ANALYSIS OF SYLLABLE STRINGS AND PAUSES FOUND IN MOTHER/CHILD CONVERSATION IN RELATION TO CHILD'S ACADEMIC PERFORMANCE

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PREFACE

This study is concerned with the analysis of syllables and pauses found in two-person conversations. The conversations analyzed are those between a mother and her child and between the same child and his or her teacher. The primary objective is to determine how the characteristics of syllable strings and pauses relate to the child's academic performance. Statistical tests are made upon the data gathered from tape recordings of these conversations to analyze this relationship.

The author wishes to express her appreciation to her major adviser, Dr. Donald E. Allen, for his guidance, assistance, and encouragement throughout this study. Appreciation is also expressed to the other committee members, Dr. Charles K. Edgley and Dr. Winona R. Somervill for their assistance in the preparation of the final manuscript.

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CHAPTER I

THE RESEARCH PROBLEM

Introduction

A child begins to learn basic skills that will be necessary later in life at an early age. Certain of these skills such as reading, writing and number skills begin being stressed as early as preschool or kindergarten and expected at certain levels of competence at the first grade level. The age from five to seven seems to be a very eventful stage for the child in terms of learning new concepts and learning to communicate them in ways that they have never before tried.

The three types of skills mentioned above can be utilized only after the child is able to communicate verbally. Speech is seen to be the basis for other skills that follow. Reading what one has heard or spoken is learned first after speech by pairing sounds heard with printed letters.

Number concepts follow next in the line of skill learning. In this case it is relating concepts of number or value to that of the printed character that is learned. After speaking, reading and understanding of numerical concepts comes another important skill: that of writing. Writing seems to tie all the other mentioned skills together.

Since these skills are so necessary and valuable, it would seem to be a good idea to be able to predict the level of performance of these skills at an early stage. By this means if a low skill level is predicted, then a little extra time could be spent with the child to see where help is needed. This extra time would probably be better spent at this stage of development of the skill than later on when habits and patterns become more fixed.

Statement of the Problem

Can a reasonable and fairly accurate estimate of academic performance (reading, writing and math skills) be made knowing certain characteristics (syllable strings and pauses) of speech patterns in the child's conversation?

Purpose of the Study

The purpose of this study is to show that the particular representations of syllable strings and pauses found in conversation between a mother and her kindergarten level child can predict the child's test scores in the areas of reading, writing and math at the first grade level. It is proposed that more and/or longer syllable strings of the child or of the mother will be correlated with higher test scores in these areas.

Background and Value of the Study

The data to be used in this study was collected by Donald E. Allen and Rebecca Guy in elementary schools in Memphis, Tennessee, and Tulsa, Oklahoma. The data consists of three tape recordings per child of 107 first-born working class children engaged in social conversation with either their mother or teacher. Each child was taped for a five-minute interval while talking to his or her mother at the kindergarten level and again taped two more times approximately one year later at the level of first grade. These two tapes were between mother and child and between teacher and child.

Reading, writing and math tests were given the children at the first grade level. The reading and math tests were extracted from the McGraw-Hill Achievement Test series. The writing test was administered by asking the child to write a story. The writing test was not standard, but was pretested and found to be a reasonable measure of writing performance.

It is hoped that this study will contribute to the study of the sociology of language in perhaps a new area that has not been fully utilized. Its emphasis on kindergarten and first grade children is valuable in that respect and also points to further research dealing with other age groups.

Another value of this study may be seen in the characteristics of langauge (speech) that are first noticed by the child. For example, "It is reported by many authors that children first attend to the intensity and duration of speech, to emotional quality and intonation rather than to its phonetic characteristics."[1] At this time in the child's development, possibly the child would still be more keenly aware of the characteristics that this report studies; that is, of syllable strings and pauses.

Assumptions

This study assumes that a physical representation (loudness variation) of a conversation can be an adequate representation of one part of conversation, and from these variations in loudness syllable strings and pauses can be defined.

This study assumes that when the taped conversation of the mothers and their kindergarten level children were recorded that each recording was made under circumstances most familiar to the child and that the child was contributing to the conversation in his or her usual manner. The recording was made in the child's home between the child and his or her mother. The mother and child were talking alone at the family dinner table. No particular topic was demanded, simply that the mother and child carry on a conversation for a five-minute interval. In other words, the conversation was spontaneous.

Although it may be argued that the child may have felt apprehensive about being recorded, this study assumes that since the recording was made in the child's home with his or her mother present that the effect of the tape recorder was minimal.

Limitations

This study does not seek to label a child as "talkative" or "quiet" as a general personality trait, but rather tries to determine how the child contributes to a conversation under circumstances most familiar to the child.

It is also realized that many other factors influence social "exchanges" called conversation; such as facial expressions, body position, pitch of voice, the setting of the place of conversation, or such concepts as sarcasms, symbolisms or metaphors. Labov phrased it this way.

> There is a great deal to be done in describing and analyzing the patterns of use of languages and dialects within a specific culture: the forms of 'speech events'; the rules for appropriate selection of speakers; the interrelations of speaker, addressee, audience, topic, channel, and setting; and the ways in which the speakers draw upon the resources of their language to perform certain functions.[2]

An illustration of one of these problems is in the following example of Hamblin, where the child was able to say a lot, but did not grasp the meaning of what he was saying.

> Despite Ross's rapid language development, his excellent articulation and his more than adequate conversation, it became apparent that there were substantial, although not obvious, gaps in Ross's grasp of expressive language.[3]

A further explanation of Ross's understanding of language is that "while his pronunciation was unusually good, these words were not used to communicate. He could name many objects, but he did not make requests, answer questions, or talk about his experiences."[4]

Although it is recognized that these problems in describing language do exist, it is still thought that syllable strings and pauses, while not necessarily related to meaning, are related to the quality of the conversation and the amount of feedback each partner in the conversation allows the other. In this way syllable strings and pauses may be studied as an important part of conversation.

Due to the enormity of factors that could be considered as part of conversation, only syllable strings and pauses will be studied in this research project.

Definition of Terms

A basic definition relative to this study is the term found in the title: syllable string. A syllable string is defined as a number of words spoken together with no pauses exceeding 0.4 seconds. If a pause is found of that length or longer, then a syllable string is determined and counted and the length of time used to utter those sounds is noted. A sentence may be a syllable string, but more usually a sentence contains several syllable strings.

In 1968 Goldman-Eisler found in her research the importance of pauses in conversation and the concept of syllable strings.

> Spontaneous speech was shown to be a highly fragmented and discontinuous activity. When even at its most fluent, two-thirds of spoken language comes in chunks of less than six words, the attribute of flow and fluency in spontaneous speech must be judged an illusion.[5]

For this study four different categories of the tape recorded conversation were separated and analyzed. They are labeled as Syllable Strings, Time Per String, Pause Time and Interactor Gap Time. These categories are summed by variables of race and sex, but are always separated in terms of adult and child.

The category of Syllable Strings is the number of syllable strings spoken by either the child or adult in the taped conversation.

Time Per String is the sum of times used in speaking the syllable strings. Time is measured in seconds.

Pause Time is the time between syllable strings while one person (child or adult) is speaking. These are pauses that one person used while speaking.

Interactor Gap Time is the pause time between speakers; for example the time between a direct question and an answer. The child's interactor gap time is that time from the point the adult stops speaking until the child begins to speak. And similarly, the adult's interactor gap time is the time from when the child stops speaking until the adult starts speaking.

Summary

It is postulated that mother/child conversation at the kindergarten level is important for predicting the child's academic performance at the first grade level. More specifically, that the physical representations of syllable strings and pauses identifiable in social conversation between a mother and her kindergarten-level child can predict the child's test scores in the areas of reading, math and writing at the first grade level. It is also predicted that more and/or longer syllable strings of the child or of the mother is correlated with higher test scores in these areas.

FOOTNOTES

[1]Roger Brown, _Words and Things_ (Glencoe, Illinois, 1957), p. 202.

[2]William Labov, _Sociolinguistic Patterns_ (Philadelphia, 1972), p. 184.

[3]Robert L. Hamblin et al., _The Humanization Process: A Social Behavioral Analysis of Children's Problems_ (New York, 1971), p. 232.

[4]Ibid., p. 218.

[5]F. Goldman-Eisler, _Psycholinguistics: Experiments in Spontaneous Speech_ (New York, 1968), p. 31.

CHAPTER II

THEORETICAL FRAMEWORK

Introduction

When Goldman-Eisler first began work on an assignment to study techniques of interviewing in 1945, she found that an interviewer's ability to use spontaneity to his own advantage in the interview was a sign of a successful interviewer. This type of interviewer used the feedback he received to define his next question. The interview was not pre-structured. She found that when efforts were made to increase the reliability and validity of the interview by structuring it more, that the interview lost this spontaneity and the more obvious was the need for feedback.

In 1968 Goldman-Eisler found that successful interviewers

> . . . operate as artists and craftsmen do, unwilling and, because their exercise is largely intuitive, unable to accept the strictures of techniques of standardization derived from alien methods such as questionnaires and tests.[1]

The interviewer, as a mother with her child, should use spontaneity and feedback from the child to successfully gain some insight into the child's contribution to the conversation. Standardization cannot be used in these dyadic conversations. The child, too, cannot hope to learn to communicate well with his mother if he does not allow her feedback to the conversation.

The spontaneity of the conversations being analyzed in this study is important in the sense of being a measure of two person's contributions to a dyadic conversation, and the feedback they allow each other.

Goldman-Eisler, trying to work within the field of psychology, was frustrated in her attempt to bring this spontaneity and its related social factors into an acceptable area of research. She found, "Living speech and language as used in spontaneous human communication was placed outside the pale of the legitimate area of psychological enquiry as indeed were other creative pursuits of human beings."[2]

Surprizingly enough, some sociologists are critical of methods similar to Goldman-Eisler's, but for opposite reasons. They feel that this type of enquiry is too concerned with methodology and not enough with sociological theory. However, another viewpoint is that, "The social sciences, and especially sociology, have long needed relevant ratio measures to analyze basic social processes."[3] This thesis has developed and applied several new techniques to the direct study of the dyadic conversation.

The conversational process in dyadic form is readily accessible to direct application of these precise measures. As Allen and Guy noted in an analysis of similar data,

> The conversational process makes an excellent vehicle for the development of precise measures. It is rich in a variety of small behavioral elements which are readily recognized and recorded. These elements combine and recombine in certain well-ordered rhythms of action and expressions.[4]

This thesis is an attempt to show that certain characteristics of language are predictors of academic performance. Specifically, there is an attempt to find relationships between sounds (and silences) found in the language of the dyadic conversation to how the child of the dyad performs academically on tests of reading, math and writing ability.

Major Theory

The major theory behind this thesis is that sounds (and silences) of language are predictors of academic performance. For the purpose of this study, the sounds of language are defined in terms of number of syllables spoken, number of syllable strings, time used in speaking these strings, time used pausing while speaking, and time used in pausing before replying to a comment or question. The language is defined as those sounds and silences found in a dyadic conversation between a mother and her kindergarten child in a tape recorded five-minute spontaneous conversation. The academic scores associated with this theory is defined as the child's academic scores in reading, math and writing at the first grade level.

It is assumed that the component parts (syllables and pauses) of a dyadic conversation exist in an identifiable form and are separable according to speaker. The methods used for this purpose are described in detail in Chapter IV, METHOD AND PROCEDURE. Only after these methods have been utilized can any further analysis be applied to the data.

Individual Consistency

Goldman-Eisler found that a major factor that had an effect on phrase length was that of individual differences and its effect was highly significant. A tentative hypothesis in this study is that syllable strings and pauses are expected to be similar for a given individual (child) speaking to two different persons (mother and teacher).

In this study the child's syllables and pauses were correlated for two different conversations. One correlation was made with the child and his mother and other with his teacher. It is hypothesized that similarities will be found in the way the child talks to his mother and the way he talks to his teacher.

If results from this hypothesis are found as expected, then the conclusions consistent with the theory will be that syllables and pauses are identifiable in a person's conversation and that these variables are reasonably consistent even when varying the speech partner and the setting where the conversation took place. This will add strength to the theory since if this hypothesis is found to be correct, then different tape recordings of the same child would not predict totally different academic scores for the same child.

Relationship to Academic Performance

To contribute to a conversation, a child must have a minimum knowledge of language usage and be able to share this knowledge through sound communication. Although many other factors are involved in conversation, sound and non-sound (silence) are always present as a part of language.

Sounds and pauses are readily available for precise measure.

According to a textbook in sociological methods, "There is no fundamental reason why social scientists cannot measure phenomena relevant to their inquiry."[5] These measures will be made and relationships to academic performance will be determined.

It is tentatively predicted that the more syllables that are spoken and the shorter the time used in pauses, the higher the academic scores of the child will be. An explanation for this prediction is that more sounds emitted would mean that more words (sounds) were being used (unless the same words were being used over and over again); and therefore a more complete knowledge of language was being used by that speaker. More knowledge of language would carry over into areas where a knowledge of language was necessary; into the academic areas of reading, math and writing.

However, it is known that there must exist a limit on the number of words that can be spoken in a five minute interval. Although this limit is not known, its presence must be noted. For example, there is also a limit on the pause time possible. If no one says a word the entire five minute interval, then the maximum pause time can only be five minutes. There is also a limit on the number of syllables one speaker can speak and still allow the other speaker time to contribute to the conversation. For if one speaker completely dominates the conversation, it is really a one-sided harangue and not a conversation at all.

