unit measure of language maturity. Scores of conservation and the five measures of language maturity were analyzed statistically to determine relationships between conservation and the five measures of language maturity.

Four hypotheses were developed to investigate the problem. These hypotheses were:

1. The mean scores for conservation and each language task will not differ significantly by sex.

2. A significantly positive relationship will be found between conservation scores and the scores of the boys on the several measures of language maturity.

3. A significantly positive relationship will be found between conservation scores and the socres of the girls on the several measures of language maturity.

4. The correlation coefficients between conservation score and the various language scores will not differ significantly by sex.

Major Findings

The analysis of the data for the study resulted in the findings listed below. Level of significance was set at $p < .05$.

1. There were no significant differences between males and females on conservation scores and the scores of the five measures of language maturity.

2. There were no significant correlations between conservation scores and the scores of the boys on the five measures of language maturity.

3. There were no significant correlations between conservation scores and the scores of the girls on the five measures of language maturity.

4. There were no significant differences in the correlation coefficients of males and females on conservation scores and scores on the five measures of language maturity.

Secondary Findings

A number of useful findings were found for which no hypotheses had been stated.

1. There were no significant correlations between conservation score and composite language score for either boys or girls.

2. A relatively low coefficient of reliability (.59) was found for the Mean Length of T-unit measure. A coefficient of .84 for Mean Length of T-unit and Ratio of Subordinate Clauses to All Clauses was due to the fact that subordinate clauses were contained within T-units.

3. Subjects' scores on the six Piagetian Conservation Tasks did not reflect a sequence of difficulty for those six tasks.

Conclusions

The data for this study have shown that the first grade boys and girls of this study scored about the same on conservation and five measures of language maturity. During the 1930's studies of child language development often found girls excelling boys in oral language production. During the 1950's and 60's Riling and Loban, among others, found no significant difference in oral language scores for boys and girls. The findings of the present study tend to support these later findings of no sex differences in oral language production. It is therefore concluded that the boys and girls of this study do not differ in their ability to produce oral language as measured in this study. Since the boys and girls of this study do not represent a normal population, there is no basis for supposing that the conclusion of no sex difference in oral language production could be drawn for the population as a whole.

The scores on conservation and the five measures of language maturity indicated that for the boys of this study there was no significant relationship between conservation scores and language scores. The mean conservation scores for the boys was 7.3 with a standard deviation of 3.9. The mean length of T-units for the boys was 7.03 with a standard deviation of .9. Length of T-units varied in an inconsistent pattern. Some subjects high in conservation produced relatively short T-units while some subjects low in conservation produced relatively long T-units.

The finding of no significant relationships between conservation and oral language maturity led to the conclusion that for the subjects of this study oral language was not closely associated with level of cognitive development. This conclusion is exactly opposite that of Sinclair-de-Zwart who found that conservation scores were significantly related to scores on Passives and Comparatives.

For the girls of this study there was no significant relationship between conservation scores and scores on the five measures of language maturity. Mean conservation score for the girls was 6.25 with a standard deviation of 4.5. Mean length of T-units was 7.09 with a standard deviation of 1.3. Some subjects high in conservation produced relatively short T-units while some subjects low in conservation produced relatively long T-units. The literature suggested that both language growth and mental growth are developmental with a steady growth from simple structures and acquisitions to an elaborate development in middle childhood. The data of this study led to the conclusion that for the forty boys and forty girls of this study, conservation as a characteristic of mental development was not closely associated with language maturity as measured in this study. This conclusion seems to be supported by Kingsley's findings of a separate symbolic language factor and a separate logical operations factor. Language and logical operations were found by both Furth and Kingsley to

function separately. The functioning of one factor did not depend on the functioning of the other. Deaf children were able to develop cognitive concepts as well as were hearing children. While there seems to be evidence that logical operations can develop separately from language many studies have shown that language can be used to successfully promote concept formation. Within the present study there is no basis for saying that conservation and language maturity would not be significantly related in a sample representing a normal population. Also, there might be found a significant relationship if a more reliable measure of language maturity were used. The reliability coefficient of .59 for the T-unit measure of language indicated little ability on the part of the T-unit to measure consistently that facet of language maturity.

