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Formal Characteristics of Speech which Mothers Address to their Young Children

by

Juliet R. Phillips

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Baltimore, Maryland

1970

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Abstract

This study examined certain aspects of the speech mothers addressed to their children who were in an early stage of language learning. The first of two sets of subjects consisted of 30 mother-child pairs. The mothers were wives of either house staff or fellows of the Johns Hopkins Hospital and were native speakers of American English. The children were first-born boys; 10 children were 8 months old, 10 were 18 months old, and 10 were 28 months old. Speech data were obtained from each mother under two conditions. Condition A: the experimenter engaged the mother in conversation for 15 minutes. Speech recorded during Condition A is called "A-speech". Condition B: the mother and child engaged in free play for 15 minutes. Speech recorded during Condition B is called "B-speech". Ten measures were used to compare B-speech with A-speech and to compare B-speech addressed to children of one age with B-speech addressed to children of other ages. The measures included six syntactic measures (length of utterance, number of verbs per utterance, number of modifiers per utterance, proportion of function words, proportion of content words, and number of verb forms) and four vocabulary measures (type-token ratio, concreteness

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of nouns, proportion of weak verbs, proportion of Old English verbs). A-speech had longer utterances, more verbs per utterance, more modifiers per utterance, a greater proportion of function words, a smaller proportion of content words, and more verb forms than B-speech. Speech addressed to 28-month boys was related to speech addressed to 18-month boys as A-speech was to B-speech.

The second set of subjects examined consisted of six mother-child pairs. The mothers were wives of staff members of the Johns Hopkins and Baltimore City Hospitals. The children were first- and second-born boys between 27 and 33 months of age. Speech data were obtained from each mother under two conditions. In Condition A the mother read a story to the experimenter; in Condition B the mother read the story to the child. Five sentences from this story were analyzed by sound spectrograph. Twelve measures were used to compare prosodic features of these sentences as read under Conditions A and B. The measures were mean fundamental frequency (ff), variance of ff, range of ff, maximum ff, minimum ff, number of inflections, extent of inflections, duration of inflections, rate of change of ff during inflections, time taken to utter the sentence, amount of time in

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which voicing occurs, and amount of time in which no voicing occurs. A-speech sentences had lower mean ff, smaller variance of ff, smaller range of ff, and lower maximum ff than the B-speech sentences. The B-speech sentences had more inflections, more extensive inflections, and more rapidly changing ff during inflections than the A-speech sentences. The B-speech sentences were also longer in total utterance time, in amount of voiced time, and in amount of unvoiced time.

From this study we can conclude that there are differences in syntax, vocabulary and intonation between speech addressed to adults and speech addressed to children. Furthermore, these differences change with the age of the person addressed. The language addressed to children during the period in which they develop basic language skills is specialized and not representative of the language spoken by adults among themselves.

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Introduction

The study of the development of grammar has been dominated for the last twelve years by the influence of the linguistic theories of Noam Chomsky. A major effect of this influence has been the channeling of research interest into the area of language production. Most studies have been concerned with the documentation and analysis of the syntax of children's speech from the appearance of two-word utterances (Brown and Fraser, 1963) to the speech of children in the early school years (Menyuk, 1964).

The development of language production depends upon the presence of a linguistic environment (Brown, 1958) but up to now few attempts have been made to describe the linguistic environment of the young child or to analyse the role of the environment in language development. The contribution of such a description and analysis to the understanding of the course of language development is potentially great; it may even be claimed that a useful theory of language development cannot be constructed without some knowledge of this crucial factor.

There are few studies which approach the question of the composition of the language environment of

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the child. Lenneberg et al. (1965) compared the verbal environments of children born to deaf parents with the environments of children born to normal parents. This study was carried out from birth through the third month and therefore bears only indirectly on the problem of the development of syntax. Drach (1969) reported a pilot study done with one subject which compared the speech addressed to the subject's 26-month child in a play session with the speech addressed by the subject to two other women. The parameters studied were utterance length, rate of speech, lexical variability and syntactic structure. The results suggested that the two types of speech are markedly different on these dimensions. Friedlander (1970) reported the first results of a project to record the language environment of infants in the home on a time-sampling basis. The aim of this recording project is to determine the percentage of speech addressed to different people in the environment and to the infant himself, the percentage of speech from different sources, and a tabulation of speech addressed to the infant in terms of types of modeling, such as expansion, correction, and word play.

The present study is similar in structure and aim to the pilot study reported by Drach, though

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independently conceived. Its purpose is to provide an exploratory, descriptive study of the linguistic environment of children during a crucial period of language learning. At first the study was intended to describe syntactic features only, but vocabulary and prosodic features were later included. It is hoped that this study will provide a basis for a future analysis of the causal relationships between different types of language environment and quantitative or qualitative differences in rate of language development.

This study examines the hypothesis that adults do not speak to children as they speak to other adults. A second hypothesis is that the speech addressed to a child becomes more adult-like as the child increases in linguistic competence. These two hypotheses reflect a new orientation toward language development. The model provided by McNeill (1968) presents the view that the child must cope with the entire adult corpus, an overwhelming task which cannot be mastered, according to this account, without the help of innate information about the universal properties of language construction. This view implies either that the child uses all the speech in his environment as a model or that there is no speech of limited

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complexity in the environment which the child could use as a model in the early stages of language learning. The orientation of the present study emphasizes the active role of the parent and suggests that the speech addressed to the child is of greater importance than other speech in the child's environment. The child does not have to cope with the full adult corpus if the speech addressed to him is simplified to a degree appropriate to his stage of development and if his attention is primarily directed toward that speech. The present study was undertaken to provide evidence in support of this new orientation.

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Method

Subjects

The thirty Ss were wives of interns, residents, and fellows of the Johns Hopkins Hospital. All Ss were American-born and native speakers of English. Each subject was the mother of a boy, her first child, who accompanied her to the taping session. The children were of three approximate ages: 8 months, 18 months, and 28 months (see Table 1).

The purpose of selecting wives of hospital staff was to insure uniform social background. All mothers had some education beyond high school and a majority had at least a bachelor's degree. Their ages ranged from 23 to 32, with the mode of 26. The families were living under comparable conditions, with similar economic circumstances and expectations. Only English was spoken in the household.