Thus, although it is predicted that more syllables will be correlated with a higher academic score, it is also noted that if too many syllables are spoken by one speaker, the correlation cannot hold.

If all children in the analysis contribute at least the minimum number of syllables necessary for the conversation to have substance, then the results might turn out to be opposite to those predicted. The children who contributed too much for a true interchange of ideas to have taken place will probably be associated with lower academic scores; therefore the children with fewer syllables spoken will appear to be better academically rated.

FOOTNOTES

[1] F. Goldman-Eisler, Psycholinguistics: Experiments in Spontaneous Speech (New York, 1968), p. 1.

[2] Ibid.

[3] Donald E. Allen and Rebecca F. Guy, Conversation Analysis: The Sociology of Talk (The Hague, The Netherlands, 1974), p. 1.

[4] Ibid.

[5] Earl R. Babbie, The Practice of Social Research (Belmont, California, 1975), p. 26.

CHAPTER III

REVIEW OF THE LITERATURE

Introduction

A review of the literature has turned up many varied approaches to the subject involved in this study: language. Some approaches are totally in the realm of psychology while others seem to borrow the best from the two fields of psychology and sociology. It is this type of approach that will be utilized in this study. Numerical procedures such as statistics will be applied to social data gathered from the social conversations recorded.

An approach also quite similar to the approach used in this study is that area of sociology called sociolinguistics. It is also sometimes called "the sociology of language." Sociolinguistics deals with large-scale social factors and their mutual interaction with languages and dialects. Also included in sociolinguistics is a field more concerned with the details of language in actual use. It is the field which Hymes has named, "the ethnography of speaking."[1] This field deals with more of the social rules and interrelationships of the persons involved and also in how they draw upon their past knowledge to contribute to the social conversation.

As previously mentioned, due to the enormity of factors that could be considered as part of conversation, the study must be limited to only a few factors. The factors that have been chosen for analysis in this study are syllable strings and pauses found in social conversation.

Psychology and Psycholinguistics

As noted before, speech is perhaps the most basic of skills that a child can have at his disposal in developing other skills such as reading, math and writing. Luria and Yudovich have commented on the importance of speech and the necessity for further research in this area.

> It is well known to scientific or materialistic psychology that speech, which reflects objective reality, directly influences the formation of complex human activity. As yet, however, insufficient material has been provided to establish, with the necessary precision and on a firm foundation of evidence, the extent to which language exercises this formative influence on mental processes . . . and with what specific results.[2]

Luria and Yudovich conducted an experiment with a pair of identical twins five years of age who suffered from a defect which created conditions for a retardation of speech development. Luria and Yudovich found that as the twins became prepared for the acquisition of a langauge system not only did they develop new forms of communication with the aid of developing verbal speech, but also there were significant changes in the structure of their conscious activity, built up on the basis of verbal speech.

Goldman-Eisler has dealt extensively with a somewhat different approach to speech. She has used the approach of dividing time into periods of activity (speech) and inactivity (silence) to arrive at a new direction in conversational analysis. In her first study, Goldman-Eisler (1951) found a stable variable in the patterning of social conversations "is to be found, not so much in those measures which are concerned with their active behavior, as in those belonging to the intervals of inactivity between the periods of action."[3] The variables of pause time and interactor gap are thought to be stable elements in this study.

A later finding of Goldman-Eisler was that

> . . . tendencies for maintaining long periods of silence or holding up action at one extreme, or incapacity to do so and precipitate action at the other, were found to constitute a relatively permanent feature of individuals' conversational behavior.[4]

This idea of individual consistency is important in predicting academic scores from syllable strings and pauses in this study, for if these two variables are not fairly stable then predictions of academic scores would vary so widely as not to be useful.

Another finding relating to pauses and interactor gaps was that "these periods of silence were shown to be the main determinants of the rate of speech and this in turn emerged as a personality characteristic of remarkable constancy."[5]

The important thing to remember is this type of study is that it is involved in social conversation; not of the type of speaking that is read from a book, but spontaneous conversation. According to Goldman-Eisler there is a big difference.

> Spontaneous speech was found to differ from readings of prepared texts in that a large proportion of pauses in spontaneous speech does not fit in with the linguistic structure, and does not serve communication.[6]

The type of psycholinguistic research that Goldman-Eisler does seems very closely tied to sociology. Her publications were very valuable in the preparation of this study.

The initial spur to Goldman-Eisler's study was the work of anthropologist E. D. Chappel. Chappel selected the duration of periods of speech and silence in interviews and their interaction as his variable, measuring and relating them in sequential order and representing their progress in time.

A considerable number of writings are now in existence in the area of psycholinguistics such as the work of George F. Mahl and G. Schultze (Psychological Research in the Extralinguistic Area, "Approaches to Semantics," edited by T. A. Sebeck et al., Mouton & Co., The Hague, 1964) and also the work of S. Ervin-Tripp and D. I. Slobin (Psycholinguistics, Annual Review of Psychology 17, 435, 1966).

The existing literature in psycholinguistics will help in this study with the identification of syllable strings and pauses and will also aid in the analysis of relationships between the two variables and other selected variables.

Individual Differences

It may appear that there is an attempt to quantify all data and to ignore individual differences. A certain amount of this will necessarily be done using the type of analyses that have been chosen; however, it is recognized that individual differences do exist and that they are important.

Joyce O. Hertzler phrased this in A Sociology of Language.

> Linguistic behavior . . . is learned, habitual, socially standardized and subject to normative control. Yet there is always some individualization of a language by members of the speech community, some particularity in each person's use of it.[7]

Goldman-Eisler also recognized the importance of individual differences.

> The duration of hesitation pauses was shown to be a highly variable phenomenon, symptomatic of individual differences, sensitive to the pressures of social interaction and to the requirements of verbal tasks and diminishing with learning; i.e., with the reduction in the spontaneity of the process.[8]

Standardized Tests

Although standardized tests have inherent in their use certain drawbacks, today's society has made their use practically indispensible in "ordering" the classroom to a certain extent. Robert Mackay commented on standardized tests.

> Standardized tests are instruments which are invented to produce objective information. It is important to note that this form of knowledge is a necessary part of any large bureaucracy of which schools are among the most refined and proliferated examples.[9]

A criticism of standardized tests being used to define intelligence was given by David Roth, "A conception of intelligence and standardized input/output pairs is useless because it neglects the irregularity and discontinuity of the interaction process."[10] Roth goes on to explain this.

> Conventional testing theory conceives of the interaction between tester or teacher and child in terms of strictly standardized and isolated pairs and questions and answers. But such standardized routines are not effective in probing children's background knowledge.[11]

This explanation notes the problems that will arise when the adult adjusts his questions to the child's answers or when the child adjusts his answers in response to the adult's actions.

In 1974 Aaron V. Cicourel wrote of the importance of having those who are most involved in the classroom being included in this type of research.

> Our academic claims to knowledge about the child's performance under testing and classroom conditions seldom include insightful reports of teachers who have written about their experiences . . . instead we usually rely on more formal discussions by educational psychologists who depend on the developments and administration of a variety of tests to support their claims about the child's abilities.[12]

In the use of this study, it might be wise to remember that what syllable strings and pauses are correlated to are standardized tests. Possibly some other measure could be found to measure "competence," but then it too would have to be "standardized."

FOOTNOTES

[1]D. Hymes, "The Ethnography of Speaking," *Anthropology and Human Behavior*, eds. T. Gladwin and W. C. Sturtevant (Washington, D. C., 1962).

[2]A. R. Luria and F. Ia. Yudovich, *Speech and the Development of Mental Processes in the Child* (Baltimore, 1973), p. 105.

[3]F. Goldman-Eisler, "The Measurement of Time Sequences in Conversational Behavior," *Br. J. Psychol.* Gen Sec 42 (1951).

[4]F. Goldman-Eisler, *Psycholinguistics: Experiments in Spontaneous Speech* (New York, 1968), p. 4.

[5]F. Goldman-Eisler, "Speech-Breathing Sctivity - A Measure of Tension and Affect During Interviews," *Br. J. Psychol.* Gen Sec 53-63.

[6]F. Goldman-Eisler, *Psycholinguistics: Experiments in Spontaneous Speech* (New York, 1968), p. 4.

[7]Joyce O. Hertzler, *A Sociology of Language* (New York, 1965), p. 406.

[8]F. Goldman-Eisler, *Psycholinguistics: Experiments in Spontaneous Speech* (New York, 1968), p. 31.

[9]Robert Mackay, "Standardized Tests: Objective/Objectified Measure of 'Competence'," in Aaron V. Cicourel et al., *Language Use and School Performance* (New York, 1974), p. 218.

[10]David Roth, "Intelligence Testing as a Social Activity," in Aaron V. Cicourel et al., *Language Use and School Performance* (New York, 1974), p. 215.

[11]Ibid.

[12]Aaron V. Cicourel, "Some Basic Theoretical Issues in The Assessment of the Child's Performance in Testing and Classroom Settings," in Aaron V. Cicourel et al., *Language Use and School Performance* (New York, 1974), p. 300.

CHAPTER IV

METHOD AND PROCEDURE

Introduction

The methods used in this study are of more of a mathematical nature than is usually found in sociology. However, it is felt that alternative approaches to the study of social interactions can be of value and use to the field of sociology.

Data Collection Background

The data used in this study was collected by Donald Allen and Rebecca Guy in elementary schools in Memphis, Tennessee and Tulsa, Oklahoma. The data includes three tape recordings per child of 107 first-born working class children engaged in social conversation with either their mother or teacher.

Each child was taped for a five-minute interval while talking to his or her mother at the kindergarten level and again taped two more times at the level of first grade; one between teacher/child and the other between mother/child. An effort was made to include an equal number of males and females and an equal number of white and black children in this study.

Reading, writing, and math tests were given the children at the first grade level. The reading and math tests were extracted from the McGraw-Hill Achievement Test series. Each test was shortened so it could be completed in ten minutes or less by the child. Reading scores ranged from 6 to 40 and math scores from 25 to 60. Appendix A contains copies of the actual tests used.

The writing test was administered by asking the child to write a story given the information, "Write a make believe story: Pretend you met a nice little dog who could talk. What did he tell you? What did you tell him?" The writing test was not standard but was pretested and found to be a reasonable measure of writing performance. One point was given in scoring the tests for each word recognizable, another point if the word was correctly formed (spelled), and another point for each correctly used punctuation mark. Writing scores ranged from 0 to 158.

Instrumentation

The hardware used in the analysis of this data was as follows: A tape recorder was used to record the social conversation. A stereo tape recorder was necessary so two different tracks could be identified; one for each speaker. Fifty-four cassettes were used for recording these conversations.

When recording social conversation, each speaker had one microphone pointed towards him. Therefore, when recording, by comparing the intensity of the two tracks, the track with the highest amplitude indicated which person was the speaker. This made it possible in analysis to separate syllable strings for each speaker.

A rectifier was used for the purpose of rectifying the current from alternating current to direct current. This was necessary for the equipment to be hooked up to the minicomputer. The rectifier was also needed to filter out wide variations due to tonal frequencies and incidental noise.

Shown in Figure 1 on the following page is an example of what the voices of the child and adult look like before being rectified. The mother's voice track is at the top and the child's is the lower track. You can see that both voices register on both tracks but on the track where the person is speaking the amplitudes are larger than those on the other track. As the chart says, its speed is two inches per second; therefore, the entire page represents a little less than five seconds of conversation. As oscilloscope was connected between tape recorder and minicomputer when sampling to verify that both tracks were being picked up by the minicomputer.

