DOCUMENT RESUME

ED 108 128 CS 001 894

AUTHOR Fischer, Karen M.

TITLE Prediction of Reading Ability from Early Language Skills. Final Report.

INSTITUTION Gloucester County Coll., Sewell, N.J.

SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.

BUREAU NO BR-4-0438

PUB DATE Feb 75

GRANT NE-G-74-0009

NOTE 84p.; Not available in hard copy due to marginal legibility of original document

EDRS PRICE MF-$0.76 PLUS POSTAGE. HC Not Available from EDRS.

DESCRIPTORS Child Language; *Language Skills; Predictive Ability (Testing); *Predictive Measurement; Preschool Education; *Preschool Learning; Preschool Tests; *Reading Ability; Reading Development; *Reading Research

ABSTRACT

A follow-up study of 42 school-age children related school-age reading, reading readiness, and listening and speaking skills with early psycholinguistic ability. The children were given measures of vocabulary, sentence imitation, comprehension and production, phoneme discrimination, IQ, and word inflection skill at age three. In addition, the children's mothers were assessed for verbal IQ and speech style. At age six, measures which included those administered at age three, as well as field independence-dependence, reading readiness, and reading skill, were given to the children. Significant correlations were found between age-three and age-six scores, and between home and maternal measures and age-six scores. It is concluded from this study that school-age reading, listening, and speaking skills are predictable from and correlated with preschool language skills. (TS)

FINAL REPORT

PROJECT NO. 4-0438
GRANT NO. NE-G-74-0009

PREDICTION OF READING ABILITY FROM EARLY LANGUAGE SKILLS

KAREN M. FISCHER
GLOUCESTER COUNTY COLLEGE
SEWELL, NEW JERSEY 08080

FEBRUARY 28, 1975

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

U.S. DEPARTMENT OF

HEALTH, EDUCATION AND WELFARE

NATIONAL INSTITUTE OF EDUCATION

OFFICE OF RESEARCH GRANTS

ABSTRACT

A follow-up study of 42 school-age children has related school-age reading, reading readiness, listening and speaking skills with early psycholinguistic ability. The children were given measures of vocabulary, sentence imitation, comprehension and production, phoneme discrimination, I.Q. and word inflection skill at age 3. In addition, the children's mothers were assessed for verbal I.Q. and speech style. Measures given to the children at age six include vocabulary, sentence imitation and comprehension, phoneme articulation, I.Q., field independence-dependence, reading readiness and reading skill. Thirty six-year-olds were tested with the Metropolitan Reading Readiness Test, and twelve received the Stanford Achievement Test. All forty-two children received all other measures given at age six. Zero-order intercorrelation coefficients were computed between all measures at ages 3 and 6, and between home and maternal characteristics and children's scores at age 6. Stepwise regression analyses with age 6 child scores as dependent variables, and age 3 child scores, home and maternal scores as independent variables, were computed.

Significant correlations were found between age 3 and age 6 scores, and home and maternal measures and age 6 scores. Multiple correlations ranging from .36 to .84 for Metropolitan Readiness subtests, and .82 to .92 for Stanford Achievement subtests were found. Similar multiple correlations were computed for school age listening and speaking skills. These

results suggest that school age reading, listening and speaking skills, are predictable from, and correlated with, preschool language skills.

TABLE OF CONTENTS

	Page
Introduction	1
Method	6
Results	21
Conclusions	35
Appendix	73

Prediction of Reading Ability

From Early Language Skills

Introduction

The nature of the reading process has been the subject of continuous debate. Some theorists argue that perceptual-motor skills such as visual perceptual abilities, general hearing abilities, fine muscle coordination, etc., are important component abilities for reading (see Bond and Tinker, 1973; De Hirsch, Jansky and Langford, 1966, Isom, 1968). These theorists will often mention central neurophysiological correlates of particular types of deficits, in addition to possible "maturational lags". Other researchers mention social and/or emotional immaturity or dysfunction as causative factors in reading failure (see Thompson, 1968; Huessy, 1968; Jones, 1969). General cognitive skills as well as specific aspects of cognitive style, such as internal vs. external locus of control, field dependence, and conceptual categorization tendencies, are posited as etiological factors in success and failure (see Wagner and Wilde, 1973). Specific linguistic abilities are often mentioned as fundamental to reading, such as speech sound discrimination and articulation (Huessy, 1973; Isom, 1973;), morphological skill (Smith, 1973;), syntactic skill (Kavanaugh and Mattingly, 1972), and perhaps a combination of all linguistic skills (Ervin-Tripp, 1973). Ervin-Tripp (1973) compares learning to read with learning a second language. One's skill in learning one's first language (mother tongue) is suggested as predictive of one's skill in learning the second language (reading). Mattingly (1972) contends that learning to read may be dependent upon the development of metalinguistic awareness, the speaker's conscious contemplation of some of the phonological, semantic and syntactic rules of his language.

Of course, the notions above are not mutually exclusive. Most hypothesized factors have received research support by studies correlating reading failure with poor skills on the factors. This research usually measures the child at school age on both reading and the skill in question. Little longitudinal work has been attempted.

Determinants of school related linguistic skills (speaking and listening) is also subject to much debate. Most of the controversy involves attempts to categorize basic skills involved in acquiring and using language. Chomsky (1968) assigns to the mind the general theory of language that he calls "universal grammar". Language consists of a "deep structure", with transformational rules mapping deep structures on to surface structures, or the actual acoustic signal. Syntactic concerns are the bases of deep structure. Other linguists (such as Lakoff, 1970) see semantic concerns as the basis of the deep structure of language.

Chomsky's discussion of human language stresses psychological skills unique to language. Geschwind (1972) argues that there are unique aspects of brain structure which influence language behavior alone. This is based on data suggesting discrete specialization of brain areas for language. Geschwind would argue that cognitive skills such as perception of numerosity, are behaviors generated from another area of the brain.

Bever (1970) and others, however, have suggested that many processes of language acquisition and use are homologous to, and in fact correlates of, general cognitive operations. For Bever, acquisition of language skills and the development of the child's sense of numerosity, come from the same general ability.

Hymes (1968) and Bernstein (1967) posit that the social milieu has a direct influence on language behavior. This implies that one cannot entirely segregate social and linguistic skills, because the situation of language production and comprehension is inevitably a social situation. One can see a different emphasis on special linguistic skills, general cognitive skills, and social skills in the various points of view.

Research on the prediction of reading, listening, and speaking, in early elementary grades, based on pre-school psycholinguistic skills, is sparse. Most research has involved concurrent administration of tests of reading, listening and speaking to first graders. Little research has been reported on attempts to predict school success from pre-school skills. Stott and Ball's (1965) review of infant and pre-school mental tests argues for the general inadequacy of these tests. The predictive power of pre-school tests is quite low. Bayley (1955) reports that the correlation between individual I.Q. tests administered at age 3, and school age I.Q., is approximately r = .3. Pre-school I.Q. tests are not good estimates of school age I.Q. score, or school success.

Pre-school vocabulary tests, such as the Peabody Picture Vocabulary Test (Dunn, 1965), are often used as assessment instruments. The reported reliability of Peabody scores for 3 1/2 year olds is .81. Reports of predictive validity are meager. One study (Klaus and Starke, 1964, reported in Dunn, 1965) showed a correlation of .39 between Peabody score at the beginning of first grade and reading scores at the end of first grade (N=270). Another widely used test at this time is the Illinois Test of Psycholinguistic Ability (ITPA). This test has been critized as failing to measure skills in the syntactic, morphological or phonological components of language. Many of the subscales seem to test auditory and visual perception and memory (Ryckman, 1969). One study of 4 & 5 year olds, that attempted to assess the value of tests such as the Wechsler Pre-school scale, the ITPA, Peabody, Vineland, and Frosting Developmental Test in predicting difficulties in reading readiness, found poor prognostic skill in all tests (Shipe, Mietgitis, 1969). The sample size used was quite small (N=16). Greater success has been reported with articulation tests. Isom (1968) reports a .5 correlation between articulation score at 3 years and later school age reading problems. A significant limitation of most research is that the children selected as subjects are part of an early-identified abnormal population, such as pre-school age patients in Speech and Hearing Clinics.

Previous research can be faulted because of small sample sizes, use of exceptional children as subjects, and dependence of tests such as the Peabody and ITPA that tap only a limited range of linquistic skills.

This research is a longitudinal study of psycholinguistic skills in a group of white, middle class children. All of the children participated in a study of the heritability of language in 3 year olds (Fischer, 1973; Waterhouse, 1972). The present study is a follow-up project to measure the children's skill in reading, listening and speaking, at the start and completion of first grade, and to relate these school abilities to the child's linguistic skills at age three. In addition, home and maternal characteristics were measured when the children were 3 year olds, and these variables were correlated with the children's success on school abilities. This longitudinal research is limited in that the subjects are drawn from a white, middle class, metropolitan population, and Standard English is the only language spoken in the homes. Inferences to non-white, rural, non-middle-class, or non-Standard-English speaking groups is problematic. In addition, the children in the research are twins, and there is some question concerning the similarity of twins and singletons in verbal skills (Mittler, 1969, 1970; McCall et al, 1973). In general, twins are found to have the same pattern of verbal skills as single borns, but to be slightly slower in acquisition (Mittler, 1970).

METHOD

Subjects

Twenty-one sets of twins were collected, using Philadelphia birth registry records and Metropolitan Philadelphia Mothers-of-Twins Club records. Only white legitimate births, where both twins weighed over 3 1/2 pounds at birth, were contacted. Approximately 80% of mothers contacted agreed to participate in the study. Subjects recruited through Philadelphia birth registry records were born in February, March or April of 1968. Due to difficulty in recruiting a sufficient sample of subjects of appropriate ages, Mothers-of-Twins Clubs were contacted. Ten sets of twins were recruited through Twins Clubs. The final sample included subjects ranging from 2 1/2 years to 3 1/2 years at the start of testing.

Blood group analysis of a number of independent Mendelian blood charactertistics was used to establish dizygocity and probability of monozygocity at or beyond the .95 level of probability. The blood antisera used in this analysis were: A_1 A_2 BO; MNSs; CcDEe; K,k; Le^a Le^b, Fy^a Fy^b, Jk^a Jk^b; Mt; Yt^a;Gy^a. Results of the blood group analysis were not given to the investigators until all data were collected and scored. Detailed descriptions of the original study and its methodology have appeared elsewhere (Fischer, 1973, Waterhouse, 1972). Table 1 reports demographic data on the twenty-one sets of twins forming the subjects of this research.