In order to investigate relationships between conservation and language maturity, conservation score and a composite language score were analyzed. No significant correlation was found. It was concluded that composite language score was no more highly correlated with conservation than were the single language scores.

The low correlation coefficients between conservation and measures of language maturity did not differ significantly by sex. There seemed to be little association of conservation with language and this was true for both boys and girls. A number of studies reviewed had found that verbal intervention aided the learning of concepts and had

been seen to effect a significant increase in IQ scores. Due to the low coefficients of this study between conservation and language, the Piagetian Conservation Tasks used in this study could not be said to be a predictor of language maturity as it was defined and measured in this study. It would seem that while conservation as defined and measured in this study did not relate significantly with language maturity as defined and measured in this study, a conclusion that conservation is not significantly related to language maturity can be applied only to the boys and girls who make up the select, homogeneous sample of this study. If this study were to be replicated using a normal population and employing a more reliable measure of language maturity different results might occur.

Recommendations

This study has investigated relationships between language maturity and Piagetian stage of mental development in first grade children. PMA IQ score range, age, and socioeconomic status were limited. Since no positive relationships were found between measures of language maturity and conservation for the age range of the subjects of this study an investigation, holding IQ score range constant, including additional age ranges would be useful. Additional age ranges would make it possible to compare the correlation coefficients between language maturity and conservation over a wider span of years.

The measures of conservation might be reduced from the six tasks of this investigation to the two tasks of Conservation of Number and Conservation of Liquids. Children have been found to conserve on these two tasks at an earlier age than for the other four conservation tasks. Conservation of Number and Conservation of Liquid might be a more appropriate measure of stage of mental development for some six year olds. A study investigating a wider range of socio-economic status and holding IQ score range constant would serve as a comparison to the present study.

Using the two conservation tasks, Conservation of Number and Conservation of Liquid, an investigation should be conducted utilizing other measures of language maturity. Language structures such as types of sentences, sentence-combining transformations, and effects of branching in sentence construction have not been studied in terms of their relationship to conservation.

Finally, using the Conservation of Number Task and the Conservation of Liquid Task, a study could be done comparing the degree of language-conservation relationship for the standard procedure of administering the conservation tasks with the procedure described by Bruner whereby subjects are not allowed to see the conservation task but hear it described by the examiner.

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APPENDIX A

APPENDIX A

QUESTIONNAIRE FOR DETERMINING SOCIO-ECONOMIC STATUS

Information to be obtained from school records and neighborhood inspection.

Pupil's Name:_____
(First) (Middle) (Last)

Birthday:_____
(Month) (Day) (Year)

Pupil's School:_____ Did you attend last year?_____

Pupil's Address: _____

What is the pupil's race? Check one: White_____ Negro_____ Indian_____ Mexican_____ Other_____

Father's Name:_____

What kind of work does the pupil's father, or guardian, do? _____ (If father, or guardian, works in a factory, or store, or office, tell what kinds of jobs he does there)_____

_____

If he has a title, like watchman, foreman, clerk, manager, president, owner, etc., write it here_____

What other kind of work has the father ever done?_____

_____

How often is the father paid? Check one: Every week_____ Once every two weeks_____ Once a month_____ By the day_____ In business for himself_____

What kind of work does the pupil's mother do?_____
What other kind of work has she ever done?_____

_____

Grade, or year of school completed by the pupil's father.

Circle one:

Grade School								High School				College							
1	2	3	4	5	6	7	8	1	2	3	4	1	2	3	4	5	6	7	8

Grade, or year of school completed by the pupil's mother.