The ages of the children were selected to insure that a range of stages of language development would be represented. At 8 months the children were babbling and some were beginning to say "ba ba" or "da da". The mothers reported no meaningful words. At 18 months the children had several words and some were beginning to combine them into strings. At 28 months

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Table 1

Age of Children in Months and Days

Age groups	Mean age	Range of ages
28-month group	28/2	27/17 - 28/25
18-month group	17/28	17/12 - 18/13
8-month group	8/4	7/21 - 9/6

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they were talking in strings of more or less intelligible English. Thus the children provided three different stimulus situations for eliciting the mothers' speech.

Procedure

The methods used in this study were developed in a pilot study involving four mother-child pairs. The pilot mothers were similar to those described above. The children differed with respect to birth order and sex. Their ages were 12-14 months. Additional material was gathered when these children were 18 months old, providing a longitudinal check on the results of the present study. The pilot study will be discussed further in the results section.

All mothers were informed that they were participating in a language development study. They were not told that their own speech was under scrutiny. All mothers assumed that the child's speech was being studied. They were interested in their children's language development and were eager to discuss it and to participate in the study. If they asked questions about the purpose of the study, they were told that it was concerned mainly with intonation.

The session was recorded on a Roberts 770X

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tape recorder at 3 3/4 inches per second. It took place inside an Industrial Acoustics Company single-walled sound-proof booth. The mother and the child were introduced into the booth, which contained toys, two chairs and a small table. The mother was instructed to play with the child as she would at home. She was also informed that after 15 minutes the experimenter would return to the booth and engage her in conversation and the child would be allowed to play without her participation for another 15 minutes. This procedure was accepted without question by the mothers, who followed the instructions with little difficulty in most cases.

After 15 minutes the experimenter entered the booth and engaged the mother in conversation on topics of common interest to these women. The object was to approximate the conversations a mother would have with other adults, especially other women, who would be her daily companions other than the child. The experimenter in this study is appropriate to this role.

The first half of the session, in which the mother addressed the child alone, will be designated Condition B, and the speech thus produced will be called B-speech. Similarly, the second half of the session will be

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called Condition A, and the speech addressed to the experimenter will be called A-speech.

Transcription

The taped material was transcribed from the beginning of each Condition until 75 utterances (defined below) or 300 words were obtained, which ever took longer. Any additional material on the tape was not used, except when a duplicate session had been recorded for purposes of replication. The basic units of measurement in the study are words and utterances; one of the major tasks of the transcription was to establish boundaries between these units.

A word was defined as the standard orthographic unit, with the dictionary for reference. Exceptions included the division of hyphenated words into separate words and the division of elisions into two words.

Example: It is a jack in the box.

Example: That 's very good.

When colloquial usage made two words into one, the standard English usage was substituted.

Example: "I'm gonna do it." was written

"I 'm going to do it."

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An utterance was defined as the conversational equivalent of a sentence. Utterance boundaries are usually marked by a final intonation contour. A pause usually occurs after an utterance. Often the utterance ending has grammatical cues as well as logical, expressive ones, although an utterance need not have the grammatical structure of a complete sentence. The utterance boundaries of B speech were easily determined since the utterances were generally separated by long pauses and were characterized by exaggerated final intonation contours. However, A-speech was often characterized by long rambling sequences that had few pauses and no clear final intonation contours, so it was often quite difficult to determine boundaries.

An effort was made to check the reliability of several aspects of the transcription. A second experimenter undertook to transcribe one complete session, including word boundaries, utterance boundaries, deletions and word codings. Comparisons were made of this transcription with the transcription made by the first experimenter. In the case of word agreement, there was 91% agreement in A-speech. These figures include boundary decisions as well as intelligibility. Thus word transcription was highly reliable.

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Siegel (1962) found a high degree of reliability when judges were asked to determine utterance boundaries in conversation speech. In the transcription replication described above, the determination of utterance boundaries was the least satisfactory of the procedures checked, with a 90% agreement in B-speech and an 80% agreement in A-speech. Examination of the transcriptions showed that there were systematic differences between experimenters in the treatment of utterance boundaries, mainly when "and" occurred between clauses. It seemed likely that further training on the part of the second experimenter would have increased the degree of reliability, and it also seemed likely that there was a fairly high degree of consistency among the transcriptions made by the first experimenter. This conjecture is supported by the reliability of measures based on number of utterances (see Appendix 6).

All vocal material on the tape was transcribed unless it was not addressed to the person relevant to the Condition. For instance, if the mother addressed the child during Condition A, that speech was not transcribed. In addition, reading, reciting, and singing were not transcribed.

Not all transcribed material was included in

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the final analysis. After a complete transcription was obtained, certain types of material were set off from the rest. If the speaker was interrupted and started the utterance again, the repeated portion was deleted.

Example: [I thought it was... Put that down Michael.] I thought it was very funny.

The bracketed section would be deleted. If the speaker decided to correct part of what she said, the corrected section was deleted.

Example: He went [on Monday] on Tuesday of last week.

Also deleted were unfinished utterances.

Example: [We went away for...] Did I tell you this before? Well, it happened last January.

Another deletion was the filled pause, usually some form of "uh" but also "and" or "but", which were used regularly by some speakers to fill a silence at the end of utterances or between utterances. Onomatopoeia and imitations of babbling were deleted, except for made-up words which were a regular part of the mother's

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communication with the child. Finally, any utterance which could not clearly be understood was deleted. The frequencies of occurrence of these deletions are reported in Appendix 1.

Coding

After a complete transcription was obtained and all deletions were marked, each word of the remaining material was coded into one of ten categories. This procedure included a large number of arbitrary decisions, because speech can not be analyzed simply into grammatical categories at the level of words, a phenomenon thoroughly discussed in the literature. It was decided nevertheless that for the purposes of this study a word-by-word analysis would be the most economical procedure; therefore the coding system was devised which is described in Appendix 2. A list of the grammatical categories used is given below.

1. nouns
2. adjectives
3. articles
4. verbs
5. auxiliaries
6. adverbs

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7. prepositions
8. conjunctions
9. pronouns
10. exclamatory words

The word categories were designed to provide the raw material for many of the measures described below. They failed to provide this material in the following respect. One of the measures consists of all the words, phrases and clauses which perform a modificatory function in the utterance. Categories 2, 6, and 7 contribute to this measure. In addition certain words in Category 8 contribute, since some, but not all, conjunctions mark subordinate clauses. Also, some clauses are not marked by conjunctions at all.