Insert Table 1 about here.

All forty-two children who participated in the original research project were located and were able to participate in the follow-up study. We did find, however, that not all the children had completed the same grade by June, 1974. Because of the variable cut-off dates for the start of school attendance in Philadelphia, and the surrounding suburban communities where the children reside, and the variability in birth dates of the children, the subjects were not at the same grade level. Thirty children had completed kindergarten in June, 1974, and twelve had completed first grade. Children were assessed with tests appropriate to their grade level. The investigator will visit the kindergarten children this spring, to complete the assessment of first grade reading skills.

TESTS

Measures Given To Children At Age 3

Vocabulary

The Picture Vocabulary test of the Stanford-Binet I.Q. Scale (Terman and Merrill, 1960) was administered. This subtest of the Stanford-Binet I.Q. Scale calls for the production of the appropriate vocabulary item in response to a picture of that item. The child's score in this test was the number of items correctly named divided by the child's chronological age in months as of the date of test administration. Form B of the Peabody Picture Vocabulary Test (Dunn, 1965) was administered. The child's score was his I.Q. as determined from tables published in the test manual. The Peabody is a word recognition test. The third vocabulary test administered was the Mehrabian Test (Mehrabian, 1970). This test essentially tests the Binet vocabulary items reformulated into the word recognition format of the Peabody. The child's score was the number of items correctly answered divided by chronological age.

Sentence Production

[illegible] Story Sequence Task (Manual for Te[illegible]istration, 1969) was used to elicit sentence production. The [illegible] part of the story sequence task was administered to the children. The child is simultaneously shown four pictures in pre-arranged order and asked to "tell me all about the pictures." The pictures show animals engaged in everyday activity: at school; in the kitchen; drinking coffee; putting on a hat. Several measures were derived from the children's descriptions. The total number of words and utterances produced was scored. Utterances included sentences and sentence fragments marked at termination by a pause and sentence terminal intonation (falling tone for a statement and rising tone for a question). The child's mean length of utterance was calculated by dividing the total number of words by the number of utterances.

A number of points should be emphasized about the mean length of utterance (MLU) calculated. The unit of analyses chosen was words, not morphemes. A word was determined by standard orthographical considerations. In addition, since the child was asked to communicate about a particular topic, the number of utterances produced was limited.

[illegible]itional [illegible]asures taken on the elicited utterances were the number of verb forms correctly emitted and the number of incorrect verb forms. Both verb counts, as well as the MLU, were divided by the child's chronological age in months at the time of test administration.

Sentence C[illegible]ension

Fraser, Bellugi and Brown (1963) have developed a sentence comprehension test. The child must choose an appropriate picture illustrating a grammatical contrast. The test was administered according to the author's original instructions. The child's score was the number of his correct responses divided by his chronological age in months at the time of test administration.

Sentence Imitation

Two sentence imitation tests were administered to the children. The Osser Test (Osser, et al., 1969) consists of eleven sentences of approximately equal length, but differing derivational complexity. Form B of the Osser test was administered. Mehrabian (1970) includes a subscale of eighteen sentences to be repeated (from Menyuk, 1969). The sentences differ in both length and complexity.

The number of sentences correctly repeated was divided by the child's chronological age in months at the time of test administration.

Word Inflection

The Berko (1958) and Mehrabian (1970) tests of inflectional skill were administered. The Berko test uses nonsense words while the Mehrabian test uses common vocabulary items. Score was the number of items correct divided by chronological age in months.

Stanford-Binet I.Q. Test

The Binet I.Q. scale was individually administered to each child (Terman and Merrill, 1960).

Measures of Maternal and Home Characteristics

(Taken When Children Were Age 3)

Wechsler Adult Intelligence Scale (WAIS)

The vocabulary subscale of the verbal intelligence test was administered to all mothers (Wechsler, 1955). The mother's standard score on the vocabulary test was used to estimate Verbal I.Q. This was predicated on the assumption that the mother would receive an identical standard score was therefore multiplied by six to estimate her total verbal standard score. Verbal I.Q. was found by reference to tables in the WAIS manual appropriate for the mother's chronological age. The assumptions on which estimates are based appear reasonable in view of the high correlation between the vocabulary subscale and total verbal I.Q. (Wechsler, 1955).

Maternal Speech Style

Mother's speech style was analyzed in two situations. The first consisted of the mothers answering an interview administered by the experimenter concerning the twin pregnancy. This situation elicited spontaneous speech from mothers. Mothers became involved in relating incidents of their pregnancy and delivery, and seemed to communicate in a natural, unstilted style.

The interview was tape recorded and transcribed by a trained transcriptionist. The transcriptionist indicated the end of an utterance by appropriate punctuation. Utterance puncture, whether of complete sentences or sentence fragments, was determined by noting a pause and sentence terminal intonation (falling lone for a statement, rising tone for a question). The transcript was examined for number of words in the first 200 utterances. One word utterances were excluded from analysis A "word" was defined by standard orthographical consideration. The mother's mean length of utterance (MLU), in this controlled speech interaction with an adult, was calculated by dividing the number of words produced, by the number of utterances examined (200).

Mother-to-Child Speech

Illustrations from a Sesame Street Book of Shapes and a German Fairy Tale were given to the mother. She was instructed to tell her child all about the pictures. The speech setting was as unstructured as possible. The first 100 utterances the mother addressed to each child were coded. Mother interacted separately with each twin on the same day. The co-twin was absent from the room for his sibling's interaction session. Assignment of first- or second-born twin to mother for the first interaction session was random. Waterhouse (1972) adapted eight measures of maternal speech style from Cazden (1965).

1. Questions

Questions were marked at termination by a pause, and the appropriate rising tone terminal inflection. Any question addressed to the child, even if unanswered, was included in this count. The question did not necessarily begin with a Wh marker.

2. Answers

Answers were all maternal utterances following a child question that continued the topic of conversation even if the utterance was not a logical reply to the query.

3. Repetitions

Maternal utterances were scored in this category if they were an exact repetition of the child's immediately preceding utterance.

4. Expansions

Maternal expansions were elaborations upon the topic of the child's immediately preceding utterance. They involved repeating the child utterance with an addition of words. Any maternal utterance that changed the verb form the child used, was also included in this category.

5. Criticisms

Criticisms were any correction or negative statement the mother addressed to the child about his speech or his behavior.

6, Directions

Any imperative directed at the child is included in this count.

7. Confirmations·

A confirmation involves the mother giving the child assurances or feedback about the truth value of his utterances. Confirmations were elicited by the child's utterances, not by his questions. The mother's reply to questions is coded under answers.

8. Assertions

Assertions are maternal utterances marked at termination by a pause and a falling intonation, that did not reiterate the content of the child's preceding utterance (was not a repetition or expansion).

Maternal Teaching Style

The mother's interaction style with her child was measured by means of the ETS eight block sorting task (Manual for Test Administration, 1969). Predicated on the work of Hess and Shipman (1965) and Brophy (1970), this task measures the influence of maternal teaching style on child performance. Blocks varying in four parameters were presented to the child. Two parameters, block shape and color, were irrelevant to the problem. The children had to learn to sort blocks into the four possible categories: tall, X; tall, O; short, X; short,O. Points were given for success in placement and for success in verbalizing the reason for the placement. ("I put it there because its a little O.)." The child could receive a total of eight points on the task,-four points for correct placement of each of two blocks. A given block (such as tall, X) could be correctly placed for height, or marking, or both categories. Verbalization of relevant attributes was also scored. No child in the study who correctly verbalized an attribute, incorrectly placed the block.

Mothers were introduced to the task by a standard presentation, as described in the test manual. In essence, the categorization principles were presented once, with mothers themselves sorting the blocks once. The mother then received as much time as she desired to teach her child. Mothers were free to use whatever instructional strategies they desired, such as threats, praise, demonstrations, etc. When mother signalled that the child was ready to be tested, the researcher tested the child's comprehension of the sorting categories, using the procedure described in the test manual.

Assignment of first or second born twin to mother for the first teaching session was random. Only one twin was in the room with mother for each teaching session. Mother taught the block sort to both twins on the same day, and data included in the data analysis is limited to mothers who completed the block sort with both twins. Scores are the children's scores on the categorization test. Each mother is represented by two scores, one score from each twin.

Mothers varied in their teaching ability and children varied in their categorization skills. Brophy (1970) found that children had lower performance as a function of both maternal teaching inadequacy and low I.Q. of the child. The relative contributions of these sources of variance were not disambiguated.

The score, on this test was the number of points received by the child for correct placement of test blocks, and for success in verbalizing the reason for placement.

Socioeconomic Status

The socioeconomic status (SES) of the child's family was determined by using an index based on the education and occupation of the head of the household. In all cases, this was the child's father. This index, reported by Reiss (1961), is called the NORC rank, and places occupations on a scale from 1 to 99. Where the job title provided by the mother was ambiguous, the amount of schooling the father achieved was used to help determine the appropriate scale score.

Measures Given To Children At Age 6

Vocabulary

Form B of the Peabody Picture Vocabulary Test (Dunn, 1965) was administered. The child's score was his I.Q. as determined from tables published in the test manual.

Sentence Imitation

Clay (1971) devised a set of English sentences to measure language acquisition in 5 to 7 year olds. Odd numbered sentences from Clay's list, in all twenty sentences were administered. The child's score was the number of sentences repeated exactly as given in the model.

Sentence Comprehension

Chomsky (1969) has studied the acquisition of syntactic structures in children between the ages of 5 and 10. Constructions studied included (A) John is easy to see, and (B) John promised Bill to go. The child must comprehend the missing subject of an infinitival complement clause. Chomsky's interviews involving (A) Easy to see, and (B) Promises were administered according to her instructions.

The child's score is the number of test questions answered correctly. The "promise" test contains eight test sentences, and the "easy to see" test has four test sentence.