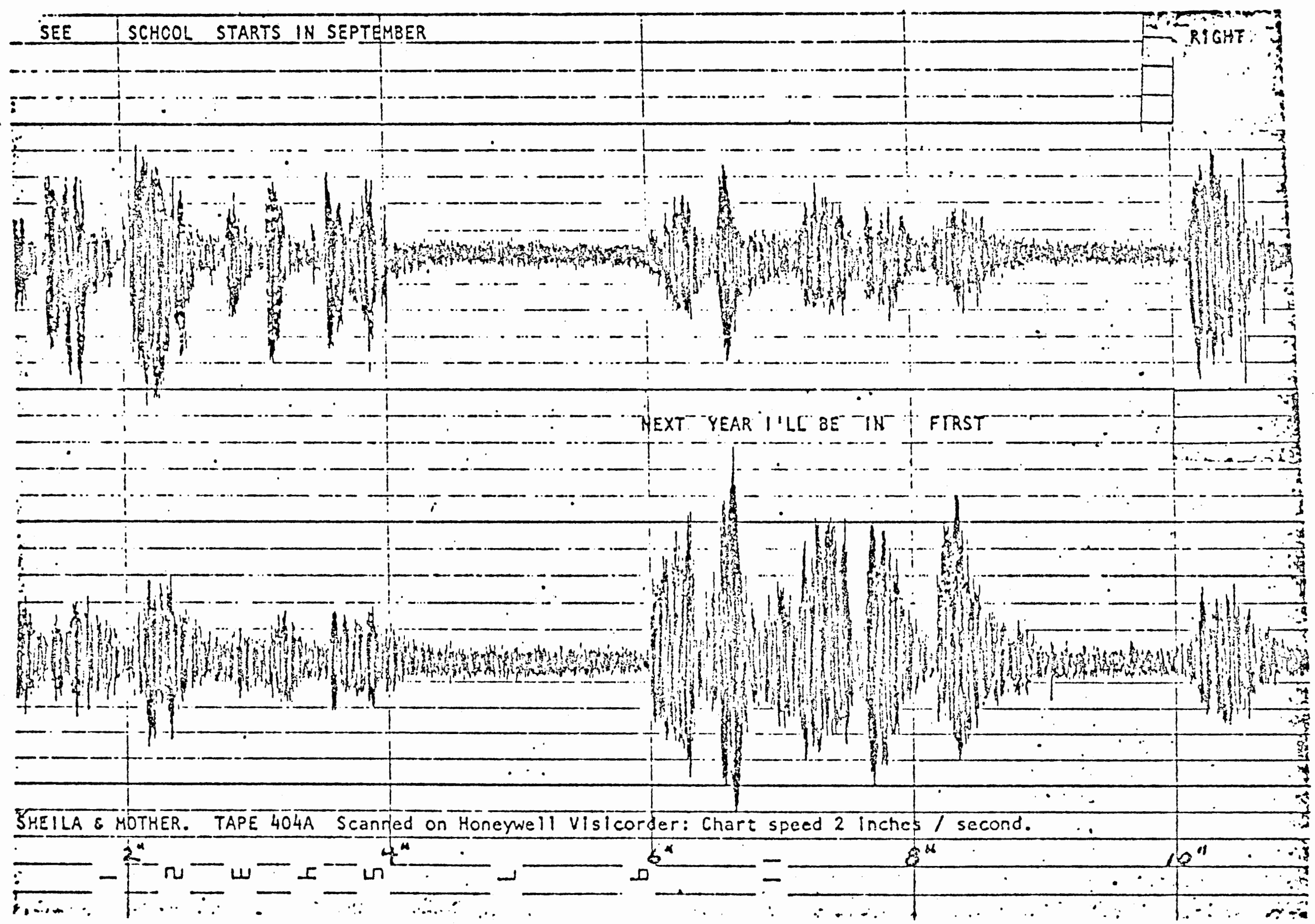
A digitizer was used to convert volts (the previous method of identifying variation of intensity) to digit values to be sampled by the minicomputer. These values are stored in groups of two. The first number represents the sampled value from Track 1 and the second number is the sampled value from Track 2.

Researchers have assumed that the average rate of speech is five syllables per second; therefore, one syllable would take 0.2 seconds or one-fifth of a second to complete. To make sure that all syllables spoken are sampled, the figure of fifty testings per second has been chosen as a sampling rate. The intensity per track is therefore sampled fifty times per second by the minicomputer.

A minicomputer was also used. It was an Interdata type and had

Figure 1.

Adult/Child Voice Tracks



a 64 kilobyte memory and a five megabyte disc storage. The minicomputer was used to compare the digit values representing high points (syllables). Each high point is assumed to be a syllable spoken. In conversation you can hear the stress each syllable receives; the minicomputer notes syllables by the number of high points found.

An example of this is in Figure 2 on the following page under the heading Source File: LAYOUT. Starting with the ninth record in this file, the first number represents a high point and its value represents the number of steps to the next high point. Each step represents 0.02 seconds, the sampling rate. The second number in the pair represents the actual value of the high point. It can range from 11 to 256. A positive value represents the child as the speaker and a negative value show the adult was speaking.

The first eight records in this file are for identification of each tape recording. The first record is the identification number. In this three-digit number, the first digit tells you what city the child was from and what race the child was. The numbers one and two represent Memphis and the numbers three and four represent Tulsa. An odd number represents a black child and an even number represents a white child. Therefore, for example, the number three in this first digit represents a black child from Tulsa. The third number in the three-digit identification number tells whether the child was a boy and an even number represents a girl. The middle digit is used simply to accommodate enough numbers to be able to represent all taped conversations uniquely.

The second through fifth records represent test scores in

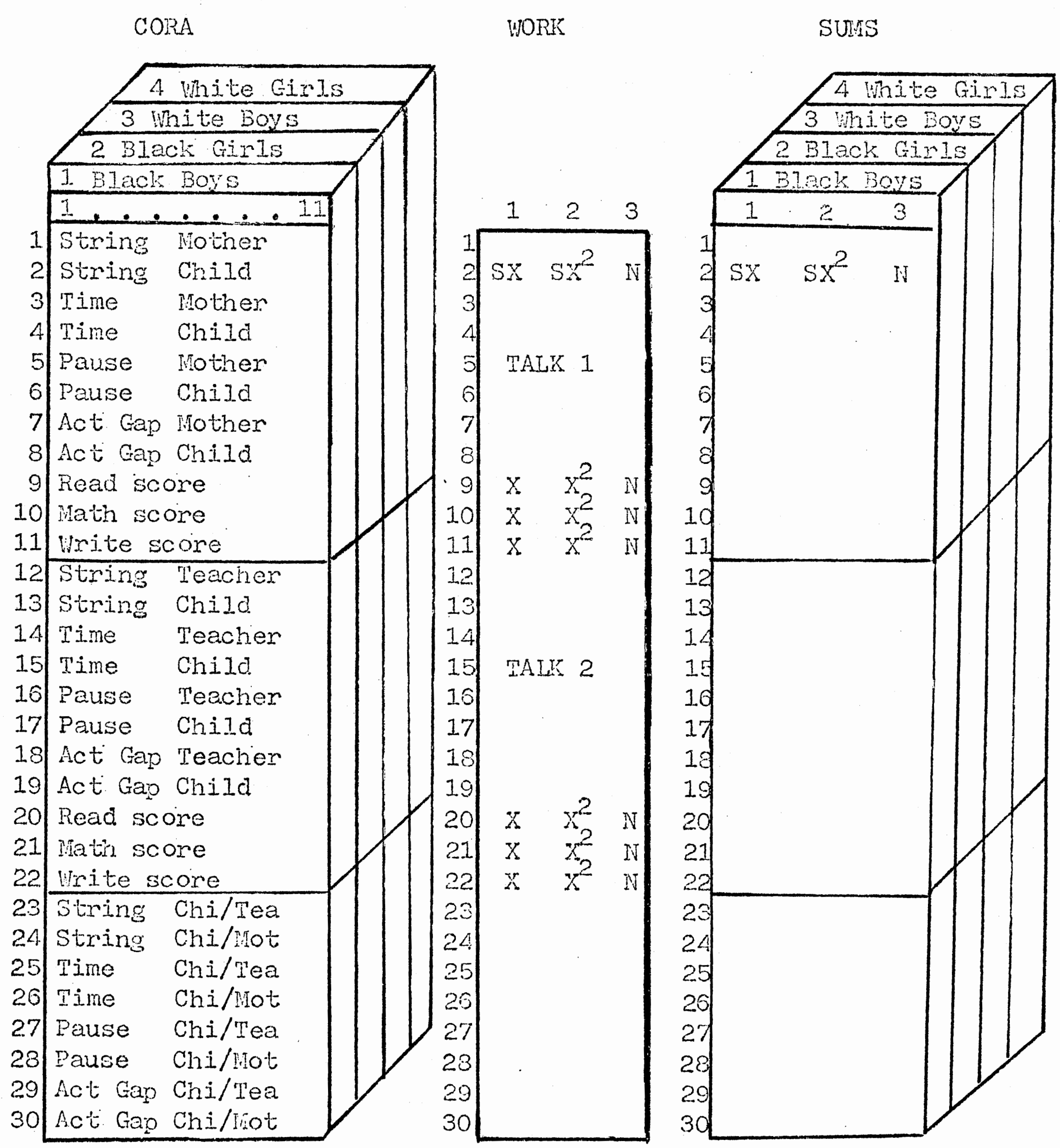
Figure 2.

Syllable Pause Record

Source File: LAYOUT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
321	48	35	12	22	276	288	300	25	50	8	60	9	70	10	40	30	-20
ID	RD	MTH	WR	PRT	TK_1	TK_2	TK_3	TIM	SYL	TIM	SYL	TIM	SYL	TIM	SYL	TIM	SYL

Representation of Correlations



reading, math, writing and a participation score which was not used in this study. The sixth, seventh and eighth records represent how long exactly each conversation was in the file LAYOUT so the minicomputer can determine exactly where to start and end each conversation.

By using these methods the minicomputer determines syllable strings, syllable string lengths, the length and number of pauses each speaker had in his or her conversation string (one group of syllable strings spoken by the same speaker), and the length and number of pauses found between interactions of the two speakers.

Three computer programs were used by the minicomputer. The first was PACKER. In PACKER, the minicomputer records high points of the samples by recording the number of steps to the next high point and its value. The values will be used in establishing syllable strings and pauses found in the conversations.

PACKER ignores machine noise and it ignores ambient noise. It counts "noise" if the two speakers' difference in high point values is less than ten. The possible value range is from 0 to 256, therefore the actual range is from 11-256. These numbers are eventually divided by 2.5 to set up a range from 4 to 100.

STACK is another computer program utilized. It identifies output by speaker and category (race, sex, age) and sums the data for later statistical tests. An illustration of what STACK represents is shown in Figure 2 on the lower two-thirds of the page. The sums are accumulated in the storage of either CORA (with dimensions of 30 by 11 by 4), WORK (30 by 3) or SUMS (30 by 3 by 4). The first conversation of the child (with his or her mother) at a kindergarten level is represented in rows one through eight in all of these storage areas. The rows nine, ten and eleven contain the test scores of the child in areas of reading, math and writing.

Rows twelve through nineteen contain records of the second conversation of the child (with his or her teacher) at the first grade level. Rows 20, 21, and 22 contain the same values as do rows 9, 10, and 11.

Rows 23, 25, 27 and 29 contain the same data as that in rows 12, 14, 16 and 18. Rows 24, 26, 28 and 30 contain the records of the third conversation of the child (with his or her mother) at the first grade level. These rows in this third section were arranged as they are to make it possible to correlate the values of the child's talking with his/her mother and teacher at the first grade level.

The four categories represented in each conversation are STRING, the number of syllables as SUM X and the total number of syllable strings as N; TIME, the sum of the time used in speaking the strings; PAUSE, the time between syllable strings while one person (child or adult) is talking; and ACT GAP, the pause time between speakers.

The storage in SUMS is used for accumulating the data. (Notice the four layers; one each for Black Boys, Black Girls, White Boys and White Girls). In other words it sums the values of the number of high points (syllables) and the values of steps to the next high points (pauses). These values are separated by categories of sex and race. The adult totals are always separated from the totals of the child.

The pause time used for these values is not the actual time between high points, because it takes a certain amount of time to speak a syllable. For purposes of analysis it is assumed that a syllable takes 0.2 seconds to speak, so a time of 0.1 seconds is added to each side of the syllable high point (before and after the syllable was spoken). This shortens the pause time between the two syllables by 0.2 seconds.

The storage of WORK is used in the following way: Data is transferred from WORK to SUMS where it is accumulated according to category. Then mathematical procedures are applied to SUMS to make the data readily available for statistical analysis. The values of this rectangle are then one by one each multiplied against each other (using first column values) to arrive at the cross products storage found in CORA. This is done separately for each layer.

JUGGLE is a third program designed to determine the value of b, the regression coeficient; t, the Student's t value showing the significance of b; p, the probability of arriving at the found value of t; and r, the correlation coefficient.

Statistical Methods

In the main model used there will be applied procedures of linear regression. The Y variable (academic performance scores) is termed the dependent variable and the X variable (syllable string and pause values) the independent variable. Several regressions will be made each using one of the four X variables for child and adult.

The other type of model used will be that of linear correlation, used to determine the amount of variation in a dependent variable explained by the independent variable.

For the regression model, it is assumed that a straight-line relationship is of use in summarizing the observed dependence of Y (academic performance) on X (syllable strings and pauses). A linear, first-order model of $Y = B_0 + B_1X + E$ is assumed. That is, for a given X, a corresponding observation Y consists of the value $B_0 + B_1X$ plus an amount E, the increment by which any individual Y may fall off the regression line.

The equation $Y = B_0 + B_1X + E$ is the model that is assumed to be true. "We begin by assuming that it holds; but we shall have to inquire at a later stage if indeed it does."[1]

Shown in Figure 3 are the formulas used in determining the statistical parameters of b, t, p and r. The regression coefficient is b, represented by B_1 in the model. B_0 in the model represents the Y intercept of the line; when X is zero then Y will have the value B_0. "b" is a measure of the slope of the regression line. A unit change in X results in a change of b units in Y. When b is positive, both variables increase or decrease together; when b is negative one variable increases as the other decreases.[2] Capital letters are used to represent the population parameters while a small letter is used to represent the estimation of a parameter.

The regression coefficient is found by the following formulas:

$$b = \frac{\Sigma X_iY_i - ((\Sigma X_i)(\Sigma Y_i)) / n}{\Sigma X_i^2 - (\Sigma X_i)^2 / n} = \frac{\Sigma(X_i - \bar{X})(Y_i - \bar{Y})}{\Sigma(X_i - \bar{X})^2} = \frac{\Sigma xy}{x^2} = b$$

"n" represents the number of cases and the term ΣX_i simply means the sum of the X values from the first case to the nth case.