Example: The dog he saw was black.

Therefore it was necessary to add another system to pick up these uncounted modifiers (see Appendix 2).

When each word in the transcription had been assigned a code number, the frequencies for the categories were tabulated and then combined into those final measures which are based on these grammatical distinctions.

Although the coding system was somewhat arbitrary, it proved capable of highly reliable application. The replication mentioned above in connection with

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the word and utterance boundaries showed 98% agreement of codings in B-speech and 97% agreement in A-speech.

Measures

The measures applied to the speech samples described above fall into two categories: measures of syntax and measures of vocabulary. A third category, measures of prosodic features, will be discussed separately because these measures are based on a different set of Ss and on different methods than the syntax and vocabulary measures.

Measures of syntax.

1. Number of words per utterance. The first and most general measure of syntax is the length of the utterance. It has been found (Wang, 1969) that length of sentence is highly correlated with currently available indices of syntactic complexity. The longer the sentence, the more complex its syntax is likely to be. Therefore length of utterance is our main index of the syntactic complexity of mothers' speech.

The use of this measure is not without precedent. Nice (1925) was the first to use mean length of response (utterance) as a measure of language development. Since then McCarthy (1930) and Templin (1957)

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used it for the same purpose. Recently it has been used as an index of complexity of adult speech (Siegel, 1963; Spradlin and Rosenberg, 1964). The units in which length is counted vary. McCarthy used the word; Cazden (1968) used the morpheme. The present study uses the word because it is easy to define and because it provides a convenient base for several other measures described below. Darley and Moll (1960) established the reliability of the measure in a sample size of 50 responses. To obtain greater centainty the present study used a sample size of 75 utterances.

It was hypothesized that A-speech has longer utterances than B-speech. If this is so, can anything be said about the composition of this increase in length? The next five measures are directed toward answering this question.

2. Number of verbs per utterance. The syntactic core of a sentence is the verb. Each verb allows additional syntactic growth. We might account in part for the greater length of utterances in A-speech by determining that there are more verbs per utterance in A-speech than in B-speech. It was hypothesized that there are more verbs per utterance in A-speech than in B-speech.

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It should be noted that, while a sentence must have a verb, an utterance need not. Especially in B-speech, utterances may consist of single nouns, exclamations and other non-sentences. However, since utterances without verbs are even more limited in structure than utterances with a single verb, we can still assume that the mean number of verbs per utterance reflects one aspect of syntactic complexity.

3. Number of modifying words, phrases and clauses per utterance. One way in which the length of an utterance can be increased is by the addition of modifiers: adjectives, adverbs, and adjectival and adverbial prepositional phrases and subordinate clauses. We might account in part for the longer utterances of A-speech by showing that there are more of these modifiers in A-speech utterances than in B-speech utterances. An hypothesis was stated to that effect.

4. Proportion of function words. Syntactic complexity of the sort we have discussed above is accompanied by an increase of function words. A simple subject-verb-object sentence is held together by order alone; a sentence with many phrases and clauses requires prepositions and conjunctions to mark the relationships which hold between the parts of the sentence. Function words are those whose

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main purpose is to signal syntactic relationships; these include the article, the auxiliary verb, the preposition, and the conjunction. It was hypothesized that function words constitute a greater proportion of words in A-speech than in B-speech. The data to test this hypothesis were provided by the first 300 words in each transcription.

5. Proportion of content words. Conversely, it was hypothesized that the proportion of content words, here defined as nouns and verbs, is smaller in A-speech than in B-speech.

It should be noted that not all categories of words are subsumed under the two headings, function words and content words. Adjectives, adverbs, pronouns, and exclamatory words are left out. This decision was made upon the evidence of the pilot study, which showed that the incidence of these words is governed by considerations other than the function/content distinction. For instance, adjectives follow the pattern of modifiers in increasing from B-speech to A-speech, although they are considered elsewhere (Brown, cites in Cazden, 1968) to be content words, which should decrease from B-speech to A-speech.

6. Number of verb forms. A minor aspect of syntactic complexity is the form of the verb. The

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form includes tense, mood, and any other factor besides number and person which makes a difference in the shape of the auxiliaries and of the verb. The first 40 verbs in each transcription were classified by form (for details see Appendix 3) to test the hypothesis that A-speech uses more verb forms than B-speech.

Measures of vocabulary.

7. Type-token ratio. An important observation about the individual words used in B-speech by the pilot mothers was that they were often repeated. One measure of degree of repetition is the type-token ratio, an index of the richness of vocabulary. The type-token ratio is obtained by dividing the number of words in a sample which are spelled differently from one another by the total number of words in the sample. Siegel and Harkins (1963) and Spradlin and Rosenberg (1964) found the type-token ratio a useful index in discriminating between speech addressed to highly retarded children and speech addressed to mildly retarded children.

Since the words were already coded into grammatical categories, these codings were included in the type-token count. For instance, the word "like" would not be counted the same in the two

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contexts "I like you" and "That's more like it", because they would have different code numbers in front of them. Thus at least some part of the semantic content of the word was taken into account in this ratio, unlike type-token ratios which have been calculated in the past. The ratio was based on the first 300 words in each sample. It was hypothesized that the type-token ratio is greater in B-speech than in A-speech.

8. Concreteness of nouns. The pilot study suggested that there is a difference between A-speech and B-speech in the choice of words, especially of nouns and verbs. This difference is great enough that the type of speech heard is often recognizable by this feature alone. Nonetheless, it is very difficult to describe the difference or point to a single differentiating feature. Several efforts were made to devise a measure which would reflect this subjective difference. The most successful of these was the concreteness measure. It was used on the material from the 28-month group only. The two other age groups were not examined on this variable because of the effort involved in arriving at the concreteness ratings. Ratings were determined for the first 30 nouns in each transcription in a manner

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modeled on Paivio, Yuille and Madigan (1968). Details of this procedure are found in Appendix 4.

A preliminary study indicated that, in some cases, very different ratings can be obtained when a context is provided for the rated word. This is true mainly when the context influences the denotation of the word markedly, for example in the sentence "He was a riot". Therefore each noun was presented for rating in a context actually or functionally identical to the context in which it occurred in the transcription.