Articulation

The Goldman-Fristoe Test of Articulation was administered to every child (Goldman and Fristoe, 1969). The Sounds-in-Words Subtest and the Sounds-in-Sentences Subtest were administered to every child by a trained Speech Pathologist, according to the directions in the test manual. Each sound production of the child taking the test was judged only for presence of error, not for type of error. The child's score was the total number of errors produced on the two subtests.

Cognitive Style

A test of field-dependence-independence has been developed by Witkin et al (1971) for use with school-age children. The Children's Embedded Figures Test (CEFT) was administered according to directions in the test manual. All children received the TENT series of stimuli. If one out of five of the last TENT items was passed, testing was continued with the HOUSE series of stimuli. The child's score was the total number of correct responses. The child must find a simple geometric shape embedded in a complex design.

Reading Readiness

Form B of the Metropolitan Readiness Tests (Hildreth, Griffiths, McGauvran, 1966) was administered to all children completing kindergarten. Five tests were administered: listening matching, alphabet, numbers, and copying. The tests will be described below:

Listening -

The child is presented with a series of sentences or paragraphs, and he indicates comprehension by marking one of three pictures in answer to a question. The more difficult items require inferences beyond a literal understanding.

Matching -

In matching, the child matches to a standard from among three choices. The stimuli are words and geometric designs. The test manual states "Matching seeks to get at visual perceptual skills..." (p.15).

Alphabet -

The child chooses a printed alphabetic character from four choices, in response to the oral presentation of a letter of the alphabet.

Numbers -

This test measures familiarity with simple numerical concepts, such as "more", "one-third", recognition of and ability to produce numerical symbols, concepts of money, etc.

Copying -

The child must reproduce letters, numbers and abstract designs.

The word meaning test of the Metropolitan was not administered, because of overlap with the Peabody Picture Vocabulary Test. The tests were administered according to directions in the test manual. The child's score on each subtest was the number of questions answered correctly. A total score was calculated by adding the scores on the five subtests.

Reading Achievement

All children completing first grade were tested with the Stanford Achievement Test, Primary I Battery, Form W (Kelley; Madden; Gardner; Rudman; 1964). The following tests were administered: word reading; paragraph meaning; vocabulary; spelling; word study skills.

Word Reading -

The child looks at a picture illustrating a word, and then selects the word which stands for the picture from four choices.

Paragraph Meaning -

The test contains a series of paragraphs of graded difficulty, from which words are omitted. The child selects a word for each omission from four choices, indicating his comprehension of the content of the paragraph.

Vocabulary -

In response to oral stimuli, the child chooses the correct printed response from three choices. The test measures word recognition.

Spelling -

A 20 item spelling test is given. The word is read, given in a sentence and reread.

Word Study Skills -

This test measures auditory perception of initial and final word sounds, rhymes, and matching printed to spoken words.

The child's score was his percentile rank on the test, as determined from the test manual. All tests were administered according to directions in the test manual.

Test Administration and Scoring

All tests were individually administered to each child. Testing of the children at age 3 was performed by the Principal Investigator and Dr. Lynn Waterhouse, as part of doctoral dissertation research projects. Testing of the children at age 6 was done by the Principal Investigator and two paid Research Assistants. In both the original and follow-up testing, co-twins were tested on the same day for any given test, but in different rooms by different examiners. The only exception was for the Goldman-Fristoe Articulation Test given at age 6. For this test, a Research Assistant who is a trained Speech Pathologist, administered the test to all children. The research on the children at age 3 was conducted from March to December, 1971. The research on the children at age 6 was conducted during July and August of 1974.

Test scoring of all measures was done separately by two investigators for each measure. Disagreements between scorers were resolved by reference to the data, written scoring instructions for unstandardized tests, and test manuals.

Data Analysis

Simple Pearson's r were calculated between all variables. Stepwise regression analyses were calculated to determine the major independent predictors of data on the 6 year olds.

Multiple regression analyses were calculated to determine the predictability of reading, speaking and listening, from early skills. The following equation was solved:

$$\tilde{z}_0 = \beta_{01.23 \cdots n} z_1 + \beta_{02.13 \cdots n} z_2 + \cdots + \beta_{0n.12(n-1)} z_n$$

The statistical significance of multiple correlations was computed by reference to the appropriate tables (Buggaley, 1964, Table B).

The data collected on 6 year olds was analyzed to measure the heritability of linguistic skills. Simple one-way analyses of variance were computed, by zygosity group, for each test of interest. Within pair variance in MZ and DZ twins was compared as recommended by Vandenberg (1968). A one tailed F test is used to test the assumption of homogeneity of variance.

The stepwise regression analyses were calculated using SPSS subprogram Regression (Nie, Bent, Hull, 1970). The F level and tolerance level for the inclusion of variables in the stepwise mode were .01 and .001, respectively.

RESULTS

The analyses were directed at determining if school-age skills of reading, listening and speaking were related to pre-school psycholinguistic abilities, and/or home and maternal characteristics. The mean score, standard deviation, mean age of subjects (in months) and sample size for tests administered at age 3 is given in Table 2.

Insert Table 2 about here

Complete data is available for all measures given at age 3, except for sentence production and phoneme discrimination score, where data is missing on one twin pair each (two subjects). The mean I.Q. of 101.24 shows this sample to be average in tested intelligence, although slightly more variable than expected. The mean Peabody Picture Vocabulary Test I.Q. of 87.12 is lower than the average of 100 expected in an unselected population. Multiple births frequently show lower scores on I.Q. and verbal ability tests (McCall, Appelbaum and Hogarty, 1973), than singleton births.

Table 3 presents means, standard diviations, and sample sizes for measures of home and maternal characteristics, including mother's I.Q. It should be noted that the sample includes only 21 families, with two children per family. Complete data was obtained on maternal I.Q., and S.E.S. Two MZ Mothers are missing from the M.L.U. data, while six mothers (two MZ and four DZ) did not provide data for the analyses of mother-to-child speech characteristics. Two mothers did not participate in the coding of maternal teaching style. All measures listed in Table 3 were taken when the children were 3 year olds.

Insert Table 3 about here

Means, standard deviations, and sample sizes for measures administered to the children at age 6 are given in Table 4. Complete data was obtained on all children for the Peabody, Sentence Comprehension, Sentence Repetition, Articulation and Embedded Figures Tests. On the reading tests, all children completing kindergarten (N=30) took the Metropolitan Reading Readiness Test, and all children completing first grade (N=12) took the Stanford Achievement Test. Note that on the retest at age 6, the children received substantially higher scores on the

---

Insert Table 4 about here

Peabody than at age 3.

Prediction of School-Age Listening and Speaking Skills

Stepwise and multiple regression analyses were performed with Peabody Vocabulary (age 6 score) as the dependent variable, and preschool psycholinguistic scores at the independent variables. Table 5 gives the results of the stepwise analysis.

Insert Table 5 about here

The simple Pearson's between the various preschool measures and Peabody Vocabulary at age 6 are not high, but the multiple of .527 is substantial. Phoneme discrimination skill at age 3 is a good predictor of the vocabulary score at age 6, while the child's verb errors in production add substantial independent variance. The Peabody score at age 3 is the third most important independent source of variance to the prediction equation. The first five predictor variables are able to account for 25 percent of the variance in Peabody score at age 6, a statistically significant multiple correlation. Knowledge of preschool I.Q. does not substantially increase the predictability of school-age vocabulary, if linguistic skills at age 3 are known since addition of Binet I.Q. to the multiple correlation only increases it to .54.

The stepwise regression to predict comprehension of the "easy-to-see" construction showed sentence comprehension at age 3 the best predictor of comprehension at age 6, although the zero-order correlation was non-significant (see Table 6).

Insert Table 6 about here

Table 7 gives the stepwise analysis for prediction of comprehension of sentences using the "promise" construction. Interestingly, this construction shows greater predictability from preschool scores than the "easy-to-see" construction, and the pattern of preschool skills contributing to the regression equation [illegible]ers for the two test sentences. Phoneme discrimination is the [illegible] comprehension as the best predictor for "easy-to-see". Mehrabian Inflection shows the second highest contribution to the "promise" multiple , while Berko Inflection holds this position for "easy-to-see". Preschool inflection skills show important over-laps with variance in school-age sentence comprehension. In all, 47 percent of variance in school-age sentence comprehension as tested in Chomskys "promise" test, is predictable from a weighted combination of pre-school-age linguistic tests. Substantial over-laps exists between variance in pre-school language tests and school-age comprehension, with six significant correlations. The multiple correlation of .681 is significant at the .05 level.

Insert Table 7 about here

Table 8 presents the stepwise analysis with sentence repetition skills as the dependent variable. We see that school-age sentence repetition is highly predictable from pre-school skills. Osser Sentences, Mehrabian Sentences, Mehrabian Inflection, Phoneme Discrimination, MLU and Berko Inflection all correlate significantly with school-age sentence repetition. Fifty-nine percent of variance at age 6 in sentence repetition is predictable from scores on language tests at age 3 (r^2 = .76). The first three variables entered in the stepwise analysis - Osser Sentence, Mehrabian Inflection and M.L.U. - alone account for 54 percent of variance in school-age sentence repetition. The multiple correlation of .76 is statistically significant.

Insert Table 8 about here

The Goldman-Fristoe Test of Articulation will be examined below. Table 9 presents the stepwise regression analysis. Osser Sentences shows the highest correlation with Goldman-Fristoe errors (r=.40), while Berko Inflection (r=.38) also gave a significant correlation. The three best independent sources of variance in the regression equation were Osser Sentences, Mehrabian Sentences and Mehrabian Vocabulary. The first seven independent variables entered in the stepwise analysis produce a statistically significant multiple correlation with articulation errors (r^2=.605).

Insert Table 9 about here

The Children's Embedded Figures Test (CEFT) is analyzed in Table 10. Children having greatest success on the embedded figures problem were most likely to be successful in word inflections (Berko Inflection r=.31), successfully repeat sentences (Mehrabian repetition r=.30), have high M.L.U. (r=.29), and be attuned to phonemic distinctions (r=.29). The three best independent predictors are Berko Inflection, M.L.U. and Production Verb Errors. CEFT is not as highly predictable from our preschool language tests, as is the school-age language measures.