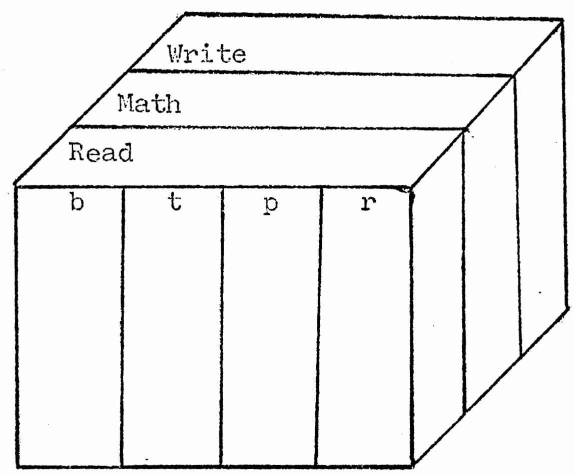
Figure 3.

Statistical Formulas

Regression Coefficient	$b = \Sigma xy \,/\, \Sigma x^2$
Student's t value Significance of b	$t = (b - b_0) \,/\, (s^2_{y \cdot x} \,/\, \Sigma x^2)^{.5}$
Variance of Error Estimate	$s^2_{y \cdot x} = (\Sigma y^2 - (\Sigma xy)^2 \,/\, \Sigma x^2) \,/\, (n - 2)^{-1}$
Correlation Coefficient	$r = \Sigma xy \,/\, (\Sigma x^2 \Sigma y^2)^{-.5}$

Computer Output Representation

Syllable strings	Adult	1
Syllable strings	Child	2
Time per string	Adult	3
Time per string	Child	4
Pause time	Adult	5
Pause time	Child	6
Interactor gap	Adult	7
Interactor gap	Child	8



The quantity ΣX_i^2 is called the uncorrected sum of squares of the X's and $(\Sigma X_i)^2/n$ is the correction for the mean of the X's. Similarly, $\Sigma X_i Y_i$ is called the uncorrected sum of products, and $(\Sigma X_i)(\Sigma Y_i)/n$ is the correction for the means. The difference of these two values is called the corrected sum of products of X and Y.

An unbiased estimate of the true variance about regression is given by the residual mean square with n-2 degrees of freedom.[3] It is denoted by $s^2_{y \cdot x}$ and defined as $\frac{\Sigma(Y - Y)^2}{n - 2}$ or $\frac{y^2 - (\Sigma xy)^2 / \Sigma x^2}{n - 2}$.

This value is necessary to compute a Student's t, and to determine the significance of "b".

To test the null hypothesis that $B_0 = b$, compute t as follows:

$$t = \frac{b - B_0}{s^2_{y \cdot x} / \Sigma x^2}$$

This method tests for t using $B_0 = 0$; therefore testing to see whether b equals zero. If b does equal zero then the regression model of the data is not a very useful one in representing the data.

The correlation coefficient is unlike a variance or a regression coefficient. The correlation coefficient is independent of the units of measure; it is an absolute or dimensionless quantity.[4]

The coefficient of determination is r^2, the square of the correlation coefficient. When $r = 0.1$, then $r^2 = 0.01$; this means that only 1% of the variation in a dependent variable is explained by the independent variable. For $r = 0.2$, the percentage is 4%, for $r = 0.5$, it is only 25%. R lies between -1.00 and +1.00. When linear correlation is small, r is near zero.

In Figure 3 on the lower half of the page you will see how these divisions are represented in the computer. Of course, on computer output records there will be printed three tables side by side to denote the three layers for the three test areas in reading, math and writing.

Further information about computer programming can be found in Appendix B, where a record of the computer programs used can be located.

Summary

Three five-minute taped conversations of each of 107 children talking to either their mother or teacher are analyzed by a minicomputer. This is done by hooking the tape recorder to a rectifier which is in turn hooked up to a digitizer, an oscilloscope, and the minicomputer.

The minicomputer identifies high points (syllables) and the time between them. Information about the data is then summed to see if there are any correlations between syllable strings (and pauses) and the child's academic scores. Statistical tests are made and values of b, t, p, r and correlations between child/mother and child/teacher conversations are determined.

FOOTNOTES

[1]N. R. Draper and H. Smith, _Applied Regression Analysis_ (New York, 1966), p. 8.

[2]Robert G. D. Steel and James H. Torrie, _Principles and Procedures of Statistics_ (New York, 1960), p. 162.

[3]Ibid., p. 169.

[4]Ibid., p. 183.

CHAPTER V

ANALYSIS OF THE DATA

Introduction

This chapter contains the findings arrived at by use of the methods of the preceding chapter. Tables I through IV found in this chapter contain regression values of b, t, p, r and correlation coefficients.

Linear Correlations

The linear correlations show good relationships in the data. In all divisions (black, white, boys, girls) TIME and STRING for either mother or teacher were positively correlated above 0.799 and in all but two cases above the value 0.993. This shows that as the number of syllable strings increases so does the time used in speaking. These particular relationships are not involved in the relationships of the child between the mother or teacher, but do show good consistency in the data.

There were several good correlations showing a relationship between the child's conversation with his mother and his teacher. These were as follows: PAUSE Mother was negatively correlated to STRING Teacher in all four divisions (black, white, boys, girls). The correlations were -0.814 for black children, -0.763 for white children, -0.805 for boys, and -0.807 for girls. This means that the more time taken for pauses in conversation by the child while talking with his mother, the less number of syllables he used when talking with his teacher.

Another encouraging correlation was that PAUSE Mother was negatively correlated with TIME Teacher in all four divisions. The correlations were -0.830 for black children, -0.780 for white children, -0.785 for boys, and -0.815 for girls. This shows that the more time used for pauses in conversation by the child with his mother, the less time was used by him in speaking syllables with his teacher.

Another correlation was found to occur only in the black children division at a level above 0.70. It was a correlation of ACT GAP Teacher and STRING Mother. It was negatively correlated at -0.775.

Also found was a correlation of -0.791 between ACT GAP Teacher and TIME Mother in black children only (at a level this high). These two correlations showed up in the other divisions also. They occurred in the interval 0.500 to 0.681 for ACT GAP Teacher and STRING Mother; and the interval 0.425 to 0.628 for ACT GAP Teacher and TIME Mother.

All correlations may be found in Tables I through IV located in this chapter.

Summary

The variables TIME Mother and STRING Mother were correlated highly as were TIME Teacher and STRING Teacher. This showed good consistency in the data, as it occurred in all divisions at a reasonably high level.

PAUSE Mother was negatively correlated to both STRING Teacher and TIME Teacher in all divisions. This is an indication of the stability of the child's conversation with two different adults.

ACT GAP Teacher was negatively correlated to both STRING Mother and TIME Mother in all divisions. This, too, is an indication of a stable ratio of two characteristics of the child's conversation with with two different adults.

Linear Regression

The r values in this section were about the same in all divisions and categories. The range was from 0.19 to a high of 0.36 in the correlations found to be significant. This shows that a maximum of only 13% of the variation in the Y variable can be explained by the X variable. It shows that linear correlation between these two variables is low, and possibly a different model (for example, the curvilinear model) could have worked better with the data. However, good results were obtained from other parameter estimates.

Black Children

Several significant correlations were found at the 0.05 level of significance or less. First, STRING Mother (the syllable string count assigned to the mother) was negatively correlated to math scores for black children ($p = 0.047$). This negative correlation means that the more strings the mother spoke, the lower the child's test scores.

Also found was that STRING Mother and TIME Mother were both negatively correlated with writing scores (p values of 0.042 and

Regression Values

		READ				MATH				WRITE			
		B	T	P	R	B	T	P	R	B	T	P	R
String	Mother	-0.00	-0.55	1.000	-0.08	-0.01	-1.71	0.047	-0.23	-0.03	-1.79	0.042	-0.25
String	Child	-0.00	-0.80	1.000	-0.11	-0.00	-0.05	1.000	-0.01	-0.01	-0.80	1.000	-0.11
Time	Mother	-0.01	-0.40	1.000	-0.06	-0.08	-1.45	0.071	-0.20	-0.18	-1.69	0.048	-0.23
Time	Child	-0.01	-0.55	1.000	-0.08	0.01	0.29	1.000	0.04	-0.06	-0.60	1.000	-0.08
Pause	Mother	-0.05	-0.83	1.000	-0.12	-0.07	-0.63	1.000	-0.09	-0.14	-0.62	1.000	-0.09
Pause	Child	0.03	1.41	0.075	0.20	0.06	1.49	0.066	0.21	0.18	2.02	0.031	0.28
Act Gap	Mother	0.01	0.11	1.000	0.02	-0.07	-0.54	1.000	-0.08	0.18	0.70	1.000	0.10
Act Gap	Child	-0.03	-0.47	1.000	-0.07	-0.04	-0.30	1.000	-0.04	0.02	0.10	1.000	0.01

Linear Correlations

		String Ch/Tea	String Ch/Mot	Time Ch/Tea	Time Ch/Mot	Pause Ch/Tea	Pause Ch/Mot	ActGap Ch/Tea	ActGap Ch/Mot
String	Child/Teacher	1.000	0.123	0.996	0.060	0.212	-0.814	-0.063	-0.393
String	Child/Mother	0.123	1.000	0.084	0.993	-0.631	-0.159	-0.775	-0.437
Time	Child/Teacher	0.996	0.084	1.000	0.026	0.258	-0.830	-0.033	-0.374
Time	Child/Mother	0.060	0.993	0.026	1.000	-0.644	-0.110	-0.791	-0.420
Pause	Child/Teacher	0.212	-0.631	0.258	-0.644	1.000	-0.422	0.478	0.193
Pause	Child/Mother	-0.814	-0.159	-0.830	-0.110	-0.422	1.000	-0.024	0.110
Act Gap	Child/Teacher	-0.063	-0.775	-0.033	-0.791	0.478	-0.024	1.000	0.364
Act Gap	Child/Mother	-0.393	-0.437	-0.374	-0.420	0.193	0.110	0.364	1.000

TABLE I.

Black Children

0.048). This is consistent with the previous finding.

It was found that PAUSE Child was positively correlated with writing scores (p = 0.031). By putting the four correlations together the following association is found: For black children the less talking a mother does and the more time the child spends in pausing while talking, the higher will be his scores - at least in writing and math.

If probabilities of p between 0.05 and 0.10 are included, then a similar association is found. PAUSE Child is positively correlated with both reading and math scores (p = 0.075 and p = 0.066). Also TIME Mother is negatively correlated with math scores (p = 0.071). These findings tend to validate the previous association and it can now be extended to: For black children, the less talking a mother does and the more time a child pauses while speaking, the more likely is the child to get a higher score in reading, writing or math.

White Children

The only significant correlation found for the white children at the 0.05 level of significance was that ACT GAP Child was negatively correlated to math scores. In other words, the more time a child took to react to an adult's question or comment, the lower his or her math score.

If the probability level is extended down to the 0.10 level of significance, then results opposite to those of the black children are found. STRING Mother and TIME Mother are both positively correlated with reading scores (p = 0.054 and p = 0.069). Thus, the more time the mother spends talking, the better the child's reading score.

Regression Values

		READ				MATH				WRITE			
		B	T	P	R	B	T	P	R	B	T	P	R
String	Mother	0.01	1.62	0.054	0.24	0.00	0.13	1.000	0.02	0.01	0.35	1.000	0.03
String	Child	0.00	0.31	1.000	0.05	-0.00	-0.24	1.000	-0.04	-0.01	-0.36	1.000	-0.06
Time	Mother	0.04	1.47	0.069	0.22	0.00	0.05	1.000	0.01	0.05	0.34	1.000	0.05
Time	Child	0.00	0.17	1.000	0.03	-0.01	-0.27	1.000	-0.04	-0.04	-0.36	1.000	-0.06
Pause	Mother	0.01	0.56	1.000	0.09	0.01	0.39	1.000	0.06	0.07	0.81	1.000	0.12
Pause	Child	-0.02	-1.35	0.085	-0.20	0.02	0.79	1.000	0.12	-0.02	-0.29	1.000	-0.05
Act Gap	Mother	0.02	0.35	1.000	0.05	-0.09	-1.05	0.149	-0.16	-0.06	-0.26	1.000	-0.04
Act Gap	Child	-0.06	-1.07	0.142	-0.16	-0.28	-2.51	0.018	-0.36	-0.31	-1.03	0.155	-0.16

Linear Correlations

		String Ch/Tea	String Ch/Mot	Time Ch/Tea	Time Ch/Mot	Pause Ch/Tea	Pause Ch/Mot	ActGap Ch/Tea	ActGap Ch/Mot
String	Child/Teacher	1.000	-0.091	0.998	-0.100	0.258	-0.763	-0.264	-0.273
String	Child/Mother	-0.091	1.000	-0.104	0.799	-0.536	-0.133	-0.500	-0.435
Time	Child/Teacher	0.998	-0.104	1.000	-0.116	0.283	-0.780	-0.249	-0.247
Time	Child/Mother	-0.100	0.799	-0.116	1.000	-0.485	-0.031	-0.425	-0.443
Pause	Child/Teacher	0.250	-0.536	0.283	-0.485	1.000	-0.522	0.241	0.604
Pause	Child/Mother	-0.763	-0.133	-0.780	-0.031	-0.522	1.000	0.088	-0.110
Act Gap	Child/Teacher	-0.264	-0.500	-0.249	-0.425	0.241	0.088	1.000	0.488
Act Gap	Child/Mother	-0.273	-0.435	-0.247	-0.443	0.604	-0.110	0.488	1.000

TABLE II.