Thirty students in an introductory psychology class[1] rated each noun on a seven-point scale, abstract to concrete. The final rating assigned to each noun was the mean of all the ratings received. The mean was calculated to two decimal places. It was hypothesized that nouns in B-speech would be rated as more concrete than nouns in A-speech.

9. Proportion of Old English verbs. Webster's

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[1]Thanks are owing to Dr. Paul Sherman for the administration of this material to his students of Introductory psychology at the University of Maryland, Baltimore County.

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Third International Dictionary was used as a source to divide the first 40 verbs of each sample into three groups: words going back to Old English and Old Norse, words coming into the language during Middle English, and words of more recent foreign origin. It was thought that the more everyday words would be the ones which had been longest in the language. New words would have been borrowed for relatively sophisticated uses while everyday words would have been retained for everyday purposes. It was hypothesized that B-speech has more verbs with roots in Old English than A-speech.

10. Proportion of weak verbs. A count was made of the same 40 verbs to test the hypothesis that the number of weak verbs increases from B- to A-speech. Weak verbs are those verbs which are declined on the paradigm "I look, I looked, I have looked".

Prosodic measures.[2]

A feature of B-speech which is evident to almost any listener is its intonation pattern.

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The mother's voice has a high-pitched, exaggerated, sing-song quality when she talks to her child. It is not easy to specify precisely the acoustical source of this perceptual quality. Its features vary over time and from mother to mother. Sometimes it seems to be mainly a difference in mean fundamental frequency. At other times it may consist of breathiness or a nasal quality in the voice. At still other times it appears to be related to peculiarities of articulation.

The present study focusses on fundamental frequency (ff) as an indicator of differences in prosodic features between B-speech and A-speech. Ff was chosen for three reasons. First, ff correlates with perceived pitch (Denes, 1959). Overall pitch is one of the features most often perceived as distinguishing between A-speech and B-speech.

Second, ff can be measured with adequate accuracy though not without considerable labor through the use

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[2]This part of the research for this dissertation was carried out in collaboration with Dr. Malcolm S. Preston and members of his staff at the John F. Kennedy Institute for the Habilitation of Physically and Mentally Handicapped Children, Baltimore Md.

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of a sound spectrograph[3], which was available for this project. In addition to ff, other accustical characteristics of speech, such as the duration of voicing breaks and the rate of speech production, can be measured from spectrograms. Some of these measures were included in the study.

Third, studies of intonation differences between dialects have focussed on ff (Hanley, 1951). These studies indicate several measures based on ff which are capable of distinguishing between dialects; it was thought that these measures could be usefully applied to the present material.

The measures were made first on a set of sentences spoken by the experimenter, who mimicked both B-speech and A-speech. The material thus obtained was carefully scanned for prosodic differences by comparing narrow-band spectrograms of structurally identical sentences uttered in the two modes. Each measure suggested in the literature or by the material itself was tested on the entire set of sentences; if it showed consistent differences between the A-speech imitation and the B-speech imitation, it was retained. Once a battery of measures was established, it was tested

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[3]Kay Sonograph, #7029A.

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further on one pilot subject with the procedure described below.

A given string of words is very rarely produced in both the A-condition and the B-condition. The intonation pattern of an utterance is closely bound up with its syntactic structure, so that utterances with different structures are not really comparable prosodically. Accordingly, a study was undertaken which provided control of sentence structure. The subjects were six wives of staff members of the Johns Hopkins and Baltimore City Hospitals, mothers of first- and second-born boys between 27 and 33 months of age. The physical situation was the same as in the main study, except that a Bruel and Kjaer condenser microphone, model #4131, was used to insure maximum fidelity of recording and readable spectrograms. The mother was asked to play with the child and to incorporate into her play the reading of a child's book which was provided. The book consists of 34 sentences and is composed appropriately for children of that age. The mothers were asked to read the story through twice. The children were accustomed to listening to stories read by their mothers; mother and child adapted easily to the situation. When the mother had finished reading,

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the experimenter entered the booth and asked the mother to read the book to her twice through as if it were a piece of adult literature. This request was met with considerable skepticism, but all mothers tried to comply. They were only moderately successful. The material is written in such a manner that it is practically impossible to treat it like adult literature, and after reading it twice to the child, the mother tended to fall into a pattern of reading which she found difficult to break.

On the basis of the data from the pilot subject, five sentences which showed a clear contrast between A-speech and B-speech were chosen for analysis. These sentences were not meant to be representative of all sentences, and the evidence they provide is only a small part of the total picture of intonation differences between A-speech and B-speech.

After the tapes were obtained, all four readings of each sentence were edited out and narrow-band spectrograms were made. Each spectrogram was marked every 42 milliseconds over the length of the utterance, and a measurement of ff was made at each sample point. In this manner a set of data was obtained which provided the raw material for the measures described below (see Appendix 5 for details).

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The first five measures are based on all observations of ff within a sentence.

11. Mean ff. The sample data were averaged over each utterance to obtain an estimate of the overall level of ff in the utterance. This measure was meant as an index of perceived overall pitch level. It was hypothesized that A-speech has a lower mean ff than B-speech.

12. Variance of ff. The variance of the sample data was calculated for each utterance. It was hypothesized that the variance of B-speech is greater than the variance of A-speech.

13. Range of ff. It was hypothesized that the range of ff in B-speech excedes the range of ff in A-speech.

14. Maximum ff. It was hypothesized that B-speech sentences have higher maximum ff than A-speech sentences.

15. Minimum ff. It was hypothesized that B-speech sentences have higher minimum ff than A-speech sentences, although pilot data indicated that the ff at the end of a declarative sentence with a falling final intonation pattern is constant for a given mother, regardless of addressee.

The next four measures are based on ff within

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inflections.

16. Number of inflections. An inflection was defined as the stretch of speech between a high point in ff and the next low point in ff, or conversely between a low point and the following high point. During an inflection the ff is changing. The number of inflections reflects the sing-song quality of the voice. It was hypothesized that B-speech has more inflections than A-speech.

17. Extent of ff change during inflections. The mean extent of change in ff during inflections is similar to the range, but it is calculated for sample points within inflections and then averaged over all the inflections in a given utterance. It was hypothesized that the average B-inflection is greater in extent than the average A-inflection.