Insert Table 10 about here

<u>Prediction of Reading Readiness Skills</u>

The Listening Test of the Metropolitan, is a test of the child's comprehension of sentences and paragraphs. Table 11 presents the stepwise regression analysis with listening as the dependent variable. The analysis of reading readiness includes Stanford-Binet Vocabulary, while previously reported analyses do not. For the Metropolitan Listening Test, Stanford-Binet Vocabulary is the highest correlate (r=.59), with Peabody Vocabulary (r=.53) and Mehrabian Vocabulary (r=.49) giving only slightly lower correlations. Other significant correlates include Osser Sentences, MLU, and Berko Inflection. Sentence Comprehension at age 3 is insignificantly correlated with listening (r=.08). In general, Listening Skill is highly related to preschool language scores, with the multiple correlation of .71 for the first 8 variables entered being statistically significant. The strongest independent variable is Binet Vocabulary, which is an encoding (production) measure. Peabody vocabulary was the second variable entered in the stepwise regression analysis, suggesting that word recognition provides additional unique sources of variance. The third variable entered was phoneme discrimination.

Insert Table 11 about here

On the Metropolitan Matching Test, visual perceptual skills are tapped. The child must match a figure to sample, from three choices. The test bears some resemblance to CEFT, where the child must locate a geometric shape embedded in a design. Interestingly, the two tests showed similar results on the regression analyses. Table 12 lists the stepwise regression with matching as dependent variable, while Table 10 provides the analysis for CEFT. In [illegible] .54, [illegible] CEFT.

r^2=.56, although the significant multiple correlations are .36 and .45, for Matching and CEFT, respectively. Many variables showed remarkably similar correlations with Matching and CEFT: Production Verb Errors (-.08, -.08); M.L.U. (.22, .29); Phoneme Discrimination (.28, .29); Berko Inflection (.31, .31); Mehrabian Sentences (.29, .30). We can conclude that CEFT and Metropolitan Matching are similar instruments, but are not substantially predictable from preschool language skills.

Insert Table 12 about here

The Metropolitan Alphabet recognition test is the dependent variable in the stepwise analyses given in Table 13. Phoneme discrimination shows a highly significant correlation with alphabet recognition (r=.69), as does Berko Inflection, with other language skills giving insignificant correlations. The child's mean length of utterance, although only slightly related to alphabet score (r=.03), is also unrelated to phoneme discrimination (r=.17), and therefore is entered second in the stepwise equation. The eleven variables entered in the equation accounted for 72 percent of the variance in alphabet recognition. The first three variables alone, account for 65 percent of the variance in alphabet score. The multiple correlation of .84 is statistically significant.

Insert Table 13 about here

Table 14 presents the stepwise analysis of Metropolitan Numbers. This subtest of the Metropolitan is often found to be the best predictor of future reading success (Hildreth et al., 1965). We see Osser Sentences significantly correlated with Metropolitan Numbers, as is Phoneme Discrimination, Berko Inflection and Binet Vocabulary. A broad range of psycholinguistic skills seem to be related to the child's numerical conceptual skills. Sixty-four percent of variability in the Numbers test seems to over-lap with variance in early psycholinguistic skills. The multiple correlation of .80 is statistically significant.

Insert Table 14 about here

The Copying Test of the Metropolitan measures eye-hand coordination, and familiarity with alphanumeric characters. Table 15 reports the results of the stepwise analysis on this variable. More than half the variance in the copying score is predictable from measured preschool language scores, with the first three variable entered in the stepwise analysis accounting for 49 percent of the variance. Phoneme Discrimination shows the highest correlation with Copying, with Mehrabian Vocabulary and Berko Inflection giving the second and third greatest independent contributions to variance. The phonemic (Phonemic Discrimination) and Morphophonemic (Inflection) tests show 3 out of the 4 highest correlations with copying, suggesting the overlap in perceptual processes involved in eye-hand coordination, and speech sound discrimination. The multiple correlation of .73 is statistically significant.

Insert Table 15 about here

Table 16 gives the stepwise analysis for the Total Metropolitan score. Phoneme Discrimination at age 3 is the best predictor of reading readiness as the child enters first grade. Other substantial correlations are found with Berko and Mehrabian Inflections (.51 and .36), Osser and Mehrabian Sentences (.49 and .36), Mehrabian and Stanford-Binet Vocabulary (.45 and .43). In all, sixty-four percent of variance in Metropolitan Reading Readiness score is predictable from variance in language scores at age 3. The multiple correlation of .81 is statistically significant.

Insert Table 16 about here

Prediction of Reading Skills

Tables 17-21 provide stepwise regression analyses of Stanford Achievement Test reading scores. Table 17 gives the Word Reading analysis. The small sample size (N=12) prevents any of the zero-order Pearson correlations from reaching statistical significance.

Insert Table 17 about here

Table 18 presents the stepwise analysis of Paragraph Reading. Four variables show significal zero-order correlations with paragraph reading: Sentence Comprehension; Stanford-Binet Vocabulary; Mehrabian Vocabulary; Berko Inflection. A multiple correlation confined to the first three independent variables would reach statistical significance (r^2 = .819, N=12, p. > .05). Sentence comprehension, Osser Sentence Repetition and Mehrabian Vocabulary administered at age 3 are highly potent predictors of reading comprehension in first grade.

Insert Table 18 about here

Stanford Vocabulary is highly predictable from preschool language. Five variables show significant zero-order correlations: Berko Inflection, Peabody Vocabulary, Mehrabian Sentences, Mehrabian Vocabulary, Phoneme Discrimination. The first eight variables entered in the stepwise analyses give a multiple r of .968, a statistically significant correlation. Further additions are not tenable. The three best independent predictors of Stanford Vocabulary are Berko Inflection, Mehrabian Inflection and Peabody Vocabulary. Interestingly, it is the inflection of nonsense items on the Berko that is positively related to later vocabulary size, and not the inflection of normal vocabulary items, as tested by the Mehrabian.

Insert Table 19 about here

Table 20 presents the stepwise analysis of word study skills. The only significant correlate is the syntax measure-Mehrabian Sentences. Word Study Skills do not seem to be as highly related to preschool language as paragraph reading and vocabulary.

Insert Table 20 about here

Table 21 presents the stepwise analysis for spelling skills. First grade spelling ability shows significant zero order correlations with preschool Sentence Comprehension and Stanford-Binet Vocabulary. Spelling does not seem to be as predictable from preschool language as paragraph reading and vocabulary.

Insert Table 21 about here

Prediction of Stanford-Binet I.Q.

The child's measured I.Q. at age 6 was the dependent variable in the stepwise regression analysis report in Table 22. Statistically significant zero-order correlations with Binet I.Q. include Berko Inflection, Mehrabian Inflection, Mehrabian Sentences, Osser Sentences, and Phoneme Discrimination. Greatest shared variance between I.Q. at age 6 and three year olds skills resides with phonemic, morphophonemic, and syntax skills. Interestingly, vocabulary, and even Stanford-Binet I.Q. at age 3, are unrelated to Stanford-Binet I.Q. at age 6, in this sample.

The stepwise analysis show the two word inflection measures contributing the greatest independent sources of variance to I.Q. Sentence comprehension, although only slightly related to I.Q., is also uncorrelated with word inflection, and so is the third variable entered in the regression equation. The total significant correlation calculated, r^2=.75, shows almost 60 percent of variance in Binet I.Q. at age 6 predictable from early language skills, and I.Q. A multiple regression analysis performed including all language tests, but excluding early Stanford-Binet I.Q., found r^2=.74.

Prediction from Home and Maternal Characteristics

Table 23 presents the stepwise analysis of the prediction of Total Score on the Metropolitan Reading Readiness Test from early home and maternal characteristics. In this analysis, mother's WAIS verbal I.Q. is the highest correlate of reading readiness. Other variables entered do not produce a significant zero-order correlation. The obtained correlation of .46 accounted for over 15 percent of the variance in reading readiness score. This in contrasts with the multiple correlation of .81 obtained in the stepwise regression predicting total score with the child's preschool language scores as independent variables. There is a measurable difference in the predictability of reading readiness from child or maternal with child score giving higher r^2s.

The Stanford Achievement Test Scores were not analyzed with home and maternal characteristics as independent variables, due to the small number of analyzable cases (N=4).

The intercorrelations of all measures given at ages 3 and 6 are given in Table I of the appendix. The inter-correlations of maternal and home characteristics, and child measures at age 6, are given in Table II of the appendix.

Similarity of Skills in Identical versus Fraternal Twins

Table III of the Appendix presents the intra-class correlation coefficients, and F ratios comparing within pair variance in MZ and DZ pairs, for measures of reading readiness and language skills administered at age 6. The Stanford Achievement tests were not included in this analyses because of the small sample size. The Stanford-Binet I.Q. test is similarly not included, because only one twin in each twin pair was administered this scale.

Peabody Vocabulary and Goldman-Fristoe Phoneme Articulation are significantly more similar in identical than fraternal pairs. All Metropolitan tests are more similar in identicals than fraternals, although the small sample size does not permit statistical significance to be assigned. The highest F ratio is obtained for the Alphabet Recognition test, and the total score.

Articulation and vocabulary show significantly greater concordance in MZs than DZs. Sentence repetition and disambiguation of embedded figures is more similar in DZ pairs than MZs in this sample. This result is unexpected. One always expects identicals to be more similar than fraternals, even if the difference in concordance is slight. The greater similarity of DZs can be attributed to sampling fluctuations due to small sample size, for measures under environmental control. An additional hypothesis is that for skills malleable by environmental forces, mothers seek to disambiguate identicals and homogenize fraternals. The result might be greater within pair similarity in fraternals than within identicals.

CONCLUSIONS

This longitudinal research project supports a number of important, although tentative, conclusions concerning the predictability of school age psycholinguistic skills, and supports inferences concerning the precursors for these skills. Before discussing these conclusions, attention should be drawn to limitations in the data analyzed.

An important limitation of this project results from the initial impetus for the work. The subjects were recruited at age 3 to participate in a study of the heritability of languages skills (Fischer, 1973; Waterhouse, 1972). No consideration was given at that time to the possibility of longitudinal research. Independent variables in the prediction equations are therefore limited to the measures of interest in the original study. Particularly for the regression analyses of reading and reading readiness skills, tests of visual and visual-motor skills at age 3 would have been valuable. Additionally, the developmental data collected cannot be analyzed into components due to endogenous (inherently generated) and exogenous (externally, environmentally generated) components. Elaborate research designs have been suggested for determining these components (Cattell, 1960; Schaie, 1965). This project is only addressed to the question of the predictability of school abilities. Causal inferences concerning inherent or environmental contributions to the development of these abilities cannot be made from the data.