White Children.

Also PAUSE Child was negatively correlated to reading scores (p = 0.085). This is again the opposite effect as that found for black children.

The concluding statement for white children would be: The quicker a child reacts to his mother's questions or comments, the higher his math score. Also, with not quite as strong an association, the more time the mother spends talking and the less the child pauses while talking, the higher the child's reading score.

Boys

The results for boys are more similar to the black children's results than to those of the white children. At the p = 0.05 level of significance, STRING Child and TIME Child are both negatively correlated wtih reading scores (p = 0.026 and p = 0.036). This means the more time (and the more syllables) the child used in conversation with his mother, the lower his reading score.

For writing, TIME Mother (p = 0.021) and TIME Child (p = 0.025) were both negatively correlated with these scores. In other words, the more time that the mother or the child used in speaking, the lower the child's writing score. PAUSE Mother was positively correlated with writing scores at p = 0.023. The more pause time the mother used in her conversation, the higher the child's writing score.

Extending the probability level down again to the range of 0.05 to 0.10, PAUSE Child is positively correlated with both reading and math scores (p = 0.052 and p = 0.062).

The general result for boys seems to be that the more pause time

Regression Values

		READ				MATH				WRITE			
		B	T	P	R	B	T	P	R	B	T	P	R
String	Mother	-0.00	-0.76	1.000	-0.11	-0.01	-1.18	0.114	-0.17	-0.01	-0.81	1.000	-0.12
String	Child	-0.01	-2.17	0.026	-0.31	-0.01	-1.23	0.103	-0.18	-0.03	-2.35	0.021	-0.33
Time	Mother	-0.02	-0.60	1.000	-0.09	-0.07	-1.08	0.138	-0.16	-0.06	-0.59	1.000	-0.09
Time	Child	-0.05	-1.92	0.036	-0.27	-0.04	-1.00	0.163	-0.15	-0.15	-2.20	0.025	-0.31
Pause	Mother	0.01	0.55	1.000	0.08	0.03	0.60	1.000	0.09	0.17	2.28	0.023	0.32
Pause	Child	0.04	1.65	0.052	0.24	0.06	1.53	0.062	0.22	0.02	0.37	1.000	0.06
Act Gap	Mother	0.03	0.48	1.000	0.07	-0.06	-0.59	1.000	-0.09	0.01	0.06	1.000	0.01
Act Gap	Child	-0.05	-0.66	1.000	-0.10	-0.09	-0.71	1.000	-0.11	0.01	0.06	1.000	0.01

Linear Correlations

		String Ch/Tea	String Ch/Mot	Time Ch/Tea	Time Ch/Mot	Pause Ch/Tea	Pause Ch/Mot	ActGap Ch/Tea	ActGap Ch/Mot
String	Child/Teacher	1.000	-0.018	0.998	-0.094	0.119	-0.785	-0.157	-0.437
String	Child/Mother	-0.018	1.000	-0.036	0.993	-0.586	0.046	-0.630	-0.550
Time	Child/Teacher	0.998	-0.036	1.000	-0.109	0.152	-0.805	-0.130	-0.423
Time	Child/Mother	-0.094	0.993	-0.109	1.000	-0.585	0.104	-0.628	-0.519
Pause	Child/Teacher	0.119	-0.586	0.152	-0.585	1.000	-0.509	0.330	0.490
Pause	Child/Mother	-0.785	0.046	-0.805	0.104	-0.509	1.000	-0.071	0.073
Act Gap	Child/Teacher	-0.157	-0.630	-0.130	-0.628	0.330	-0.071	1.000	0.446
Act Gap	Child/Mother	-0.437	-0.550	-0.423	-0.519	0.490	0.073	0.446	1.000

TABLE III.

Boys

used by either the child or the mother and the less time used in talking, the higher were the academic scores.

Girls

At the 0.05 level of significance the same was found as was found for white children (and math scores); ACT GAP Child was negatively correlated with reading scores ($p = 0.031$). This means the longer the child took to react to input of her mother, the lower her reading score.

An ACT GAP correlation was also found in the 0.05 to 0.10 probability range where ACT GAP Mother was negatively correlated with child's math score ($p = 0.085$). If the mother took a longer time to react to her child, her child's math score would be lower.

The following were all negatively correlated with academic scores of the girls: STRING Mother with Math ($p = 0.034$), TIME Mother with Math ($p = 0.053$), STRING Mother with Write ($p = 0.057$), and TIME Mother with Write ($p = 0.064$). This would seem to show, as before, the more time (and syllables) used by the mother, the lower the child's academic scores.

One further correlation was PAUSE Child with Write ($p = 0.053$), which was positively correlated. In this case, as was found before, the more the child paused while speaking, the higher her (in this case) writing score. PAUSE Child was positively correlated with reading, math and writing for black children and with reading and math for boys.

Regression Values

		READ				MATH				WRITE			
		B	T	P	R	B	T	P	R	B	T	P	R
String	Mother	-0.00	-0.68	1.000	-0.10	-0.02	-1.95	0.034	-0.27	-0.03	-1.58	0.057	-0.23
String	Child	0.00	0.52	1.000	0.08	0.00	0.38	1.000	0.06	0.00	0.24	1.000	0.03
Time	Mother	-0.01	-0.47	1.000	-0.07	-0.08	-1.64	0.053	-0.23	-0.18	-1.51	0.064	-0.21
Time	Child	0.02	0.72	1.000	0.10	0.03	0.61	1.000	0.09	0.04	0.39	1.000	0.06
Pause	Mother	0.01	0.33	1.000	0.05	0.00	0.02	1.000	0.00	-0.11	-0.75	1.000	-0.11
Pause	Child	0.01	0.51	1.000	0.07	0.06	1.83	0.040	0.26	0.15	1.63	0.053	0.23
Act Gap	Mother	-0.07	-0.91	1.000	-0.13	-0.16	-1.34	0.085	-0.19	0.06	0.19	1.000	0.03
Act Gap	Child	-0.14	-2.02	0.031	-0.28	-0.28	-2.45	0.018	-0.34	-0.37	-1.19	0.112	-0.17

Linear Correlations

		String Ch/Tea	String Ch/Mot	Time Ch/Tea	Time Ch/Mot	Pause Ch/Tea	Pause Ch/Mot	ActGap Ch/Tea	ActGap Ch/Mot
String	Child/Teacher	1.000	0.073	0.997	0.042	0.443	-0.807	-0.102	-0.109
String	Child/Mother	0.073	1.000	0.037	0.850	-0.601	-0.292	-0.681	-0.352
Time	Child/Teacher	0.997	0.037	1.000	0.007	0.487	-0.815	-0.081	-0.075
Time	Child/Mother	0.042	0.850	0.007	1.000	-0.549	-0.207	-0.587	-0.352
Pause	Child/Teacher	0.443	-0.601	0.487	-0.549	1.000	-0.456	0.475	0.243
Pause	Child/Mother	-0.807	-0.292	-0.815	-0.207	-0.456	1.000	0.012	-0.158
Act Gap	Child/Teacher	-0.102	-0.681	-0.081	-0.587	0.475	0.012	1.000	0.404
Act Gap	Child/Mother	-0.109	-0.352	-0.075	-0.352	0.243	-0.158	0.404	1.000

TABLE IV.

Girls

Summary

For all but the categories of white children, STRING and TIME values of the mother were consistently negatively correlated with the child's academic score. In the category of white children these contradictory findings were not at the 0.05 level of significance. This would seem to indicate that the more time (and syllables) used by a mother in talking to her child, the lower the child's academic scores. This also seems to be true for STRING and TIME values of the child.

PAUSE seems to be consistently positively correlated to academic scores whether PAUSE time belongs to the child or mother. Note that pause time was positively correlated to academic scores only when it was time within the speaker's syllable strings. This is not the same as the pause time between speakers, which was consistently negatively correlated wtih academic scores.

The only contradictory value of PAUSE to the above association was again found only in white children at a level of significance below that of 0.05. This occurred when PAUSE Child was negatively correlated with reading scores at the probability level of 0.085.

This linear regression model, though with fairly low r values, consistently found very similar results in the signs of correlations of syllable strings and pauses to academic scores. Therefore, it is believed that its results are meaningful.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Introduction

The original predictions included in the theoretical framework chapter were partially verified but with certain necessary qualifications. The original predictions were modified to include both extremes possible in a conversation; that of too little being said to communicate meaning and that of too much being said by one speaker to allow for a dyadic conversation.

Summary of Findings

Linear Correlations

The correlations found between TIME Mother/STRING Mother and between TIME Teacher/STRING Teacher added to confidence in the worth of the data. If there had been no positive correlation between the number of syllable strings and the time it took to speak them, it would have been hard to make any hypotheses based on the results.

Other correlations found gave strength to the assumption of stability in the characteristics of syllable strings (and pauses) used when talking to different persons. Therefore, in this case, different tape recordings of the same child would not predict totally different academic scores for that same child. These correlations were: PAUSE Mother was negatively correlated to both STRING and TIME Teacher in all four divisions. Also ACT GAP Teacher was negatively correlated to both STRING and TIME Mother in all four divisions.

The linear correlation section of analysis was intended to justify the validity of the methods of analysis and of the data. It is felt that the linear correlations found have accomplished this objective.

Linear Regression

This study has shown several consistent correlations that have not turned out as predicted originally. For example, it was predicted that more/and or longer syllable strings spoken by either the child or the mother would be positively correlated with the child's academic performance. All cases at the 0.05 level of significance or better and most others down to the 0.10 level of significance have shown just the opposite effect.

In essence it was found that more/and or longer syllable strings spoken either by the child or the mother was usually negatively correlated with academic scores.

The factor that predicted relationships in more cases than any other was that of the PAUSE Time of the child. In all cases this was positively correlated with the academic scores at the 0.05 level of significance. The only contradiction noted was at the 0.085 level of significance for white children. There, PAUSE Time of the child was found to be negatively correlated with academic scores.

Syllable strings were found to be negatively associated with academic scores in all cases except for that of white children. In this category both STRING Mother and TIME Mother were positively correlated with academic scores at significance levels of 0.054 and 0.069.

The ACT GAP of the child and the mother was consistently negatively correlated with academic scores.

A significant finding in linear regression was that it did not seem to matter whether STRING, TIME PAUSE or ACT GAP was separated into two categories of child or mother, because the findings were very similar for each.

Another important finding was the low r value found in each significant correlation as noted in the previous chapter. This indicates that the linear regression model is not a very good representation of the data.

Conclusions

In view of the above findings, it is felt that correlations of syllable strings and pauses to academic scores is a slightly more complicated relationship than was previously predicted. The original relationship of more syllable strings positively correlated to higher academic scores has been modified to include the qualification: "up to a point." Although it is logical that the child must contribute some "sound" to the conversation, this contribution must have some limit on it, simply because of the limits of time imposed on the conversation and the allowance that has to be made for the other person in the dyad to contribute to the conversation.

In tapes listened to, the mother seemed to be prompting the child to do most of the talking, perhaps assuming that this study was mainly concerned wtih the child's conversation. As this occurred, the child would have used more of the time available for speaking; therefore, talking in more than half of the available conversation time.

If the child continued to talk to his mother without additional input (feedback) from her, he would be more realistically talking "at" his mother and the give-and-take of the conversation would not be found. If the above explanation did occur in most of the tapes, then the results obtained would have been expected.

Therefore the conclusion to be made about the relationship between syllable strings and academic scores is a modified version of the original prediction. That is, the more syllables used, the higher the child's academic scores, but only up to a certain point. After that point is reached, the more syllables used, the lower the child's academic score.

This "point" could be compared to a point of diminishing returns. You can put more into a conversation and get better communication, but if you put too much into it, then the conversation actually loses some of its value.

This conclusion would be consistent with Goldman-Eisler's findings that feedback and spontaneity are important in a good interview. Feedback and spontaneity should also be important in mother/child conversations. This feedback and spontaneity is probably an important element of all good conversations. The give-and-take nature involved in the exchange of meanings makes this necessary.

In the case of the children's tapes, most of the children were contributing enough to the conversation for exchanges to be made, but it is predicted that under the circumstances most were also contributing too much for a true spontaneous conversation to be taking place. That is why the results turned out as they did. This may also explain why the category of white children had opposite correlations. These children may not have reached that point of diminishing returns. They may have been having a conversation with their mother, allowing her input (feedback), but not monopolizing the conversation.

Pause time as correlated to academic scores was also effected by a point of diminishing returns. Up to a certain point the less pause time was associated with a higher academic score, but as more and more syllables were contributed by one speaker, the more valuable pause time would become to a conversation, and it would be found that more pause time was correlated with higher academic scores.

Interactor gap time alone was consistently found to be negatively correlated wtih high academic scores. It, too, may have a certain point where correlations change sign beyond that point, but its limits were not reached by this study.