18. Duration of inflections. It was hypothesized that B-speech inflections have a greater time span than A-speech inflections.

19. Mean rate of change of ff during inflections. By dividing the extent of an inflection by the duration of that inflection, one obtains the rate at which the ff changes during the inflection. The mean value of this measure for all inflections within a given utterance was thought to be an index of the perceptual

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quality of intonation. It was hypothesized that the mean rate of change is greater in B-speech than in A-speech.

The next three measures are not based on ff.

20. Length of time taken to utter sentence. B-speech often appears to be more deliberate and drawn out than A-speech. Given that no hesitations or expressive pauses occur in the utterance, the total length of the utterance is an index of overall articulation rate. It was hypothesized than B-speech utterances are longer than A-speech utterances.

21. Amount of time when no voicing occurs. When the spectrograms were sampled, some sample points fell into spaces where no voicing occur and where therefore the ff could not be measured. These blanks were not included in the calculation of the mean and variance of the fundamental frequency. They are interesting in themselves, however, because they represent unvoiced fricatives and sibilants and the pause before voicing in stops. The length of these consonant pauses is related to the subjective impression of care and clarity in articulation. It was hypothesized that B-speech has a greater amount of non-phonated time than A-speech.

22. Amount of time when voicing occurs. If the

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time when no voicing occurs is greater in B-speech than in A-speech, does this increase account entirely for the increase in sentence length, or is there also an increase in phonated time? It was hypothesized that B-speech has longer voiced time than does A-speech.

Twenty-two measures have been described in the preceding section. Each measure is accompanied by a statement of the difference expected between A-speech and B-speech. As indicated in the introduction, each prediction of a difference between A-speech and B-speech applied to differences between the speech samples addressed to children of different ages. If it is predicted that B<A, then it is predicted that 8>18>28. Similarly, if it is predicted that B<A, then it is predicted that 8<18<28. Below is a list of the measures and their accompanying predictions.

Measures of syntax.

1.	Number of words per utterance.	B<A; 8<18<28.
2.	Number of verbs per utterance.	B<A; 8<18<28.
3.	Number of modifiers per utterance.	B<A; 8<18<28.
4.	Proportion of function words.	B<A; 8<18<28.
5.	Proportion of content words.	B>A; 8>18>28.

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6.	Number of verb forms.	B<A; 8<18<28.
Measures of vocabulary.		
7.	Type-token ration.	B<A; 8<18<28.
8.	Concreteness of nouns.	B>A.
9.	Proportion of Old English verbs.	B>A; 8>18>28.
10.	Proportion of weak verbs.	B<A; 8<18<28.
Measures of prosodic features.		
11.	Mean fundamental frequency.	B>A
12.	Variance of ff.	B>A
13.	Range of ff.	B>A
14.	Maximum ff.	B>A
15.	Minimum ff.	B>A
16.	Number of inflections.	B>A
17.	Mean extent of change in ff during inflections.	B>A
18.	Mean duration of inflections.	B>A
19.	Mean rate of change of ff during inflections.	B>A
20.	Length of time taken to utter sentences.	B>A
21.	Amount of time when no voicing occurs.	B>A
22.	Amount of time when voicing occurs.	B>A

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Reliability

It would have been inconvenient for mothers to come back twice for tapings; data obtained this way would be subject to familiarity effects in any case. An odd-even reliability test was ruled out because of the sequential dependencies in the material. It was finally decided that the best method was to gather twice as much material during a single session as would be needed ordinarily and to process it as two separate sessions. This was possible because some children were willing to stay more than the half hour usually required and because a half hour is usually more than sufficient time to gather 75 utterances or 300 words in each condition. Double sessions were run on three subjects, one in each age group. Comparisons of the results of the double sessions showed that the reliability of most of the measures was satisfactory (see Appendix 6).

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Results and Discussion

Syntax and vocabulary measures

The difference between A-speech and B-speech was tested with the Wilcoxon signed-ranks test. The Mann-Whitney U-test was to examine the differences among the age groups; four separate comparisons were made: 8-month vs. 18-month B-speech, 18-month vs. 28-month B-speech, 8-month vs. 18-month A-speech, and 18-month vs. 28-month A-speech. The last two comparisons were not required by the hypothesis being tested; they were examined to make sure that differences found in B-speech were not due to differences among subject groups. The hypothesis of difference among ages was tested by two applications of the same test; in order to test this hypothesis at the .05 level of significance, we must test each comparison at the .025 level. The results of these tests are given in Tables 2 and 3.

Table 2 shows that the expected differences between B-speech and A-speech were found in each measure. Table 3 shows that the expected difference between 8-month B-speech and 18-month B-speech was not found; the expected difference between 18-month B-speech and 28-month B-speech was found in five

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Table 2

Statistical Significance of Comparisons of B-speech and A-speech, Determined by the Wilcoxon Signed-Ranks Test

Measure	Significance level (one-way)
Number of words per utterance	$p<.001$
Number of verbs per utterance	$p<.001$
Number of modifiers per utterance	$p<.001$
Proportion of function words	$p<.001$
Proportion of content words	$p<.001$
Number of verb forms	$p<.001$
Type-token ratio	$p<.001$
Concreteness[a]	$p<.003$
Proportion of weak verbs	$p<.009$
Proportion of Old English verbs	$p<.001$

[a] $N=10$

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Table 3

Statistical Significance of Age Differences

Determined by the Mann-Whitney U-Test

Measure	Age groups compared	Addressee: child	Addressee: Adult
Number of words per utterance	8-18	---	---
	18-28	$p<.025$	---
Number of verbs per utterance	8-18	---	---
	18-28	$p<.025$	---
Number of modifiers per utterance	8-18	---	---
	18-28	$p<.01$	---
Proportion of function words	8-18	---	---
	18-28	---	---
Proportion of content words	8-18	---	---
	18-28	---	---
Number of verb forms	8-18	---	---
	18-28	$p<.01$	---
Type-token ratio	8-18	---	---
	18-28	$p<.01$	---
Proportion of weak verbs	8-18	---	---
	18-28	---	---
Proportion of Old English verbs	8-18	---	---
	18-28	---	---

Note.--A significance level greater than .025 is denoted by '---'.