The group of children studied is a very small, non-representative sample from a suburban-urban area. It has been suggested that twins differ from singletons in aspects of development (Mc[illegible], 1972). One large comparison of twins and singleton 4 year olds on the Illinois Test of Psycholinguistic Abilities found twins scoring approximately two-thirds of a standard deviation below singletons, but displaying the same profile, or [illegible] (1972). The subjects of this research were all same-sex twins, and any appreciable differences between twins and single borns in the development of the abilities studied, could limit the applicability of these findings. In addition to the limitation to twin births, subject recruitment contained a number of biases. Although the initial screening list contained the names of all twins born in Philadelphia during 3 months of 1968, recruitment was limited to white, legitimate births, where both twins weighed over 3 1/2 lbs. at birth. Some suburban twins were recruited through Mothers-of-Twins Clubs. All children came from father-present, English-speaking homes. The social class index computed showed this group to be at about the national median of the occupational scale.

Interpretation of the obtained multiple correlations must [illegible] the multiple. In a subsequent sample (or [illegible] error of measurement [illegible] differently distributed. If the weights found in one sample [illegible], the [illegible] criterion variable will decrease. The formula for estimating the correlation in a population between the criterion and the weighted sum of the predictors is:

$$R' = \sqrt{\frac{(N-1)R^2 - (n'-1)}{N-n'}}$$

in which R' is the shrunken multiple, N is the number of cases, and n' is the number of predictor variables selected at any stage (DuBois, 1965, p. 185). The shrinkage increases as N decreases. This problem is usually solved by cross validation, with weights applied to a new sample, and the validity found taken as a better indication of the tr validity. The obtained multiple correlations are over-estimate of the true correlations, especially in light of the small number of cases in the study.

In examining the zero order correlations on which the regression analyses are based, it should be emphasized that the correlation coefficients were not corrected for attenuation. The small sample size, and the restriction to white, middle-class families, reduced the range of abilities and environments for subjects. Correlations in a less restricted sample would probably be higher. Additionally, the obtained correlations were not corrected for test unreliability. Many of the measures given in both the early, and follow-up study, are unstandardized tests with little or no reliability information available. Well standardized instruments include the Stanford-Binet, WAIS, Peabody, Metropolitan Stanford Achievement and Goldman-Fristoe Tests.

[illegible] Sentence Repetition, and Berko Word Inflection Tests, are research instruments that have not undergone careful test development procedures. Differences in the obtained correlations between various tests may reflect differences in the relibilities of the measures, in addition to "true" differences in relatedness. The tests used, and in particular the unstandardized tests, also suffer from validation deficiencies Some research has linked children's performance on language tests, such as sentence imitation, with grammatical competence displayed in spontaneous utterances.

In general, construct validity has been inferred from the test content.

Reading Readiness

The subtests of the Metropolitan Readiness Tests have been validated in terms of both construct and predictive validity. The test manual reports correlations ranging from .50 to .76 between the Metropolitan and various measures of general intelligence. One study of 277 pupils entering 1st grade in Oregon gave a correlation of .67 between mental age on the Stanford-Binet Intelligence Scale, and total score on Form R of the Metropolitan. Predictive validity of the Metropolitan is substantial. The 1964-1965 USOE First Grade Reading Study, with 9497 children as subjects, found correlations of .57 to .67 for Metropolitan total score and subtests of Stanford Achievement Test, Form X. Studies of the prediction of Metropolitan Achievement Test scores in first grade from Metropolitan Reading Readiness report correlations ranging from .58 to .81 (Hildreth, Griffiths and McGouvran 1969). The authors summarize their review of the validity research on the test as follows: "An overall estimate would place the prediction at a level of at least .60, a value that must be considered as very good for test results for five-and six-year old children who are in almost every instance taking their first group-administered test." (Hildreth, Griffiths and McGouvran, 1969, p.23). The Metropolitan Readiness Tests is an important and widely used measure of school readiness administered to thousands of American children annually, and is quite similar in content to other widely used readiness tests.

Significant correlations were obtained between Metropolitan tests of listening, matching, alphabet recognition, number knowledge, and copying, and age 3 Stanford-Binet I.Q., vocabulary, sentence repetition, word inflection, and phoneme discrimination scores (see Table I, appendix). In general, the highest correlations were with Stanford-Binet I.Q., with phoneme discrimination giving the second strongest correlates. Sentence comprehension and production were insignificantly related to Metropolitan scores.

Regression analyses found high multiple correlations for most subtests of the Metropolitan, as well as for total score, with pre-school language tests as independent variables. The significant correlations ranged from .71 for listening to .84 for alphabet recognition, with $r^2=.81$ for the total score. We find that sentence comprehension and production are often important independent contributors to the multiple correlation coefficients. Comprehension and production were not highly correlated with the other preschool language scores, and therefore made substantial contributions to r^2, although the measures were not highly correlated with the Metropolitan. The intercorrelation matrix of the preschool language tests is given in Fisher (1973, Table 13).

The comparison of MZ and DZ twins finds substantially greater similarity in MZ pairs on the Metropolitan tests, although the sample size was too small to permit statistical significance to be reached.

Reading Skill

Reading achievement displayed significant correlations with early skills, despite the small sample available for analysis. Early Sentence Comprehension was significantly correlated with two out of five subtests, and Berko Word Inflection and Mehrabian Vocabulary were also significantly correlated with two subtests. Sentence production was unrelated to the Stanford scores. The significant multiple correlations obtained in the stepwise analyses were .92 for vocabulary and .82 for paragraph meaning. Shrinkage of the multiple correlation is expected in a new sample, however, becauae of the very small sample size and large number of predictors in each equation.

The vocabulary regression analysis showed early vocabulary as important predictors, with word inflection as the most important independent sources of variance. Morphophonemic and morphological skill, as tapped by word inflection and word knowledge tests, predict school-age vocabulary. The Stanford vocabulary test gave higher zero order correlations than the Peabody (Table 5). Perhaps test administration procedures account for this discrepancy. The Peabody was administered at the end of a lengthy test administration session, and subject fatigue could have caused inattention, and therefore, increased measurement error. The highest correlate for Peabody vocabulary is with phoneme discrimination, a measure that significantly correlates with Stanford vocabulary.

A comparison of the Metropolitan regression analyses and Stanford analyses suggest that early language skills make slightly different contributions to skill on the various tests. The different sample sizes resulted in a greater number of significant r^2s for Metropolitan then for Stanford regression analyses.

School Age Listening, Speaking and Cognitive Skills

Prediction of Binet I.Q., Embedded Figures, Peabody Vocabulary, Clay Sentence Repetition, Goldman-Fristoe Articulation, and Chomsky's Sentence Comprehension Tests, in general, showed lower multiple correlations than the reading and reading readiness tests. The larger sample sizes in these analyses substantially reduced the standard error of the multiple correlations, implying that the obtained r^2s are closer to the true values.

Home Characteristics

The mother's verbal I.Q. was the best predictor of child reading and language skills in the group of home characteristics. Variability in measured social class was only slightly related to variability in school skill in this sample. Mother's verbal complexity in speech to an adult (MLU) was uncorrelated with child achievement. Children who achieved higher scores when more successful at disembiguating figures and repeating sentences. The highest correlation obtained was between articulation errors on the Goldman-Fristoe Test and maternal answers, suggesting that children with articulation problems demand and receive more maternal attention by soliciting answers to questions.

The correlation of maternal I.Q. and child I.Q. is .49, substantially higher than the correlation of .14 obtained between Stanford-Binet I.Q. at ages 3 and 6. Most research has shown low correlations between school age I.Q. and preschool and infant intelligence (Bayley, 1955). Items on the Binet Scale at age three include tests of vocabulary recognition and eye-hand coordination, while age 6 Binet items test verbal and mathematical conceptual abilities. The factor structure of the Stanford-Binet, and other tests of mental ability, seems to shift between the preschool years and school age. The types of abilities measured by the WAIS and school age Binet are probably similar. Most research reports increasing correlations with child age between parent and offspring in I.Q., with parent-offspring correlations stabilizing approximately .50 (Erlenmeyer-Kimling and Jarvik, 1963).

Mother's I.Q. can be viewed as a better estimate of the child's adult intelligence level than the child's own I.Q. score measured at age three. It can then be hypothesized that reading, listening and speaking scores that correlate significantly with the child's age 3 I.Q. represent skills important for preschool cognitive ability, while school age scores correlated significantly with maternal I.Q. measure skills that overlaps with adult intellectual abilities. She can also [illegible] environmental stimulation for her child. Her intelligence would be an important determinant of the quality of stimulation provided for the offspring. According to this interpretation, mother's intelligence affects the environmental component of variance in psycholinquistic skills.

Recommendations

The school-age language and reading tests examined showed substantial correlations with pre-school psycholinguistic tests. The multiple correlations obtained suggest the feasibility of producing a preschool testing instrument for assessment purposes. The only instrument now available - the Illinois Test of Psycholinguistic Abilities - has been criticized for testing auditory and visual perception and memory. It is questionable if it directly taps skills in the syntactic, morphological or phonological components of language (Ryckman, 1969).

It would be premature to examine the regression analyses for specific information about particular language skills. Most of the independent variables are unstandardized tests. It is quite likely that preschool skills tested by unstandardized tests, if assessed with more reliable instruments, would show higher correlations with the dependent measures. The results concerning the relative contribution of the various preschool measures would also shift, as measurement error decreased. An accurate determination of the relative contribution of various linguistic skills to school success must await the development of reliable, well standardized preschool language tests. The step-wise regression analyses do suggest, however, that school-

[illegible]

abilities in all components of language. Syntactic, semantic, and phonological skills are all represented among the significant correlation coefficients. The traditional focus on the size of the child's vocabulary appears to be untenable.

In interpreting the results noted, the usual caveat applies to all correlational research: correlation does not imply causation. One cannot assume that interventions aimed at improving significant preschool language skills, even if successful in raising preschool skills, will necessarily affect the school age skills. The possibility that early intervention would prevent school-age disability exists, however, and would seem to be an important area for further theoretical and applied research.