Circle one:

Grade School								High School				College							
1	2	3	4	5	6	7	8	1	2	3	4	1	2	3	4	5	6	7	8

Was the father born in the United States?_____
Was the mother?_____

What type of dwelling do you live in? Check One:
Apartment house_____ Duplex_____ Single-family dwelling_____.
How many rooms are there in the dwelling in which you live?_____

APPENDIX B

Films

INSTRUCTIONS TO BE FOLLOWED BY INTERVIEWERS[1]

(Each interview will be conducted immediately after the child has seen the film.)

A. "The Ant and the Dove"

1. After brief conversation to put the child at ease, turn the recorder on.
2. Record the child's code number on the tape, so that his speech sample can be identified.
3. Ask the child to tell in his own words the story of the ant and the dove.
4. When he has finished telling the story, ask the child: "Do you think this story shows that one good turn deserves another?" If his answer is yes, say: "Explain why you think so." If his answer is no, say: "Explain why you do not think so."

B. "The North Wind and the Sun"

1. After putting the child at ease, turn the recorder on.
2. Record the child's code number, so that his speech sample can be identified.
3. Ask the child to tell in his own words the story of the North Wind and the Sun.

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[1]Roy C. O'Donnell, William J. Griffin, and Raymond C. Norris, Syntax of Kindergarten and Elementary School Children: A Transformational Analysis, NCTE Research Report No. 8 (Champaign, Illinois: National Council of Teachers of English, 1967), pp. 107-108.

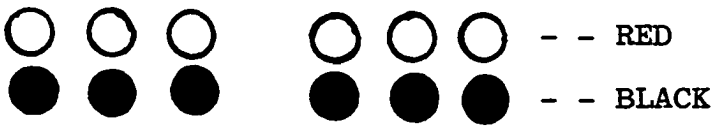
4. When he has finished telling the story, say: "Which do you think is more powerful, the North Wind or the Sun?"
5. After he answers the question, say: "Why do you think so?"
6. Then say to the child: "This story is supposed to show that you can sometimes do more by being gentle than you can by using force. Do you agree or disagree with the idea that gentleness is sometimes better than force?"
7. Ask him to explain why he agrees or disagrees, and ask him to give examples from his experience showing that gentleness is more effective than force, or vice versa. These examples could come from experiences in his family, his neighborhood, or his school. Encourage the child to talk freely and at length.

APPENDIX C

PIAGETIAN CONSERVATION TASKS[1]

1. Test for conservation of number.

Have the children line up six black checkers in one row and six red checkers in another row:



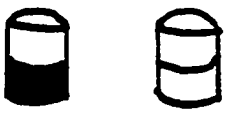
Ask the child if he agrees that there are the same number of red checkers as there are black checkers. After he agrees to this fact, stack the red checkers, one on top of the other, and leave the black checkers as they were:



Next, ask the child if there are still the same number of black checkers as there are red checkers. If he answers "yes" he is able to conserve number. If he answers "no" he is unable to conserve number.

2. Test for conservation of liquid.

Pour the same amount of water in two containers of equal size. For convenience, you may wish to color the water in one container red:



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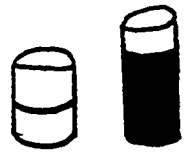
[1]John W. Renner, Robert F. Bibens, and Gene D. Shepherd, Guiding Learning in the Secondary School (New York: Harper and Row, Publishers, 1972), pp. 95-100.

Ask the child if he agrees that the containers are the same size and that they contain the same amount of liquid. After he agrees to these facts, pour the clear liquid into a taller, thinner container and ask the child if there is still the same amount of liquid in the two containers:



If the child answers "yes" he is able to conserve liquid. If he answers "no" he is unable to conserve liquid.