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of the nine measures which were carried out on all age groups, namely number of words per utterance, number of verbs per utterance, number of modifiers per utterance, type-token ratio, and number of verb forms. We can conclude therefore that there is a change in these five measures over age of child, beginning at 18 months, such that the mother speaks in a more adult fashion as the child grows older.

It is interesting to note the extent of the differences between B-speech and A-speech. Table 4 shows the means of the measures for each age-condition. Utterances addressed to 28-month children were on the average 1/2 word longer than utterances addressed to 18-month children; utterances addressed to the adult were on the average more than four words longer, or twice as long, as utterances addressed to 28-month children. The length-of-utterance effect was thus substantial as well as significant.

There were .61 more verbs in A-speech than in 28-month B-speech. This might mean that A-speech had two verbs in every other utterance, while 28-month B-speech had at most one verb per utterance. There were about 10 fewer verbless utterances per 100 utterances in 18-month B-speech than in 28-month B-speech. There were about 2 1/2 modifiers per

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Table 4

Means of All Measures by Age and Addressee

Measure	Age	Addressee	
		Child	Adult
Number of words per utterance	28	4.01	8.47
	18	3.47	8.37
	8	3.56	8.45
Number of verbs per utterance	28	.92	1.53
	18	.80	1.57
	8	.82	1.50
Number of modifiers per utterance	28	.83	2.60
	18	.60	2.56
	8	.73	2.65
Proportion of function words	28	.19	.26
	18	.18	.25
	8	.19	.28
Proportion of content words	28	.36	.32
	18	.37	.32
	8	.35	.31
Number of verb forms in 40 verbs	28	8.5	9.5
	18	6.9	9.3
	8	7.2	9.8
Type-token ratio	28	.41	.52
	18	.34	.52
	8	.31	.51
Concreteness ratings	28	6.00	5.27
Number of weak verbs in 40 verbs	28	11.7	12.9
	18	9.4	13.5
	8	11.3	14.7
Number of Old English verbs in 40 verbs	28	38.1	35.7
	18	37.6	35.2
	8	38.3	36.2

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utterance in A-speech, compared with .83 modifiers in 28-month B-speech and .60 modifiers in 18-month B-speech. The proportion of function words, nearly constant at about 19% in B-speech, rose to about 26% in A-speech. Conversely, the proportion of content words dropped from about 36% in B-speech to about 32% in A-speech.

To summarize, the change in length of utterance was substantial and was made up in part by changes in number of verbs and number of modifiers per utterance; it was accompanied by a change in proportion of function words and content words. We can affirm that utterances addressed to children become more complex syntactically as the children grow older.

The type-token ratio was nearly constant at about .52 in A-speech. This means that in every 100 words spoken, 48 were repetitions. This measure is the only one in which 8-month B-speech was substantially, though not significantly, different from 18-month B-speech in the expected direction. Apparently the mothers repeated themselves a great deal to the 8-month babies even when their speech was adult-like in syntax and vocabulary. The type-token ratio declined from .41 in 28-month B-speech to .34 in 18-month B-speech. At the youngest age, then, 69 words out of 100 were

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repetitions.

The overall difference in concreteness between B-speech and A-speech nouns is due to the fact that A-speech contained some very abstract nouns as well as many concrete ones, whereas B-speech contained almost exclusively nouns rated as highly concrete. All the measures of vocabulary followed this pattern; the bulk of words used in A-speech and B-speech occupied a small range on any given continum; the difference in vocabulary lay in the exceptions which were found mainly in A-speech and which lay far out along the continum. For this reason, differences in vocabulary were difficult to detect if the scale used to measure them had only two or three values. The few exceptions could not be given enough weight to counter the bulk of sameness and the random variations in the majority of cases. The concreteness measure offered a scale with a wide range of values and was therefore the most effective measure in this study for detecting vocabulary differences.

The analysis of the verb forms illustrates the problems of vocabulary differences. The tabulation of verb forms offers much more information than is represented in Table 4. Without the support of statistical analysis, some of the additional relationships suggested

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by the data will be mentioned here.

The verb form means shown in Table 4 are based on the number of forms found in the first 40 verbs of each sample. There is reason to believe that 40 is not a large enough sample to give a good estimate of the number of forms used by the mother in her daily speech. To get a better idea of the true population of verb forms, the data for mothers within age groups were pooled, and the number of verb forms in each pool was counted. The results are given in Table 5. The cell values are larger than the entries in Table 4, and the difference between A-speech and B-speech more marked. Finally, all data in B-speech were pooled, all data in A-speech were pooled, and the two samples were counted. There were 30 forms in A-speech and 19 in B-speech. The number of forms in all of B-speech is equal to the number in 28-month data alone, while the pooled sample for A-speech is greater by 5 than the largest component sample. Of the 30 verb forms in A-speech, 11 are not found in the B-speech samples. Of the 19 forms in the B-speech samples, 2 are not found in the A-speech samples.

Two things are clear from these results. First, B-speech uses a small number of verb forms compared with A-speech. Second, A-speech used most of the forms in B-speech and also, though less often, a

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Table 5

Number of Verb Forms in Samples Pooled within Age Groups

	Age groups		
Addressee	8 months	18 months	28 months
Adult	23	25	22
Child	13	14	19

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variety of forms besides. Tables B-D in Appendix 3 give the frequencies of verb forms for the six age by addressee conditions.

The number of weak verbs in 40 verbs is relatively small, about 14 for A-speech and 11 for B-speech. Most verbs used in casual conversation are strong verbs; the verb "to be" accounts for a large proportion of all verbs. Once again, the figures are somewhat misleading, because the weak verbs in B-speech, such as "want" and "look", are few and often repeated, while the weak verbs in A-speech are many and varied. The same is true for verbs which are not of Old English origin, which account for 4 out of 40 verbs in A-speech and 2 out of 40 in B-speech.

In summary, there are differences in vocabulary between B-speech and A-speech, but this study has not developed methods sensitive enough to reveal the full nature and extent of these differences. The most sensitive vocabulary measure presented here is the concreteness measure. Since it is very difficult for the rater to say what he judges when he chooses a concreteness rating, it is not clear what quality of the stimuli this measure reflects. For the moment we could call it "everydayness". Mothers seem to use ordinary, household words with their children and to

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avoid words which have low frequencies of usage, or unfamiliar, remote, or intangible referents. The concreteness measure appears to be sensitive to these qualities.