This research suggests the desirability of developing reliable, and well-standardized pre-school language tests of syntactic, morphological, and phonlogical skills. To be of greatest practical value, the tests should be simple enough for use by most practitioners in contact with young children, including educators. Tests of this sort, as demonstrated in this project, show substantial promise as diagnostic and predictive instruments for school-age language skills. In addition, the research suggests that skills from all components of language are important precursors of school language skills and that emphasis in the preschool curriculum on the development of a limited range of language skills may be detrimental to later school success.

Table 1

Demographic Information Concerning Twins

MZ Pairs Pair No.	Sex	Birth Order	Birth Weight	Previous Births	Total Children in Family
1 a	Female	1	3-11	2	4
b		2	4-0		
4 a	Female	1	6-12	1	6
b		2	4-10		
6 a	Female	1	5-2	0	2
b		2	5-3		
7 a	Female	1	5-0	0	2
b		2	5-3		
8 a	Male	1	5-11	1	4
b		2	5-7		
10 a	Female	1	6-9	2	4
b		2	5-15		
13 a	Female	1	6-3	2	4
b		2	5-8		
15 a	Female	1	4-1	0	2
b		2	4-15		
16 a	Female	1	6-2	1	3
b		2	6-0		
17 a	Male	1	4-9	4	7
b		2	4-6		
18 a	Male	1	4-13	0	2
b		2	4-8		
DZ Pairs					
2 a	Female	1	5-14	4	6
b		2	5-12		
3 a	Male	1	6-12	1	4
b		2	5-9		
5 a	Male	1	5-8	2	4
b		2	4-11		
9 a	Female	1	5-6	1	3
b		2	6-14		

Table 1 (continued)

DZ Pairs Pair No.	Sex	Birth Order	Birth Weight	Previous Births	Total Children in Family
11 a	Female	1	4-1	4	6
b		2	5-6		
12 a	Female	1	6-11	1	3
b		2	6-12		
14 a	Female	1	6-6	1	3
b		2	4-12		
19 a	Female	1	7-13	1	3
b		2	7-3		
20 a	Male	1	7-4	2	4
b		2	6-4		
21 a	Male	1	7-9	4	6
b		2	7-7		

Table 2

Mean and Standard Deviation of Test Scores, Mean Age of Subjects, and Number of Subjects for Language Tests and I.Q. Given At Age 3.

	Test Score			
	Mean	Standard Deviation	Months Mean Age	Number of Subjects
Vocabulary				
Stanford-Binet	.30	.07	40.2	42
Peabody P.V.T.	87.12	15.36	38.6	42
Mehrabian	.58	.08	44.1	42
Sentence Production				
MLU	.13	.05	44.0	40
Correct Verbs	.13	.05	44.0	40
Verb Errors	.03	.05	44.0	40
Sentence Comprehension	1.06	.29	43.3	42
Sentence Imitation				
Osser	.07	.08	43.7	42
Mehrabian	.18	.09	43.7	42
Word Inflection				
Berko	.21	.14	43.5	42
Mehrabian	.09	.04	43.8	42
Phoneme Discrim.	.33	.11	45.7	40
Stanford-Binet I.Q.	101.24	17.81	39.7	42

Table 3

Mean Score, Standard Deviation, and Sample Size for Home and Maternal Characteristics

	Mean	Standard Deviation	Number of Subjects
S.E.S.	51.19	18.22	21
W.A.I.S. I.Q.	106.88	16.96	21
Maternal M.L.U.	9.05	2.49	19
Questions	51.00	13.00	15
Answers	1.44	2.60	15
Expansions	1.94	2.74	15
Repetitions	1.72	3.18	15
Assertions	24.34	14.99	15
Criticisms	1.96	1.63	15
Confirmations	11.26	5.85	15
Directions	5.26	4.64	15
Mother's Teaching	.10	.05	19

Table 4

Means, Standard Deviations, and Sample Sizes of Measures of Reading, Cognitive and Psycholinguistic Skill Given to Children at Age 6.

Test	Mean	Standard Deviation	Sample Size
Peabody Picture Voc.	102 ~~10.29~~	26.2	42
Sentence Comprehension			
Easy to See	5.0	3.9	42
Promise	[illegible]	[illegible]	42
Sentence Repetition	10.0	1.8	42
Articulation	2.9	3.8	42
Embedded Figures	8.6	4.3	42
Metropolitan			
Listening	11.7	2.0	30
Matching	10.8	2.3	30
Alphabet	14.5	1.9	30
Numbers	15.3	3.4	30
Copying	7.6	3.0	30
Total	60.0	9.3	30
Stanford Achievement			
Word	66.4	20.4	12
Paragraph	53.8	32.5	12
Vocabulary	56.7	27.5	12
Word Study	70.7	26.3	12
Spelling	[illegible]	[illegible]	[illegible]

Table [illegible]

[illegible] Vocabulary [illegible]

[illegible]*

[illegible]	Multiple R	Single R
[illegible]	.315	.31[1]
[illegible]	.412	-.22
[illegible]	[illegible]	[illegible]3
Other Sentences	.517	-.05
Senten[illegible]	.520[1]	.21
[illegible]	.523	-.05
Mental [illegible]	[illegible]25	.23
Berko Inflect[illegible]	.526	.17
[illegible]	.527	-.03
[illegible] Vocabulary	.527	.12

*[illegible] regression equation: None

[illegible]

Table 6

Stepwise Regression Analysis Predicting Sentence Comprehension From Preschool Language Skills - Easy to See*

Variable	Multiple R+	Simple R
Sentence Comprehension	.203	-.20
Berko Inflection	.300	.15
Osser Sentences	.372	-.04
Mehrabian Sentences	.412	..08
Mehrabian Vocabulary	.445	.13
Mehrabian Inflection	.455	.10
Phoneme Discrimination	.457	.06
M.L.U.	.457	.01

*Variables not entered in the regression equation: Peabody vocabulary; Production Verb Errors.

+Obtained multiple correlation is insignificant

Table 7

Stepwise Regression Analysis Predicting Sentence Comprehension From Preschool Language Skills - Promise*

Variable	Multiple R	Simple R
Phoneme Discrimination	.538	.54 [2]
Mehrabian Inflection	.600	.5[illegible] [2]
Peabody P.V.T.	.640	.35 [illegible]
Mehrabian Vocabulary	.660	.06
Berko Inflection	.666	.38 [2]
Osser Sentences	.673	.39 [2]
Mehrabian Sentences	.681	.28 [1]
Production Verb Errors	.681	.11
Sentence Comprehension	.681	.19
M.L.U.	.681	.23

* Variables not entered in the regression equation: None

[1] $p < .05$

Table 8

Stepwise Regression Analysis Predicting Sentence Repetition From Preschool Language Skills *

Variable	Multiple R	Simple R
Osser Sentences	.670	.67 [2]
Mehrabian Inflection	.727	.55 [2]
[illegible]	.73[illegible]	.44 [2]
Mehrabian Vocabulary	.746	.01
Production Verb Errors	.752	.13
Phoneme Discrimination	.757	.55 [2]
Mehrabian Sentences	.759	.62 [2]
Berko Inflection	.761 [1]	.51 [2]

* Variables not entered in the regression equation: Peabody Vocabulary, Sentence Comprehension.

[1] p < .05

[2] p < .01

Table 9

Stepwise Regression Analysis Predicting Goldman-Fristoe Articulation Score From Preschool Language Skills *

Variable	Multiple R	Simple R
Osser Sentences	.402	-.40 [2]
Mehrabian Sentences	.452	-.21
Mehrabian Vocabulary	.493	.10
Berko Inflection	.544	-.38 [2]
Peabody P.V.T.	.569	.06
M.L.U.	.593	-.24
Phoneme Discrimination	.599	-.22
Sentence Comprehension	.605 [1]	-.14
Production Verb Errors	.608	-.23
Mehrabian Inflection	.612	-.22

* Variables not entered in the regression equation: None

[1] $p < .05$

[2] $p < .01$

Table 10

Stepwise Regression Analysis Predicting Children's Embedded Figure Score From Preschool Language Skills *

Variable	Multiple R	Simple R
Berko Inflection	.31 [1]	.31 [1]
M.L.U.	.36	.29 [1]
Production Verb Errors	.44	-.03
Mehrabian Vocabulary	.48	-.07
Sentence Comprehension	.50	.23
Peabody P.V.T.	.51	.17
Osser Sentences	.52	.18
Mehrabian Sentences	.54	.30 [1]
Phoneme Discrimination	.55	.29 [1]
Mehrabian Inflection	.56	.20

* Variables not entered in the regression equation: None

[1] [illegible]

Table 11

Stepwise Regression Analysis Predicting Metropolitan Listening From Preschool Language Skills*

Variable	Multiple R	Simple R
Stanford-Binet Vocab.	.59	.59[2]
Peabody Vocab.	.[illegible]5	.5[illegible]
Phoneme Discrimination	.68	.30
Osser Sentences	.69	.37[1]
Mehrabian Vocab.	.70	.40[2]
M.L.U.	.71	.31[1]
Mehrabian Inflection	.71	.26
Production Verb Errors	.71[1]	.17
Mehrabian Sentences	.72	.23
Berko Inflection	.72	.39[1]

*Variables not entered in the regression equation: Sentence Comprehension

[1] $p < .05$

[2] $p < .01$

Table 12

Stepwise Regression Analysis Predicting Metropolitan Matching From Preschool Language Skills*

Variable	Multiple R	Simple R
Osser Sentences	.35[1]	.35[1]
Production Verb Errors	[illegible]	-.03
Mehrabian Vocab.	.46	.27
Peabody Vocab.	.48	.02
M.L.U.	.49	.22
Sentence Comprehension	.50	.01
Phoneme Discrimination	.51	.28
Mehrabian Inflection	.53	.13
Berko Inflection	.53	.31
Mehrabian Sentences	.53	.29
S-B Vocab.	.54	.19

*Variables not entered in the regression equation: None

[1] $p < .05$

Table 13

Stepwise Regression Analysis Predicting Metropolitan Alphabet From Preschool Language Skills*