3. Test for conservation of solid amounts.

Prepare two pieces of clay containing the same amount of clay and roll them into balls of equal size. For convenience, you may wish to use two colors of clay, i.e., blue and red. Ask the child if he agrees that there is the same amount of blue clay as red clay:

RED - - 

BLUE - - 

Next, deforn the piece of red clay by rolling it into what you may want to call a "snake":



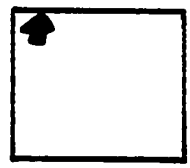
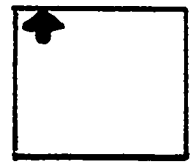


Ask the child if there is still the same amount of red clay as there is blue clay. If the child answers "yes" he is able to conserve amounts. If he answers "no" he is unable to conserve.

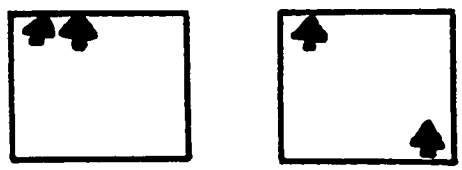
4. Test for conservation of area.

Show the child two fields of grass (green construction paper) of equal size. Explain that each field of grass

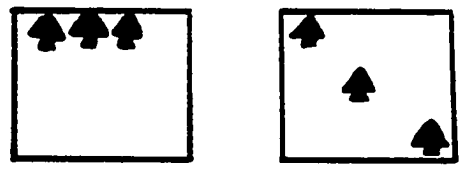
is owned by a farmer; Mr. Green owns one, and Mr. Jones owns the other. Both Mr. Green and Mr. Jones built a barn on their field. (Place a barn made of red construction paper or a toy barn on each field and explain that the barns are exactly the same size.)

Mr. Green-   -Mr. Jones

Ask the child if there is still the same amount of grass on each field. Record his answer. Next, tell the child that Mr. Green and Mr. Jones built another barn; Mr. Green built his second barn right next to his first barn. Mr. Jones left a space of grass between his two barns:



Again ask the child if there is still the same amount of grass on each field. Explain to the child that Mr. Green and Mr. Jones built a third barn and placed them in the same manner as they had before:

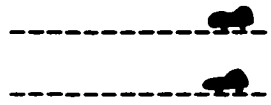


Ask the child if there is still the same amount of grass on each field. If he says "yes" he is able to conserve area.

5. Test for conservation of length.

Place two strings of beads (equal in length) next to

each other. This is to represent two roads. Next, place a toy car at the beginning of each road:



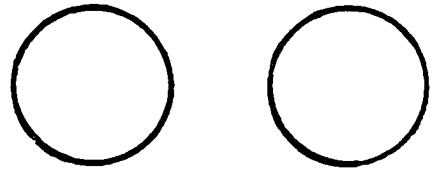
Ask the child if he agrees that both roads are the same length. After he agrees that both are the same length, pose the problem: "If the cars travel the same speed, which car, the red one or the blue one, will reach the end of the road first? Or will they reach the end of the road at the same time?" Record the child's answer. Then move one road back and ask the same question:



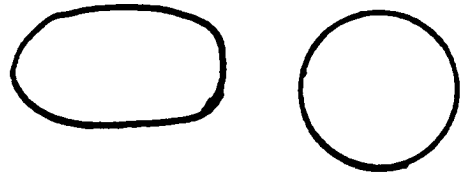
If the child now states that the cars will reach the end of the road at the same time, he conserves length.

6. Test for conservation of weight.

During this test, do <u>not</u> let the child hold or handle the two pieces of clay. Form two balls of clay equal in size and tell the child that they weigh exactly the same:



Deform one of the balls of clay to make a pancake:



Ask the child which would weigh more, the ball or the pancake, or would they both weigh the same. If the child answers that they would both still be the same weight, he is able to conserve weight.

Variation of procedure for weight test.
Give the child two equal balls of clay. Add and subtract clay until he agrees that they weigh the same. Now take the two balls of clay from the child and flatten one into a pancake. Do not let the child lift them after you have made the pancake. Ask the child which piece weighs more, the ball or the pancake. If both procedures are used, did it vary his answer?