From the information presented so far, one might conclude that there is no difference between speech addressed to 8-month children and speech addressed to 18-month children. There is evidence that this is not the case. During the collection of the data it was observed that the interaction between mother and child in the 8-month group was qualitatively different from the interaction in the other groups. The mother talked when playing with the child, but she did not appear to be talking to the child. What she said had the aspect of a soliloquy, although her intonation pattern was similar to and often more extreme than that of the other groups, and her utterances were often separated by sequences of soundplay and onomatopoeia. She seemed to be amusing the child with the sound quality of her voice, rather than communicating. She often repeated in a sing-song manner whatever she had been saying. The child responded very little to what his mother was saying and gave no evidence that he understood or was interested in the message she conveyed, in contrast to the older children for

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whom the content of the mother's speech was important in structuring play. The 8-month baby did however respond to the onomatopoeia, as to any interesting sound in the environment, for at this age the babies were especially attracted to strange and brilliant noises.

Each mother in the 8-month group seemed to have her own style of speech production. Some spoke with very simple utterances and onomatopoeia throughout; some were very adult-like in the structure and content of their remarks. These styles are reflected in the ranges of the measures within the 8-month group. For instance, in the case of length of utterance, the following inequalities hold for the high and low points of the ranges of the different age groups: $8_L<18_L<28_L<18_H<8_H<28_H$. These inequalities differ from expectation in that the high point for the 8-month range falls above the high point for the 18-month range, showing that some mothers in the 8-month group are behaving more adult-like with respect to length of utterance than would be expected if a monotonic relationship held among these three groups. Inspection of these ranges suggested that an examination of the variances would clarify the nature of the relationships among the means.

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Another reason for undertaking an examination of the variances was the observation that the ranges for the A-speech samples are very much larger in several instances than the ranges for the B-speech samples. This fact suggests that there is more similarity among mothers in their B-speech than in their A-speech. Another interpretation is that A-speech is more varied than B-speech even within the speech of one mother, and that the apparent dissimilarity among mothers is due to the inadequacy of the sample size to reveal the true frequencies of the less usual occurrences. (This effect is demonstrated in the results of the verb form measure.) Either interpretation implies that B-speech is more circumscribed than A-speech.

The variance of B-speech was compared with the variance of A-speech within age groups for each of nine variables. These are the results, as shown in Table 6.

1. For three of the measures, the variance of A-speech is significantly greater than the variance of B-speech at the age levels of 18 and 28 months. These measures are: length of utterance, number of verbs per utterance, and number of modifiers per utterance.

2. The concreteness measure, for which

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data were collected at the 28-month level only, has greater variance in A-speech than in B-speech.

3. The variance in the number of Old English verbs at 18 months is greater in A-speech than in B-speech. This finding is made somewhat suspect by the failure of 28-month B-speech to differ from A-speech on this measure.

Other differences which do not reach the level of significance are nonetheless suggestive. There seem to be consistent tendencies for the content measure and the type-token ratio to be more variable in B-speech than in A-speech; perhaps these effects are due to the tendency of some mothers to repeat single nouns in talking to their children.

To summarize, we can conclude from Table 6 that there was less variability in the syntactic complexity of the speech addressed to 18- and 28-month children than in the syntactic complexity of the speech addressed to the adult.

The variance of B-speech for each age group was compared with the variance for each of the other age groups. The results are shown in Table 7. Table 8 gives a condensed account of the findings in Table 7.

It is very difficult to evaluate these results statistically, because the measures are not independent

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Table 6

Comparisons of Variances of A-speech and B-speech

Measure	age group	s^2_B	s^2_A	t^a	significance level (one-way)
Number of words in 75 utterances	28	2516.54	14103.30	2.77	p<.025
	18	472.72	11376.30	6.65	p<.001
	8	3405.57	7558.44	1.26	---
Number of verbs in 75 utterances	28	87.66	612.40	3.27	p<.01
	18	58.22	455.88	3.45	p<.005
	8	256.93	389.29	.60	---
Number of modifiers in 75 utterances	28	447.88	1898.90	2.23	p<.05
	18	74.46	1234.46	5.41	p<.001
	8	278.77	582.89	1.08	---
Number of function words in 300 words	28	68.77	78.71	.22	---
	18	35.60	25.12	- .49	---
	8	257.60	89.66	-1.53	---
Number of content words in 300 words	28	53.43	31.17	-1.21	---
	18	99.29	35.83	-1.65	---
	8	142.68	35.73	-2.43	---
Number of verb forms in 40 verbs	28	1.39	2.94	1.09	---
	18	2.32	2.90	.32	---
	8	2.18	1.76	.31	---
Number of types in 300 tokens	28	121.73	75.43	- .68	---
	18	126.99	89.29	- .50	---
	8	501.73	81.51	-2.94	---
Total concreteness ratings for 30 nouns	28	17.77	152.96	3.70	p<.005
Number of weak verbs in 40 verbs	28	47.12	8.99	-2.74	---
	18	8.71	9.17	.07	---
	8	48.46	18.01	-1.45	---
Number of Old English verbs in 40 verbs	28	4.10	6.23	.62	---
	18	1.82	8.18	2.34	p<.025
	8	2.68	2.40	- .16	---

Note. - A significance level greater than .05 is denoted by '---'.

[a]McNemar (1962), p. 246.

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Table 7

Comparisons of Variances of Age Groups within B-speech

Measure	age groups compared	s_1^2	s_2^2	F	significance level (one-way)
Number of words in 75 utterances	28-18	2516.54	472.72	5.32	p<.05
	18-8	472.72	3405.57	7.20	p<.02
	28-8	2516.54	3405.57	1.35	---
Number of verbs in 75 utterances	28-18	87.66	58.22	1.51	---
	18-8	58.22	256.93	4.41	p<.05
	28-8	87.66	256.93	2.93	---
Number of modifiers in 75 utterances	28-18	447.88	74.46	6.02	p<.02
	18-8	74.46	278.77	3.74	---
	28-8	447.88	278.77	1.60	---
Number of function words in 300 words	28-18	68.77	35.60	1.93	---
	18-8	35.60	257.60	7.24	p<.02
	28-8	68.77	257.60	3.74	---
Number of content words in 300 words	28-18	53.43	99.29	1.86	---
	18-8	99.29	142.68	1.44	---
	28-8	53.43	142.68	2.67	---
Number of verb forms in 40 verbs	28-18	2.50	2.32	1.08	---
	18-8	2.32	2.18	1.06	---
	28-8	2.50	2.18	1.14	---
Number of types in 300 tokens	28-18	121.73	126.99	1.04	---
	18-8	126.99	501.73	3.95	---
	28-8	121.73	501.73	4.12	p<.05
Number of weak verbs in 40 verbs	28-18	47.12	8.71	5.41	p<.02
	18-8	8.71	48.46	5.56	p<.02
	28-8	47.12	48.46	1.03	---
Number of Old English verbs in 40 verbs	28-18	4.10	1.82	2.25	---
	18-8	1.82	2.68	1.47	---
	28-8	4.10	2.68	1.53	---

Note. - A significance level greater than .05 is denoted by '---'.