The low r scores found in the linear regression model suggest that the straight line representation of this data is not a very good one. It is thought that a curvilinear model might be more closely related since the correlations are predicted along a straight line only up to a certain point, where they then go the opposite direction. The low r score was helpful in determining that the model needed to accurately represent this data was most likely not linear.

Recommendations for Further Research

The tape recordings used in this study sould be analyzed for the amount of exchanges made. Not just the time in interactor gaps, but the number of times the conversation changed speakers. This would show the give-and-take of the conversation.

More careful attention should be paid to the number of syllables and syllable strings spoken in each tape recording and then have these numbers individually correlated with the academic scores of the child to see if the point of diminishing returns can be found. Possibly the question, "What part (per cent) of a conversation can one person use in speaking time without taking away from the give-and-take (feedback) involved in the dyadic conversation?" could be answered in another research study.

Another question raised has been, "Is interactor gap time always negatively correlated with academic scores, or does it, too, reach a point where more gap time is positively associated with academic scores?"

To further understand the social implications associated with the "sounds" of a conversation, the best method would probably include a videotape of the conversation. Body movements such as eye contact or restlessness could be observed and related to the outcomes found by the data.

Finally, the curvilinear model should be tried as a possible alternative representation of the data found in this study.

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APPENDIXES

APPENDIX A

READING AND MATH TESTS

READING TEST

TEACHER'S GUIDE FOR READING TEST

(Time About 15 Minutes)

Reading mastery near end of first grade. Levels 7 and 8

To the pupils:

Write your name on the line where it says "Name".

On Subtest 1 at the top of Page 1, mark an X in the box where you see a word which is the same as the word I read.

1 Andy	2 eat	3 uncle	4 keep		(Level 7)
6 poked	7 fence	8 much	9 read	10 start	(Level 8)

On Subtest 2, mark an X in the box in the picture which starts with the same sound as the word which I read. (Level 7)

1 moon 2 slide 3 fly 4 white 5 spider

In Row 6 are three words. Mark an X in the box by the word which starts with the same sound as the word which I read. (Level 7)

6 hat 7 key 8 umbrella 9 truck 10 they

On Subtest 3 in Picture Number 1, think of the sound that the picture starts with, and then mark an X in the box by the letter that has the same sound. Then do the same with pictures 2, 3, 4, and 5. (Level 8)

On Subtest 6 in the first word group Number 1, read the four words. Then mark an X in the box of the two words which go together. Then do group 2, 3, and 4. (Level 8)

On Subtest 7
Read Question Number 1 and think whether the answer should be "yes" or "no". Then mark an X in the box by Yes, if it is "yes", or in the box by No if the answer is "no".
The questions are 1, 2, 3, 4, 9, 10, and 11. (Level 8)

On the last page, Page 3, read the sentences beside each group of pictures. Then mark an X by the picture which answers the questions. (Level 7)

Page 1

READING TEST

CITY ____________________

NAME ____________________ SCHOOL ____________________

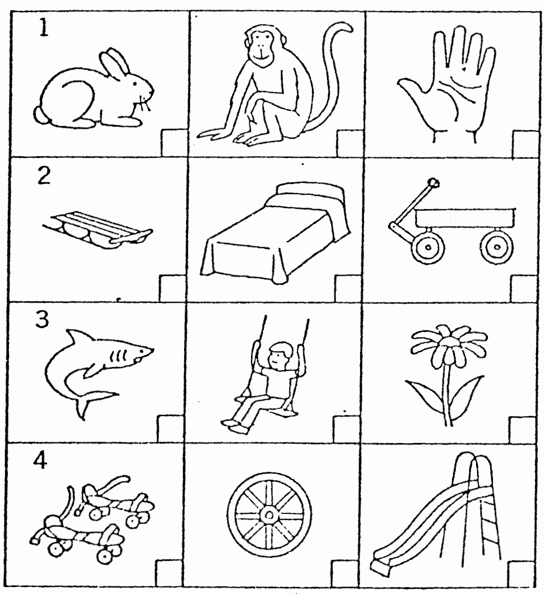
SUBTEST 1: Word Recognition

1	2	3	4
☐ Carlos	☐ at	☐ uncle	☐ cap
☐ John	☐ it	☐ circle	☐ keep
☐ Andy	☐ out	☐ donkey	☐ jeep
☐ Kim	☐ eat	☐ apple	☐ crab

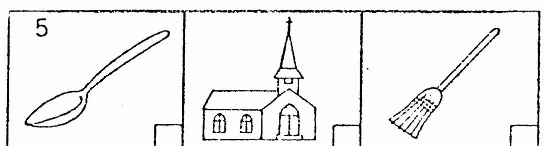
6.	7.	8.	9.	10.
☐ pony	☐ farm	☐ moon	☐ round	☐ start
☐ pocket	☐ flew	☐ much	☐ room	☐ stick
☐ park	☐ fence	☐ many	☐ read	☐ story
☐ poked	☐ four	☐ money	☐ rest	☐ street

SUBTEST 2: Word Analysis

1
2
3
4



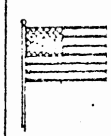
5



6	new ☐	puppy ☐	happy ☐
7	kite ☐	first ☐	like ☐
8	one ☐	uncle ☐	isn't ☐
9	they ☐	three ☐	tree ☐
10	stay ☐	that ☐	talk ☐

READING TEST Page 2 Name______________________

SUBTEST 3: Word Analysis (Initial Consonants, Clusters, and Digraphs)

1.	2.	3.	4.	5.
				
☐ d	☐ g	☐ h	☐ cl	☐ cl
☐ l	☐ p	☐ t	☐ tr	☐ fl
☐ k	☐ j	☐ k	☐ dr	☐ pl
☐ h	☐ q	☐ b	☐ sl	☐ fr

SUBTEST 6: Relationships

1.		2.		3.		4.	
fire	old	Janet	luck	else	fish	eat	ground
☐	☐	☐	☐	☐	☐	☐	☐
☐	☐	☐	☐	☐	☐	☐	☐
let	hot	master	girl	swim	hill	moon	cake

SUBTEST 7: Comprehension

1. Are all sisters girls?
   ☐ yes ☐ no

2. Can people read when they are asleep?
   ☐ yes ☐ no

3. Is it dry outdoors when it rains?
   ☐ yes ☐ no

4. Do some animals eat grass?
   ☐ yes ☐ no

9. Is page two in a book next after page one?
   ☐ yes ☐ no

10. Do people like to work hard when they are tired?
   ☐ yes ☐ no

11. Will your shadow be in back of you if the sun is in front of you?
   ☐ yes ☐ no

READING TEST Page 3 Name______________________

40. (Level 7)

What one tells you

that the rain comes down?

41.

It can't fly.

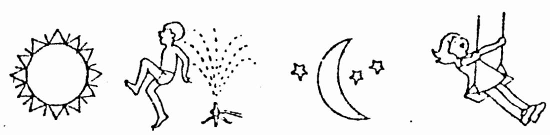
It comes up

in the morning.

It will go down at night.

It makes shadows,

What is it?



42.

You see it in the meadow.

The calf will eat it.

The colt will eat it.

The lamb will eat it.

It is green.

What is it?

43.

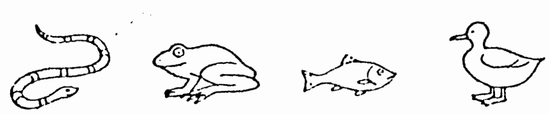
It likes to swim in the pond.

It is not a fish.

It is not a frog.

It is not a snake.

What is it?



MATH TEST

To be used after p

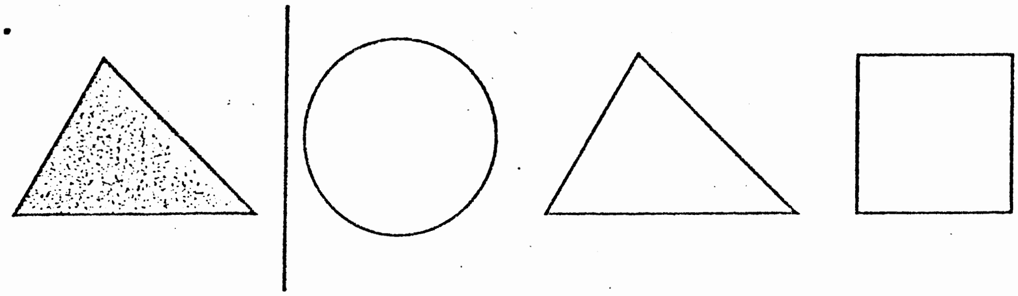
TEST 1

NAME ______________________________

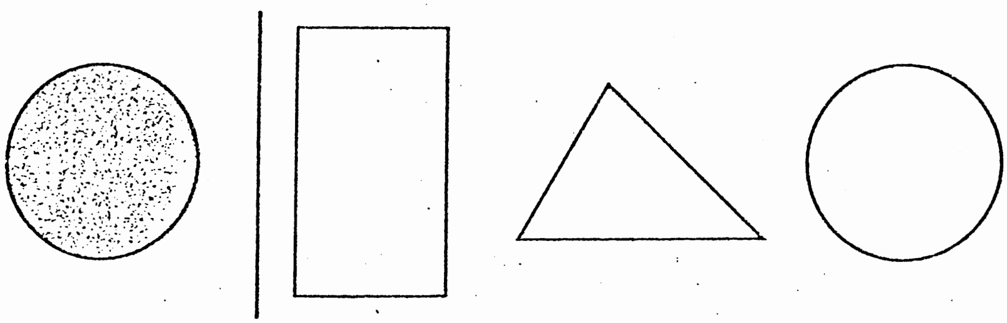
(Time About 15 Minutes)

MARK AN "X" ON THE SHAPE THAT MATCHES THE SHADED ONE.

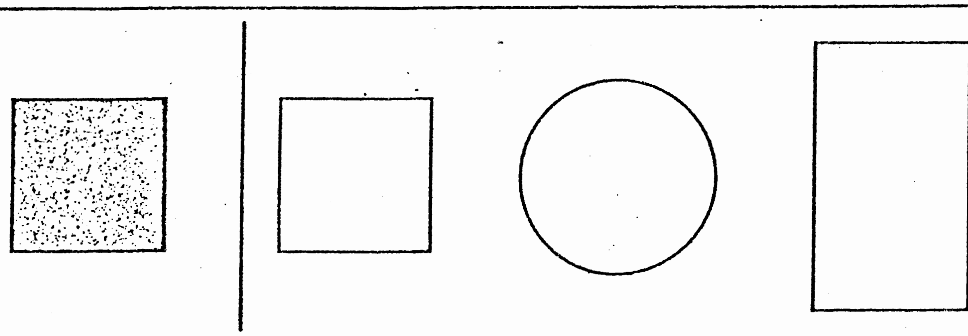
1.



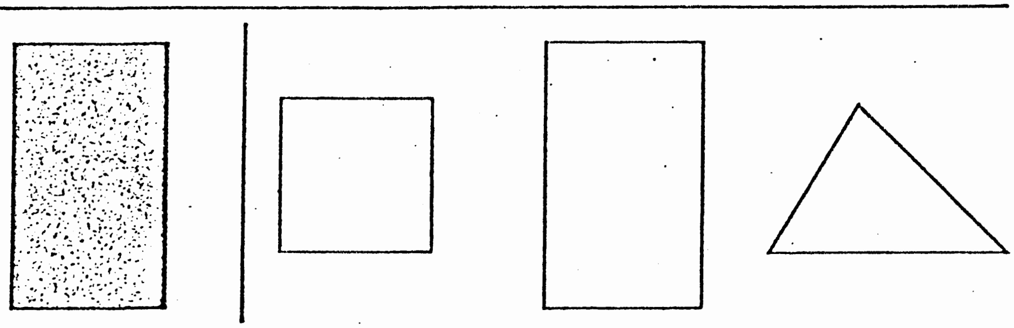
2.



3.



4.

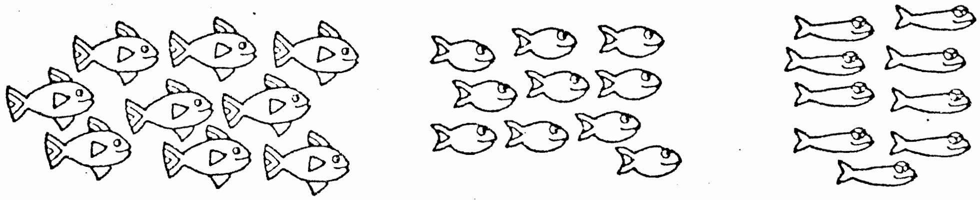


To be used

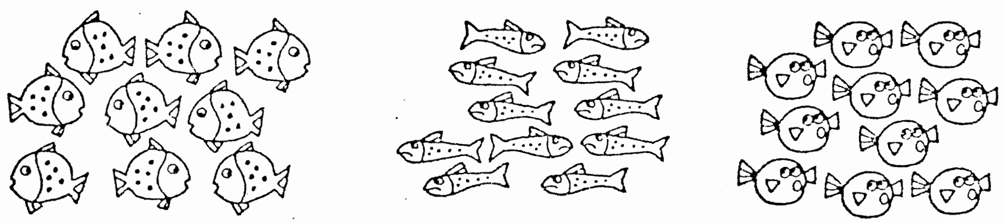
NAME ______________________ TEST 2

Mark each set of ten with a check (✓).

1.