Variable	Multiple R	Simple R
Phoneme Discrimination	.69	.69[2]
M.L.U.	.75	-.03
Mehrabian Vocab.	.81	.23
Mehrabian Inflection	.83	.26
Peabody Vocab.	.83	.09
Mehrabian Sentences	.83	.21
Osser Sentences	.84	.26
S-B Vicab.	.84	.16
Sentence Comprehension	.84	.26
Production Verb Errors	.84	-.04
Berko Inflection	.84[1]	.44[2]

*Variables not entered in the regression equation: None

[1] $p < .05$

[2] $p < .01$

Table 14

Stepwise Regression Analysis Predicting Metropolitan Number From Preschool Language Skills*

Variable	Multiple R	Simple R
Osser Sentences	[illegible]	.53[2]
Mehrabian Sentences	.61	.2[illegible]
Production Verb Errors	.67	-.10
Phoneme Discrimination	.71	.42[2]
Sentence Comprehension	.75	-.08
Mehrabian Vocab.	.78	.31[1]
M.L.U.	.79	.11
Berko Inflection	.79	.41[1]
Peabody Vocab.	.80	.21
S-B Vocab.	.80	.40[1]
Mehrabian Inflection	.80[1]	.32[1]

*Variables not entered in the regression equation: None

[1] $p < .05$

[2] $p < .01$

Table 15

Stepwise Regression Analysis Predicting Metropolitan Copying From Preschool Language Skills*

Variable	Multiple R	Simple R
Phoneme Discrimination	.60	.60[1]
Mehrabian Vocab.	.67	.40[2]
[illegible] Inflection	.70	.34
Sentence Comprehension	.71	.19
S-B Vocab.	.71	.25
Mehrabian Inflection	.72	.34
M.L.U.	.72	.31
Peabody Vocab.	.72	.12
Osser Sentences	.72[1]	.25
Mehrabian Sentences	.73	.30

*Variables not entered in the regression equation: Production Verb Errors.

[1] $p < .05$

[2] $p < .01$

Table 16

Stepwise Regression Analysis Predicting Metropolitan Total Score From Preschool Language Skills*

Variable	Multiple R	Simple R
Phoneme Discrimination	.62	.62 [2]
Mehrabian [illegible]	[illegible]	[illegible]
Sentence Comprehension	.76	.10
Osser Sentences	.77	.49 [2]
Mehrabian Sentences	.79	.36 [1]
Production Verb Errors	.80	-.02
Mehrabian Inflection	.81	.36 [1]
Peabody Vocab.	.81	.25
Berko Inflection	.81	.51 [2]
MLU	.81	.26
S-B Vocab.	.81[1]	.43 [2]

*Variables not entered in the regression equation: None

[1] $p < .05$

[2] $p < .01$

Table 17

Stepwise Regression Analysis Predicting Word Reading Score

From Preschool Language Skills*

Variable	Multiple R +	Simple R
Sentence Comprehension	.462	.46
Mehrabian Inflection	.553	-.06
[illegible]	[illegible]	.35
Mehrabian Vocabulary	.663	.24
Phoneme Discrimination	.744	.13
Production Verb Errors	.808	.08
Mehrabian Sentences	.941	.45
M.L.U.	.971	.07
Peabody P.V.T.	.975	.36
Osser Sentences	.976	.08

*Variables not entered in the regression equation: Berko Inflection.

+ [illegible] multiple correlation is insignificant

Table 1[illegible]

Stepwise Regression Analysis Predicting Paragraph Meaning Score From Preschool Language Skills *

Variable	Multiple R	Simple R
Sentence Comprehension	.769	.77 [2]
Osser Sentences	.784	.[illegible]
Mehrabian Vocabulary	.81[illegible]	.5[illegible] [2]
Stanford-Binet Vocabulary	.832	.56 [1]
Mehrabian Inflection	.866	.24
Peabody P.V.T.	.905	.37
Berko Inflection	.941	.51 [1]
Mehrabian Sentences	.972	.38
Phoneme Discrimination	.992	.49
M.L.U.	.993	.03

* Variables not entered in the regression equation: Production Verb Errors.

[1] $p < .05$

[2] $p < .01$

Table [illegible]

Stepwise Regression Analysis Predicting S.A. Vocabulary

from Preschool Language Skills

Variable	Multiple R	Simple R
Berko Inflection	.704	.70[2]
[illegible]	[illegible]	-.05
Peabody P.V.T.	.859	.63[1]
Stanford-Binet Vocabulary	.893	.10
Osser Sentences	.923[1]	.35
Mehrabian Sentences	.945	.63[1]
M.L.U.	.963	.25
Production Verb Errors	.968	-.14
Mehrabian Vocabulary	.978	.51[1]
Phoneme Discrimination	.982	.52[1]

Table 20

Stepwise Regression Analysis Predicting Word Study Skills From Preschool Language Skills

Variable	Multiple R +	Simple r
Mehrabian Sentences	.515	.51
Peabody P.V.T.	.541	.18
Mehrabian Vocabulary	.585	[illegible]
Phoneme Discrimination	.674	.09
Sentence Comprehension	.700	.32
Osser Sentences	.757	.19
Mehrabian Inflection	.828	.06
Production Verb Errors	.899	.16
Stanford-Binet Vocab.	.949	.08
Berko Inflection	.953	.29

+ Obtained multiple correlations are insignificant

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	.09
[illegible]	[illegible]	.25
[illegible]	[illegible]	.19
[illegible]	[illegible]	.52
[illegible]	[illegible]	.32
[illegible]	[illegible]	.47
[illegible]	[illegible]	.37
[illegible]	[illegible]	.34

TABLE 22

Stepwise Regression Analysis Predicting Stanford-Binet I.Q. From Early Language Skills and I.Q.

Variable	Multiple R	Simple R
Berko Inflection	.45	.45*
Mehrabian Inflection	.52	.44*
Sentence Comprehension	.60	-.04
Stanford-Binet I.Q.	.68	.14
Mehrabian Vocabulary	.74	.10
M.L.U.	.75 *	.23
Production Verb Errors	.75	-.10
Peabody Vocabulary	.76	.03
Mehrabian Sentences	.76	.44*
Osser Sentences	.76	.37*

Variables not entered in the regression equation: Phoneme Discrimination

*p <.05

Table [illegible]

Stepwise Regression [illegible]

Score From Early Home [illegible] Maternal [illegible]

Variable	Multiple R	Simple R
WAIS I.Q.	.[illegible]*	.[illegible]*
[illegible]	[illegible]	[illegible]

[a]Variables not entered in the regression equation: [illegible]

Expansions; Repetitions; [illegible]; Confirmations; Answers;

[illegible] Teaching

* p [illegible] .05

[illegible]

[illegible], A. [illegible] New [illegible]: [illegible], [illegible]4.

[illegible], N. [illegible] the growth of intelligence. American Psychol[illegible], [illegible], 1[illegible], [illegible].

[illegible], B. [illegible] and restricted codes: An outline. International Journal of Linguistics, 196[illegible], [illegible], [illegible].

[illegible], J. The child's learning of English Morphology. Word, 19[illegible], 14, 1[illegible]-17[illegible].

[illegible]
[illegible] guage. New York: Wiley, 1970.

Bond, G.L., & Tinker, M.A. Reading difficulties: Their diagnosis and correction. New York: Appleton-Century-Crofts, 197[illegible].

Brophy, J. E. Mothers as teachers of their own preschool children: The influence of socioeconomic status and task structure on teaching specificity. Child Development, 1970, 41, 79-94.

Cattell, R.B. The multiple abstract variance analysis equations and solutions for nature-nurture research on continuous variables Psychological Review, 1960, 67, 353-372.

Cazden, C. B. Environmental assistance to the child's acquisition of grammar. Unpublished Doctoral Thesis, Harvard Univ., 1965.

Chomsky, C. The acquisition of syntax in children from 5 to 10. Cambridge, Mass.: M.I.T. Press, 1969.

Clay, M.M. Sentence repetition: Elicited imitation of a controlled set of syntactic structures by four language groups. Monographs of the Society for Research in Child Development, 1971, 36 (3, Serial No. 14[illegible]).

DeHirsch, K., Jansky, J., & Langford, W.S. Predicting reading failure. New York: Harper & Row, 1966.

Dunn, L.M. [illegible] manual [illegible] the Peabody Picture Vocabulary [illegible]

DuBois, P.H. An introduction to psychological statistics. New York: Harper & Row, 1965.

[illegible]

Ervin-Tripp, S. Reading as second language learning. In M. Douglass (Ed.), Claremont Reading Conference. Claremont: Claremont University Press, 1973.

Fischer, K. M. A comparison of the similarity in language skills of identical and fraternal twin pairs. Unpublished Ph.D. Thesis, University of Pennsylvania, 1973.

Fraser, C., Bellugi, U., & Brown, B. Control of grammar in imitation, comprehension and production. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 121-135.

[illegible]

Goldman, R., & Fristoe, M. Goldman-Fristoe Test of Articulation: Examiner's Manual. Circle Pines, Minn.: American Guidance Service, 1969.

Hess, R. D. & Shipman, V. C. Early experience and the socialization of cognitive modes in children. Child Development, 1965, 26, 869-886.

Hildreth, G. H., Griffiths, N. L., & McGauvran, M. E. Metropolitan Readiness Tests: Manual of directions. New York: Harcourt, Brace & World, 1969.

Huessy, H. R. Medical and epidemiological aspects of reading disability. In M. Douglass (Ed), Claremont Reading Conference. Claremont: Claremont University Press, 1973.

Hymes, D. H. The ethnology of speaking. In J. A. Fishman (Ed.), Readings in the sociology of language, The Hague: Mouton, 1963.

[illegible], J. B. Some neurophysiological findings in children with reading problems. In M. Douglass (Ed.), Claremont Reading Conference. Claremont: Claremont University Press, [illegible].

[illegible], J. Dyslexia: Identification and remediation in a public school setting. Journal of Learning Disabilities, [illegible].

Kelley, T. L., Madden, R., Gardner, E. F., & Reidman, H. C. Stanford Achievement Test: Directions for administering. New York: Harcourt, Brace & World, 1964.

[illegible]

Lakoff, G. Global rules. [illegible]

Manual for [illegible]
Princeton: [illegible]

Manual for [illegible]
Princeton: [illegible]

Mattingly, I. G. Reading, the linguistic process, and linguistic awareness. In J. F. Kavanagh & I. G. Mattingly (Eds.), [illegible] The relationship between speech and reading. Cambridge: M.I.T. Press, 1972.