APPENDIX D

Language Tasks

Comparative Markers

1. Present the child with two dolls; one doll is given six marbles and the other doll is given two marbles.
   Ask the child: Is this fair? Are both dolls happy? Why not?[1]
2. Present two dolls; one doll is given a short, thick pencil and the other doll is given two long, thin pencils.
   Ask the child: Is this fair? Are both dolls happy? Why not?[2]
3. Present two dolls; one doll is given a large sphere of plasticine and the other doll is given a smaller sphere of plasticine (both height and width are less than the first sphere).
   Ask the child: Is this fair? Are both dolls happy? Why not?

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[1]Sinclair-de-Zwart, "Developmental Psycholinguistics," p. 322.

[2]Jean Piaget, "Linguistic Structuralism," Structuralism, translated and edited by Chaninah Maschler (New York: Harper and Row, 1971), 95.

Reversibles

1. Present the child with a doll (Bill) and a toy car.

   Say: Bill washes his car. (Interviewer acts out the sentence as he says it.)[1]

2. Present the child with a red marble and a blue marble.

   Say: The red marble pushes the blue marble. (Interviewer acts out the sentence as he says it.)

   Say: Now tell me what happened, but I want you to start this way: the blue marble. . . . Interviewer performs action after which child gives passive sentence.[2]

3. Present the child with a boy doll and a girl doll along with a toy food item.

   Say: The boy feeds the girl. (Interviewer acts out the sentence as he says it.)

   Say: Now tell me what happened, but I want you to start this way: the girl. . . . Interviewer performs action after which child is to give passive sentence.[3]

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[1]Ursula Bellugi-Klima, "Some Language Comprehension Tests," Childhood Education, ed. by Celia Stendler Lavatelli (Urbana: University of Illinois Press, 1971), 167-168.

[2]Sinclair-de-Zwart, "Developmental Psycholinguistics," p. 333.

[3]Bellugi-Klima, "Language Comprehension Tests," p. 168.

APPENDIX E

SIGNIFICANCE OF THE DIFFERENCE BETWEEN COEFFICIENTS FOR CONSERVATION AND RATIO OF SUBORDINATE CLAUSE TO ALL CLAUSES

$$z = \frac{z_{r_1} - z_{r_2}}{\sqrt{1/(N_1-3) + 1/(N_2-3)}}$$

$$z = \frac{-.020 - .182}{\sqrt{1/37 + 1/37}}$$

$$z = \frac{.202}{\sqrt{.027 + .027}}$$

$$z = \frac{202}{\sqrt{.054}}$$

$$z = \frac{.202}{.7348}$$

$$z = .27^{*}$$

SIGNIFICANCE OF THE DIFFERENCE BETWEEN COEFFICIENTS FOR CONSERVATION AND PASSIVES

$$z = \frac{-.199 - .013}{\sqrt{1/37 + 1/37}}$$

$$z = \frac{.212}{\sqrt{.027 + .027}}$$

*Not significant

$$z = \frac{.212}{\sqrt{.054}}$$

$$z = \frac{.212}{.7348}$$

$$z = .29^{*}$$

*Not significant

APPENDIX F

CALCULATION FOR RELIABILITY OF T-UNIT MEASURE OF LANGUAGE

$$r = \frac{N\Sigma XY - \Sigma X \Sigma Y}{\sqrt{[N X^2 - (X)^2]\ [N Y^2 - (Y)^2]}}$$

$$r = \frac{80x4079.01 - 555.7x579.2}{[80x3965.45 - (555.7x555.7)]\ [80x4363.72 - (579.2x579.2)]}$$

$$r = .416$$

SPEARMAN-BROWN CORRECTION FORMULA

$$r_{xx} = \frac{2r_{\frac{1}{2}\frac{1}{2}}}{1 + r_{\frac{1}{2}\frac{1}{2}}}$$

$$r_{xx} = \frac{2(.416)}{1 + .416} = \frac{.832}{1.416}$$

$$r_{xx} = .587$$