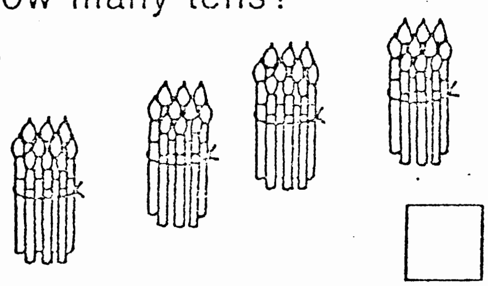


2.

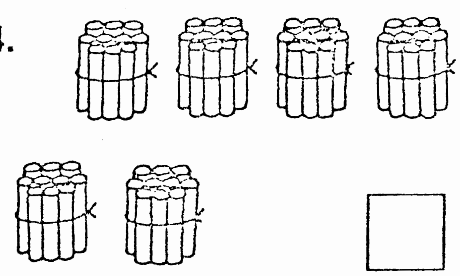


How many tens?

3.

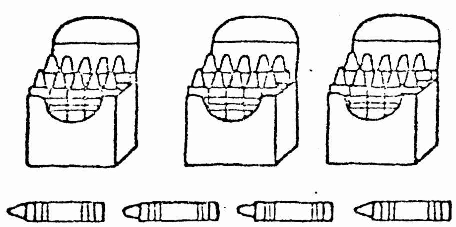


4.



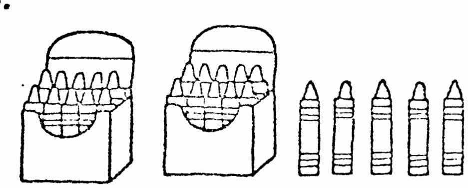
How many?

5.



____ tens and ____

6.



____ tens and ____

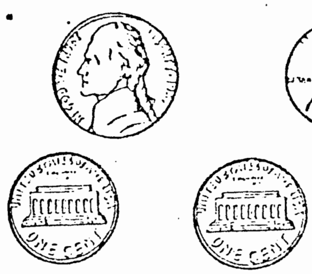
To be used after p

TEST 3

NAME ______________________________

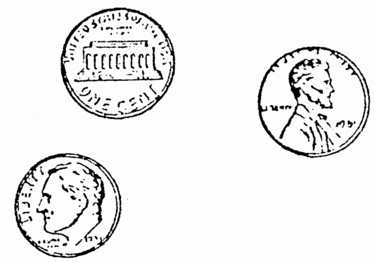
Give the value of each collection.

1.



____ ¢

2.



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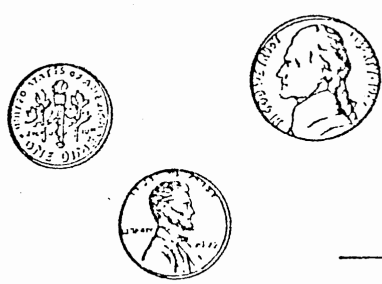
3.



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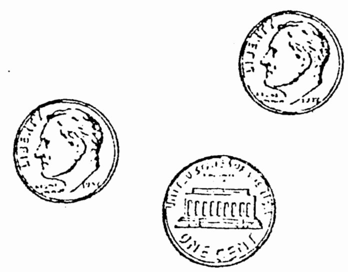
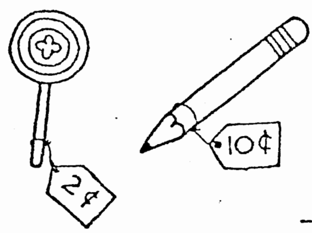
4.



____ ¢

5. How much for both?



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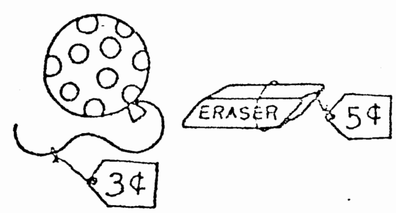
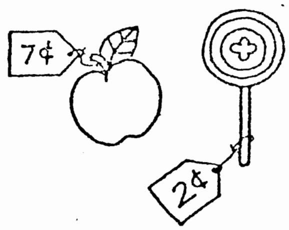
6.



____ ¢

7.



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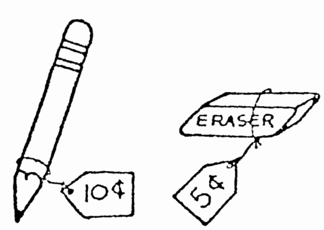
8.



____ ¢

TEST 4

Solve.

7. $5 + 4 = \square$

8. $3 + 3 = \square$

9. $6 + 2 = \square$

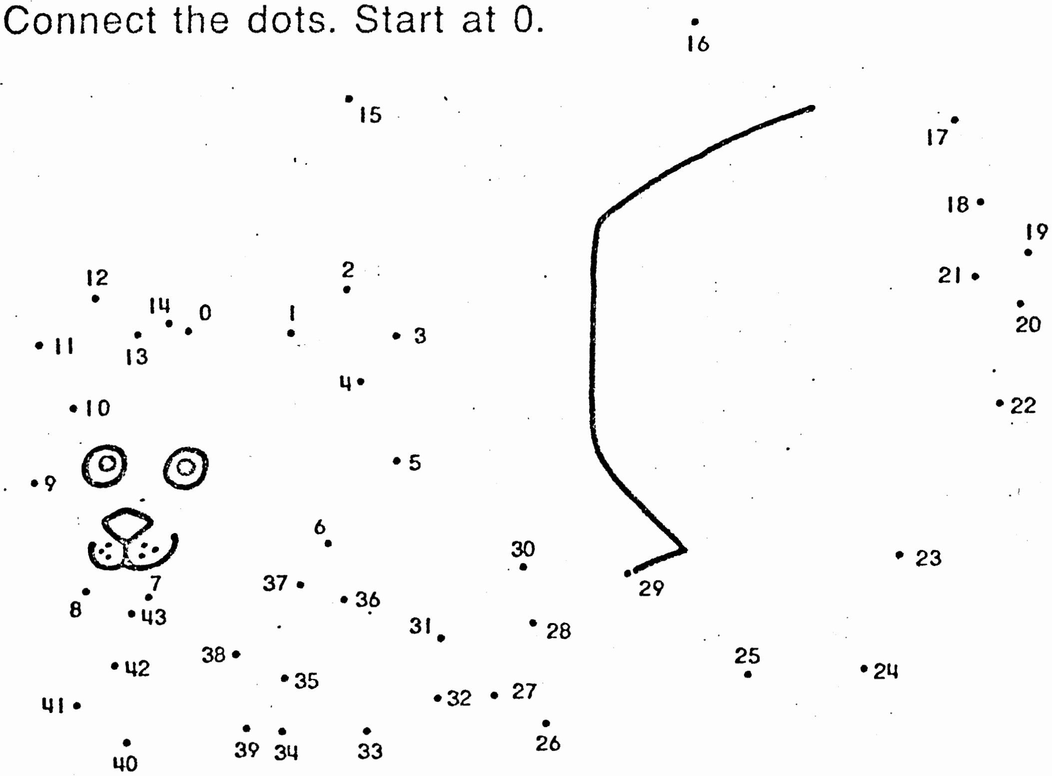
10. $7 - 3 = \square$

11. $9 - 1 = \square$

12. $8 - 4 = \square$

13. $\begin{array}{r} 7 \\ +2 \\ \hline \end{array}$ 14. $\begin{array}{r} 3 \\ +5 \\ \hline \end{array}$ 15. $\begin{array}{r} 6 \\ +1 \\ \hline \end{array}$ 16. $\begin{array}{r} 6 \\ -2 \\ \hline \end{array}$ 17. $\begin{array}{r} 8 \\ -5 \\ \hline \end{array}$ 18. $\begin{array}{r} 7 \\ -3 \\ \hline \end{array}$

Connect the dots. Start at 0.

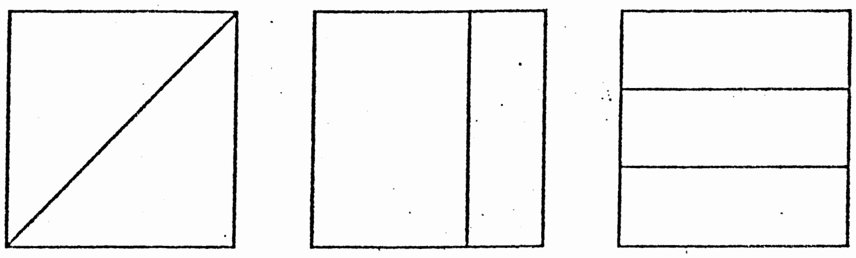


To be used

NAME ______________________________ TEST 5

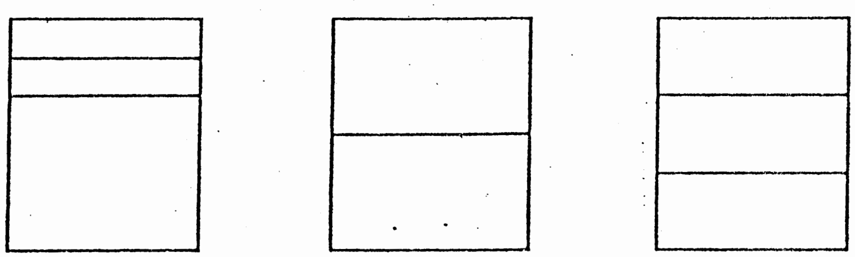
Mark the one divided into halves.

1.



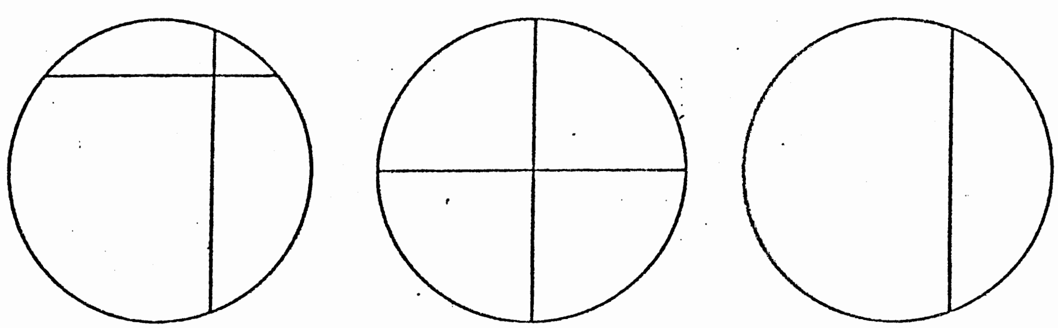
Mark the one divided into thirds.

2.



Mark the one divided into fourths.

3.