McCall, R.B., Appelbaum, M. I., [illegible] Developmental changes in mental performance. Monographs of the Society for Research in Child Development, [illegible]

Mehrabian, A. Measures of vocabulary and grammatical skills for children up to age six. Developmental Psychology, 1970, 2, 439-446.

Menyuk, P. Sentences children use. Cambridge: M.I.T. Press, 1969.

Mittler, P. Genetic aspects of psycholinguistic abilities. Journal of Child Psychology & Psychiatry, 1969, 10, 165-176.

Mittler, P. Biological and social aspects of language development in twins. Developmental Medicine and Child Neurology, 1970, 12, 741-757.

Nie, N. H., Bent, D. H., & Hull, C. H. Statistical package for the social sciences. New York: McGraw-Hill, 1970.

Osser, H., Wang, M., & Zaid, F. The young child's ability to imitate and comprehend speech: A comparison of two subcultural groups. Child Development, 1969, 40, 1063-1075.

Reiss, A. J. Occupations and social status. Glencoe, Ill.: Free Press, 1961.

Ryckman, D.B. The factors of the Illinois Test of Psycholinguistic Abilities: A comparison of 18 factor analyses. Exceptional Children, 1967, 34, [illegible]

[illegible]
M. Douglass (Ed.), [illegible]
Claremont: Claremont University Press, [illegible]

[illegible]

Stott, L. H. & Ball, R. S. Infant and preschool mental tests: Review and evaluation. Monographs of the Society for Research in Child Development, 1965, 30 (3, Serial No. 101).

Templin, M. Certain language skills in children: Their development and interrelationships. University of Minnesota Institute of Child Welfare Monograph, 1957.

Terman, L. M. & Merrill, M. A. Stanford-Binet Intelligence Scale: Manual for the third revision, Form L M. Boston: Houghton Mifflin, 1960.

[illegible] Reading deficit and its relation to social [illegible]. In M. Douglass (Ed.), Claremont Reading Conference. Claremont: Claremont University Press, 1968.

[illegible]r, S. R. & Wilde, J. E. Learning styles: Can we grease the cogs of cognition? In M. Douglass (Ed.), Claremont Reading Conference. Claremont: Claremont University Press, 1973.

Waterhouse, L. H. Genetic and sociocultural influence on language development. Unpublished Ph.D. Thesis, University of Pennsylvania, 1972.

Wechsler, D. Manual for the Wechsler Adult Intelligence Scale. New York: Psychological Corporation, 1955.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A. Manual: Childrens Embedded Figures Test. Palo Alto: Consulting Psychologists Press, 1971.

APPENDIX

Table I

Zero Order Correlations Between Cognitive, Language, and Reading Scores at Age 6, and [illegible] Child Variables.

	Age 6				
Age 3	Peabody	Stanford-Binet I.Q.	Embedded Figures	Sentence Repetition	[illegible]
Stanford-Binet I.Q.	.08	.14	.38**	.38**	[illegible]
Vocabulary					
Mehrabian	.12	.10	-.07	.01	[illegible]
Peabody	.23	.03	.17	.18	[illegible]
Stanford-Binet	.29*	.24	.05	.17	
Sentence Comprehension	.21	-.04	.23	.21	[illegible]
Sentence Repetition					
Osser	-.05	.37**	.18	.67**	[illegible]
Mehrabian	-.03	.44**	.30*	.62**	[illegible]
[illegible]					
[illegible]	-.22*	.10	-.08	.13	[illegible]
[illegible]	-.06	[illegible]	-.07	.12	[illegible]
[illegible]	-.05	.23	.29*	.44**	[illegible]
[illegible]					
[illegible]	.17	.45**	.31*	[illegible]**	[illegible]
Mehrabian	.23	.44**	.20	.55**	[illegible]
[illegible]	.31*	.59**	.29*	.5[illegible]**	[illegible]

*p [illegible]

**p [illegible]

Table I

	Age 6					
	Comprehension			Metropolitan		
	Toy	Promise	Listen.	Match.	Alpha.	No.
[illegible]						
Stanford-Binet I.Q.	-.28*	.49**	.65**	.39*	.31	.54**
Vocabulary						
Mehrabian	.13	.06	.49**	.27	.23	.41
Peabody	.09	.35*	.53**	.02	.09	.21
Stanford-Binet	-.01	.35*	.59**	.19	.16	.40*
Sentence Comprehension	-.20	.19	.08	.01	.26	-.09
Sentence Repetition						
Osser	-.04	.39**	.37*	.36*	.26	.53**
Mehrabian	.08	.28*	.23	.29	.21	.28
Sentence Production						
Verb Errors	-.05	.11	-.25	-.08	-.04	-.10
Verbs Correct	-.07	.17	.08	-.17	.04	-.09
MLU	.01	.23	.31	.22	-.03	.12
Word Inflection						
Berko	.15	.38**	.39*	.31	.44**	.41*
Mehrabian	.10	.53**	.26	.13	.26	.32*
Phoneme Discrim.	.06	.54**	.30	.28	.69**	.42*

Table I (continued)

	Age 6						
	Metropolitan		Stanford Achievement				
Age 3	Copying	Total	Word	Para.	Vocab.	Study	Spell
Stanford-Binet I.Q.	[illegible]**	.67**	.44	.73**	.10	.09	.19
Vocabulary							
Mehrabian	.3[illegible]*	.45**	.24	.53*	.51*	.34	.25
Peabody	[illegible]	.25	.36	.37	.63*	.18	.19
Stanford-Binet	[illegible]	.43*	.35	.56*	.10	.08	[illegible]
Sentence Comprehension	[illegible]	.10	.46	.77**	.56*	.32	[illegible]
Sentence Repetition							
Osser	[illegible]	.49**	.08	.16	.35	.15	.18
Mehrabian	[illegible]	.36*	.45	.38	.63*	.51	[illegible]
Sentence Production							
Verb Errors	[illegible]	-.02	-.25	-.38	-.33	-.35	[illegible]
Verb Correct	[illegible]	-.06	.08	-.09	-.14	.16	[illegible]
M.L.U.	[illegible]	.26	.07	.03	.25	.32	[illegible]
Word Inflection							
Berko	[illegible]	.51**	.32	.51*	.70**	.25	[illegible]
Mehrabian	[illegible]	.36*	-.06	.24	-.06	.06	[illegible]
Phoneme Disc.	[illegible]	.62**	.13	.49	.52*	.09	[illegible]

Table [illegible]

[illegible] Cognitive, Language, and [illegible] Maternal Characteristics

[illegible]	[illegible]	Stanford-Binet I.Q.	Embedded Figures	Sentence Repetition
[illegible]	[illegible]	[illegible]**	[illegible]**	.36**
[illegible]	[illegible]	[illegible]	.17	-.05
Mother's Teaching	.12	.22	.31*	.38**
Mother's Speech				
[illegible]	[illegible]	[illegible]	.08	-.04
Answers	-.0[illegible]	-.05	.01	-.29*
Explanations	-.[illegible]	.0[illegible]	.16	.10
Repetitions	-.[illegible]	.06	-.16	-.22
Assertions	.1[illegible]	.1[illegible]	.14	.17
Criticisms	.[illegible]	.07	.12	-.17
Confirmations	.[illegible]	.0[illegible]	.03	-.00
[illegible]	-.1[illegible]	-.31	-.20	-.42**
SES	[illegible]*	.[illegible]	.20	.27*

* [illegible]

** [illegible], 1 tail

Table II (continued)

	Age 6			
	Goldman-Friston	Comprehension Easy	Comprehension Promise	Metropolitan Total
Variable				
WAIS I.Q.	-.18	.27*	.07	.46*
Mother's MLU	.07	-.12	-.27*	-.21
Mother's Teaching	-.12	-.04	.26*	[illegible]
Mother's Speech				
Questions	-.24	-.09	.11	.36*
Answers	.59**	.04	.08	.06
Expansions	-.11	.07	-.22	.32
Repetitions	.05	-.14	-.25	-.01
Assertions	.12	.01	.07	-.03
Criticisms	.03	.17	.18	.06
Confirmations	-.07	-.01	.02	.28
Directions	-.10	-.22	.01	.06
SES	-.01	.19	-.04	-.08

Table III

[illegible] and [illegible] Pairs on Tests Given

		[illegible] Mean Square	DF	[illegible] Mean Square	DF	F
[illegible]						
[illegible]	[illegible]	[illegible].22	8	4.28	5	
	[illegible]	[illegible]	[illegible]	.2[illegible]	6	1.63
		.7[illegible]		.31		
[illegible]	Betw.	9.22	8	6.33	5	
	Within	1.77	9	4.16	6	2.35
		.68		.21		
[illegible]	Betw.	5.88	8	7.68	5	
	Within	.3[illegible]	9	1.08	6	2.78
		.88		.75		
[illegible]	Betw.	25.18	8	8.60	5	
	Within	2.78	9	7.16	6	2.58
		.82		.09		
[illegible]	Betw.	16.51	8	8.40	5	
	Within	1.94	9	3.33	6	1.72
		.79		.43		
Total	Betw.	240.1[illegible]	8	57.20	5	
	Within	7 28	9	20.16	6	2.77
		.34		.48		
[illegible]	Betw.	[illegible]00.71	1[illegible]	807.00	9	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		.[illegible]				

Table [illegible] (cont.)

		Mean Square	[illegible]	[illegible]	[illegible]	[illegible]
Metropolitan						
Embedded	Betw.	[illegible].11	[illegible]	[illegible]		
Figures	Within	6.[illegible]	[illegible]	[illegible]		[illegible]
Compre-hension	Betw.	17.[illegible]	[illegible]	[illegible]	[illegible]	
Easy	Within	13.[illegible]	[illegible]	[illegible]		[illegible]
		.[illegible]		[illegible]		
Promise	Betw.	[illegible].7	[illegible]	[illegible]	[illegible]	
	Within	1.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		.[illegible]		[illegible]		
Sent.Repet.	Betw.	1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Within	[illegible]	[illegible]	[illegible]	[illegible]	
		[illegible]		[illegible]		
Goldman-Fristoe	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]**
		.[illegible]		[illegible]		

* P < .05, 1 tail

** P < .01, 1 tail