APPENDIX B

LISTING OF COMPUTER PROGRAMS

STACK Program

```
$BATCH
$ASSM
       SCFAT
$FORT
C THIS PROGRAM "STACK": SOURCE FILE "LAYOUT": KEEP FILE "KORRAL".
C FOR MAIN LOOP CONTROL: DEBUG NUMBER=1: THEN NUMBER=100.
C HEAD DATA: ID,READ,MATH,WRITE,PARTAKE,&BLOCK&DATA PT, 3 STOPS.
       IMPLICIT INTEGER*2 (I-N)
       INTEGER*2 IL(128),IN(130),DIR(128),HEAD(128)
       DIMENSION CORA(30,11,4),WORK(30,3),SUMS(30,3,4),HOLD(3),TEMP(1680)
       EQUIVALENCE (IN(3),IL(1)),(TEMP(1),CORA(1,1,1)),
      1 (TEMP(1321),SUMS(1,1,1))
       DATA LAYOUT,KORRAL,ICON,KREAD,KWRITE/1,2,5,92,60/
       REWIND LAYOUT
       REWIND KORRAL
       DO 10 I=1,1680
10     TEMP(I) = 0.
       WRITE(5,15)
15     FORMAT(' ENTER NSTART & NSTOP: 1, PRINT KORRAL; ELSE, 0.')
       CALL INPUT(ICON,A,B,C)
       NSTART = IFIX(A)
       NSTOP = IFIX(B)
       NPRINT = IFIX(C)
       IF(NSTART.EQ.1) CALL SYSIO(56,KORRAL,IST,ISTDEV,
      1 TEMP(1),TEMP(1680),4,0,0)
       CALL READER(DIR,0,LAYOUT,KREAD)
       DO 200 NREC=NSTART,NSTOP
       REWIND KORRAL
       CALL SYSIO(88,KORRAL,IST,ISTDEV,TEMP(1),TEMP(1680),4,0,0)
       IF(ISTDEV.EQ.0) GO TO 19
       CALL IOERR(ISTDEV)
       STOP 12
19     CALL READER(HEAD,DIR(NREC),LAYOUT,KREAD)
       DO 22 I=1,30
       WORK(I,1) = 0.
       WORK(I,2) = 0.
22     WORK(I,3) = 1.
C HOLD(1)=SYLLABLES IN STRING: HOLD(2)=TIME: HOLD(3)=GAP.
       HOLD(1) = 1.
       HOLD(2) = .2
       N1 = DIR(NREC) + 1
       N2 = DIR(NREC+1) - 1
       L = 3 - 2 * MOD(HEAD(1)/100, 2) + MOD(HEAD(1) + 1, 2)
C L=1 FOR BLACK, L=3 FOR WHITE. +0 FOR BOYS. +1 FOR GIRLS.
       KID = 0
       KR = 0
       DO 100 NGO=N1,N2
       CALL READER(IL,NGO,LAYOUT,KREAD)
       K1 = 3
C ENTER ACADEMICS. READ,MATH,WRITE IN WORK ARRAY.
       IF(NGO .GT. N1) GO TO 30
       K1 = 5
```

```
      DO 25 I=1,2
      LEAP = 11 * (I/2) + 7
      DO 25 J=2,4
      K = J +  LEAP
      WORK(K,1) = FLOAT(HEAD(J))
 25   WORK(K,2) = WORK(K,1)**2
 30   DO 90 J=K1,130,2
      IF(IABS(IN(J-1))+IABS(IN(J+1)).NE.IABS(IN(J-1)+IN(J+1)))GO TO 40
      IF(IN(J) .GE.  20) GO TO 60
      HOLD(1) = HOLD(1) + 1.
      HOLD(2) = HOLD(2) + FLOAT(IN(J)) / 50.0
      GO TO 80
 40   JUMP = 2
      GO TO 70
 60   JUMP = 0
 70   HOLD(3) = FLOAT(IN(J)) / 50.0
      LAND = KR + KID
      DO 75 N=1,5,2
      I = N + LAND + JUMP * (N/5)
      N4 = N/2 + 1
      DO 72 K=1,2
 72   WORK(I,K) = WORK(I,K) + HOLD(N4)**K
 75   WORK(I,3) = WORK(I,3) + 1.
      HOLD(1) = 1.
      HOLD(2) = .2
      KID = 0
      IF(IN(J+1) .LT.  0) KID = 1
 80   DO 85 K=6,8,2
 85   IF(NGO.EQ.HEAD(K).AND.J-2 .GT.HEAD(K+1)) KR= 11 * (K/4)
      IF(NGO .EQ.  HEAD(10) .AND.  J-2 .GE.  HEAD(11))GO TO 120
 90   CONTINUE
 100  IN(2) = IN(130)
 120  DO 125 I=1,30
      DO 125 J=1,3
 125  SUMS(I,J,L) = SUMS(I,J,L) + WORK(I,J)
      DO 135 I=1,30
      J2 = 11 - 3 * (I/23)
      KR = 11 * ( (I-1) / 11)
      DO 135 J=1,J2
      K = J + KR
 135  CORA(I,J,L) = CORA(I,J,L) + WORK(I,1) * WORK(K,1)
      DO 150 I=1,30
      WORK(I,1) = 0.
      WORK(I,2) = 0.
 150  WORK(I,3) = 1.
 158  REWIND KORRAL
      CALL SYSIO(56,KORRAL,IST,ISTDEV,TEMP(1),TEMP(1680),4,0,0)
      IF(ISTDEV.EQ.0) GO TO 159
      CALL IOERR(ISTDEV)
      STOP 13
 159  WRITE(6,160) NREC,HEAD(1)
 160. FORMAT(' SAMPLE NO:',I4,' & ID NO.',I4,' LAST ADDED KORRAL.')
```

```
      IF(NPRINT .EQ. 0) STOP
200   CONTINUE
      DO 220 K=1,4
      WRITE(6,204) K
204   FORMAT(/' CORA:',I3,'   1, BLACK; 3 WHITE, ODD BOYS.'/1X)
      DO 220 I=1,30
      J2 = 11 - 3 + (I/23)
      WRITE(6,210) I,(CORA(I,J,K),J=1,J2)
210   FORMAT(1X,I2,1X,11F11.0)
220   IF(MOD(I,11) .EQ. 0) WRITE(6,210)
      WRITE(6,206)
206   FORMAT(/' SUMS BY 3; BLACK BOYS, GIRLS; WHITE BOYS, GIRLS'/1X)
      DO 240 I=1,30
240   WRITE(6,244) I,((SUMS(I,J,K),J=1,3),K=1,4)
244   FORMAT(1X,I2,1X,4(F3.0,F11.0,F7.0,3X))
      STOP
$ASSM
   LIST
$FORT
      END
.U       EXT FUNC
IL       INT2 VAR
IN       INT2 VAR
DIR      INT2 VAR
HEAD     INT2 VAR
CORA     REAL VAR
WORK     REAL VAR
SUMS     REAL VAR
HOLD     REAL VAR
TEMP     REAL VAR
LAYOUT   INT2 VAR
KORRAL   INT2 VAR
ICON     INT2 VAR
KREAD    INT2 VAR
KWRITE   INT2 VAR
@R       EXT FUNC
10       LABEL
I        INT2 VAR
15       LABEL
@H       EXT FUNC
INPUT    EXT FUNC
A        REAL VAR
B        REAL VAR
C        REAL VAR
NSTART   INT2 VAR
IFIX     EXT FUNC
NSTOP    INT2 VAR
NPRINT   INT2 VAR
SYSIO    EXT FUNC
IST      INT2 VAR
ISTDEV   INT2 VAR
READER   EXT FUNC
```

PACKER Program

```
         1         2         3         4         5         6         7 7
1234567890                                                           0 2

      IMPLICIT INTEGER*2 (I - N)
      INTEGER*2 IN(260),IL(256),MAP(256),ND(3)
      DIMENSION R(5)
      DATA ICON,INTAKE, LAYOUT/5,1,2/,ND/9,0,0/
C THIS PROGRAM "PACKER": SOURCE FILE "INTAKE": OUTPUT FILE "LAYOUT".
C INTAKE HALFWORDS = 100 / SECOND * 900 = 90000. FOR EACH OF 3 SEGMENTS
C OF 300 SECONDS NEED 117 CYCLES * 256 = 29952 & 48 OF 118TH CYCLE.
      WRITE(5,1)
    1 FORMAT(' ENTER VALUES: ID, READ, MATH, WRITE, PARTAKE.')
C EXAMPLE 1ST CASE, SPENCER LUCAS: 231,36,69,18,44.
      CALL INPUT(ICON,R(1),R(2),R(3),R(4),R(5))
      DO 2 I=1,5
      IN(I) = 0
    2 MAP(I) = IFIX(R(I))
      NSTEP = 9
      DO 50 M=1,3
      KEEP = 5
      DO 40 NET=1,118
      IJUMP = 3 + 4 * (1/NET)
      READ(1) IL
      DO 3 I=5,260
    3 IN(I) = IL(I-4) / 64
C (1/64) * RAWSCORE SETS RANGE 0 - 256: TALK RANGE IS 11 - 250.
      I2 = 257 - 208 * (NET/118)
    4 I1 = IJUMP
      DO 30 I=I1,I2,2
      MO = I
      IF(IN(I+1) .G.T IN(I) ) MO = I + 1
      IF(IN(MO) .LE. IN(MO-2) ) GO TO 30
      IF(IN(MO) .LE. IN(MO+2) ) GO TO 30
      IF(IN(MO) .LT. 11 .OR. IN(MO) .GT. 250) GO TO 30
      IF(IABS(IN(I) - IN(I+1) ) .LT. 10) GO TO 30
      IT = MOD(MO+1, 2)
      DO 14 JUMP=4,8,2
      IJUMP = I + JUMP
      IF(IJUMP .GE. I2) GO TO 16
      IF(IN(IJUMP+IT) .GE. IN(I+IT) ) GO TO 4
   14 CONTINUE
C ENTER SYLLABLE FOR CHILD NEGATIVE, ADULT POSITIVE: CONVERT TO 0 - 100.
   16 A = FLOAT(IN(MO) ) / 2.5
      NN = A
      MAP(NSTEP+1) = NN * (-1)**(IT+1)
      MAP(NSTEP) = (I - KEEP) / 2
      KEEP = I
      NSTEP = NSTEP + 2
      ND(M) = ND(M) + 2
      IF(NSTEP .LT. 257) GO TO 4
      NSTEP = 2
      WRITE(2) MAP
   30 CONTINUE
      DO 40 I=1,4
   40 IN(I) = IN(I+256)
   50 CONTINUE
      NBACK = ND(1) + ND(2) + ND(3)
C BACK UP TO START OF THIS RECORD, TO RECORD DATA STOPS.
      READ(2) MAP
      DO 60 J=6,8
   60 MAP(J) = M(J-5)
      STOP
      END
```

JUGGLE Program

```
$BATCH
$ASSM
      SCRAT
$FORT
C THIS PROGRAM: "JUG" SOURCE FILE "KORRAL" DON ALLEN
C JUG FINDS REGRESSION, T, F, R IN ADULT-CHILD TALK & SCHOOL.
      IMPLICIT INTEGER*2 (I-N)
      DIMENSION CORA(30,11,4),COR(30,11),SUMS(30,3,4),SUM(30,3)
      DIMENSION OUT(16,4,3),TAG(8),DUM(30,11)
      DATA TAG/'BLAC','K   ','GIRL','S   ','WHIT','E   ','BOYS','
      DATA KORRAL/1/
      REWIND KORRAL
      READ(KORRAL) CORA,SUMS
      DO 100 KICK=1,4
      K1 = KICK - 3 * (KICK/4)
      K2 = 4 - (KICK/4) - 2 * (1/KICK)
      N2 = KICK * 2
      N1 = N2 - 1
C LOAD COR WITH SUM XY, GET SUM LITTLE XY.
      DO 5 I1=1,19
      I = I1 + 11 * (I1/12)
      J2 = 11 - 3 * (I1/12)
      DO 3 J=1,3
3     SUM(I,J) = SUMS(I,J,K1) + SUMS(I,J,K2)
      DO 5 J=1,J2
5     COR(I,J) = CORA(I,J,K1) + CORA(I,J,K2)
      TN = SUM(9,3)
      DO 7 I1=1,19
      I = I1 + 11 * (I1/12)
      J2 = 11 - 3 * (I1/12)
      DO 7 J=1,J2
      JJ = J + 22 * (I1/12)
7     COR(I,J) = COR(I,J) - (SUM(I,1) * SUM(JJ,1)) / TN
      DO 25 I=9,11
      NDECK = I - 8
      SLY2 = COR(I,I)
      DO 25 J1=1,8
      J = J1 + 14 * (J1/9)
      JKOL = J1 - 8 * (J1/9)
      OUT(J1,1,NDECK)=COR(J,I)/COR(J,JKOL)
      S2YDX=(COR(I,I)-(COR(J,I)**2)/COR(J,JKOL)) / (TN-2)
      IF(J1.GT.8) WRITE(6,20) (KM,KM=5,5),J1
      OUT(J1,2,NDECK)=OUT(J1,1,NDECK)/(S2YDX/COR(J,JKOL))**.5
      IF(J1.GT.8) WRITE(6,20) (KM,KM=6,6),J1
20    FORMAT(' IN DO 25 J1=1,16 DID LINE'I4,' CYCGT=',I4)
      OUT(J1,3,NDECK)=PRBF(1.,TN-2.,OUT(J1,2,NDECK)**2)
      IF(J1.GT.8) WRITE(6,20) (KM,KM=7,7),J1
      OUT(J1,4,NDECK)=COR(J,I)/(COR(J,JKOL)*COR(I,I))**.5
      IF(J1.GT.8) WRITE(6,20) (KM,KM=8,8),J1
25    CONTINUE
      WRITE(6,26) TAG(N1),TAG(N2)
26    FORMAT('1MOTHER AND KINDERGARTNER:',4X,2A4//1X)
```

```
      WRITE(6,65)
65    FORMAT(/1X/21X,'READ',32X,'MATH',32X,'WRITE'/1X)
66    FORMAT(11X,3('B',7X,'T',7X,'P',7X,'R',11X)/1X)
68    FORMAT(/' CHILD TALK: ODD WITH TEACHER; EVEN WITH MOTHER.'/1X)
      DO 80 I=1,8
      IF(MOD(I-1,8) .EQ. 0) WRITE(6,66)
80    WRITE(6,90) I,((OUT(I,J,K),J=1,4),K=1,3)
90    FORMAT(1X,I2,2X,3(2F8.2,F8.3,F8.2,4X))
      DO 75 I=23,30
      M = I - 22
      DO 75 J=1,8
      N = J + 22
75    DUM(I,J,)=COR(I,J)/(COR(I,M)*COR(N,J))**.5
      WRITE(6,68)
      WRITE(6,69)
69    FORMAT('   CORRELATIONS.'/1X)
      DO 76 I=23,30
76    WRITE(6,78) I,(DUM(I,J),J=1,8)
78    FORMAT(6X,I2,8F8.3)
100   CONTINUE
      STOP
      END
.U        EXT FUNC
CORA      REAL VAR
COR       REAL VAR
SUMS      REAL VAR
SUM       REAL VAR
OUT       REAL VAR
TAG       REAL VAR
DUM       REAL VAR
KORRAL    INT2 VAR
@R        EXT FUNC
@W        EXT FUNC
100       LABEL
KICK      INT2 VAR
K1        INT2 VAR
K2        INT2 VAR
N2        INT2 VAR
N1        INT2 VAR
5         LABEL
I1        INT2 VAR
I         INT2 VAR
J2        INT2 VAR
3         LABEL
J         INT2 VAR
TN        REAL VAR
7         LABEL
JJ        INT2 VAR
25        LABEL
NDECK     INT2 VAR
SLY2      REAL VAR
J1        INT2 VAR
```

VITA 2

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Candidate for the Degree of

Master of Science

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