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Table 8

Summary of Significant Findings in Table 7

Relationship between variances of age groups	Number of measures showing this relationship	Number of times this relationship is significant, $p<.05$
28>18	7	3
8>18	8	4
8>28	6	2
8,28>18	6	2

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of each other. We can however point to some patterns which it might be fruitful to investigate. It appears that the speech addressed to 18-month children was less variable than any other speech examined. The small variance in the 18-month data is suggestive, since this is the age at which children begin to use syntax. Perhaps the mother senses that this is a crucial time in language development and responds by limiting her speech to the bare minimum of forms in order to provide the simplest possible model for the novice speaker. It also appears that 8-month speech was more variable than other B-speech examined. If this is true, it supports our previous contention that the equality between the means of 18-month B-speech and 8-month B-speech is misleading.

It is possible that we do not find the expected difference between 8-month B-speech and 18-month B-speech because the trend which is observed between 18 months and 28 months depends on aspects of verbal communication between mother and child which are not present at 8 months. This would be true if the mother depends on verbal feedback from the child in adjusting the level of her speech; since the 8-month child does not produce words, the mother has nothing to guide her.

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Another explanation is that these mothers were more self-conscious than the other mothers. The 8-month babies proved to be unusually quiet in the sound-proof booth, in comparison with the behavior the mothers reported as typical. This made several of the mothers uncomfortable, and remarks of the type "Why aren't you talking today? Don't you want to talk to me?" were repeated fairly often during the B-session. Such remarks were more adult-like than most of B-speech and may have been intended for the experimenter. The older children were generally quite talkative and even when quiet involved the mother in play to the extent that she did not have time to worry about whether she was measuring up to what she imagined to be the requirements of the situation. The only way to test this second explanation is to see what these mothers typically say to the child in the home, a logical sequel to the present study.

Let us accept for the moment that speech to 8-month babies is not on the same continuum which we have observed between 18-month and 28-month speech; we may now ask at what age this trend begins. Data from the pilot study suggest a partial answer to this question. The material for

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the pilot study, described in the methods section (p. 16), was gathered when the children were 12 months old and again when they were 18 months old. Although the sample is very small (N=4), the close agreement between the 18-month pilot data and the 18-month main study data suggests that it would be reasonable to compare the 12-month pilot data with the main study data. These 12-month data have the additional virtue that they were collected when the mothers and children were thoroughly familiar with the experimental situation and with the experimenter, eliminating the problem of bias due to self-consciousness which may contribute to the results of the 8-month group.

Table 7 shows the means of six measures for the three age groups in the main study and the two age groups in the pilot study. Significance levels have not been calculated for these relationships because of the small number of pilot subjects and because the measures were developed through inspection of the pilot data. However, insepction suggests that the trend which has been demonstrated between the ages of 18 months and 28 months may begin at least as early as 12 months in some cases. In four of the six measures compared, the 12-month figure differs from

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both of the 18-month figures in the expected direction. In the other two measures, the 12-month figure holds the expected relationship with the 18-month figure for the pilot subjects, though not with the 18-month main study figure.

Prosodic measures

Table 10 shows the results of the intonation study. The mean differences between B-speech and A-speech were in the expected direction in all five of the sentences for eight of the twelve measures: mean ff, standard deviation of ff, range of ff, maximum ff, unphonated time, number of inflections, extent of inflections, and rate of change of ff during inflections. For total time of utterance and phonated time, the difference was in the expected direction for four of the sentences; "I see my hoe" failed to show a difference in the expected direction for these two measures. Since three sentences showed significant differences as measured by the Walsh test, one can conclude that these two measures reflect a difference of importance in this set of sentences. Inspection of the data bears this out; the negative results for "I see my hoe" are due to one highly

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Table 9

Mean Values of Main Study and Pilot Study Data

Measure	Age group of children addressed				
	8 months	12 months[a]	18 months[a]	18 months	28 months
Number of words in 75 utterances	267.30	234.75	265.25	260.50	301.10
Number of verbs in 75 utterances	61.40	57.75	61.50	60.00	69.10
Number of modifiers in 75 utterances	55.10	46.25	50.75	44.70	61.90
Number of function words in 300 words	57.40	47.75	57.00	54.40	58.10
Number of content words in 300 words	105.30	126.25	121.25	110.80	107.10
Number of types in 300 tokens	92.20	102.50	113.50	101.90	122.20

[a]Pilot data.

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aberrant utterance by one mother. Two more measures, duration of inflections and minimum ff, showed no regular or significant differences, with the exception of duration of inflections in "I see my tools outside".

On the whole, when these sentences were produced under the B condition, they exhibited higher and more variable ff than when they were produced under the A condition; this was due mainly to more inflections and higher peaks of ff during inflections, rather than to a change in minimum ff. Sentences were longer in duration in the B condition than in the A condition because both the voiced sections and the unvoiced sections were protracted.

Figures 1 and 2 show the contours of the sentences in terms of the average maximum ff in each segment. Since ff is a correlate of perceived stress, these graphs give some idea of the differences between the stress patterns of A-speech and B-speech. First, B-speech tends to exaggerate the stressed segments of A-speech. This is especially clear for the segment "tools" in "I see my tools outside". Second, B-speech tends to stress different segments of the sentence. This is illustrated by the segment "I" in "I think I'll play in my sandbox". Third, the form of the stress is often distinctive in B-speech.

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Figure 1
Maximum Fundamental Frequencies of Sentence Segments

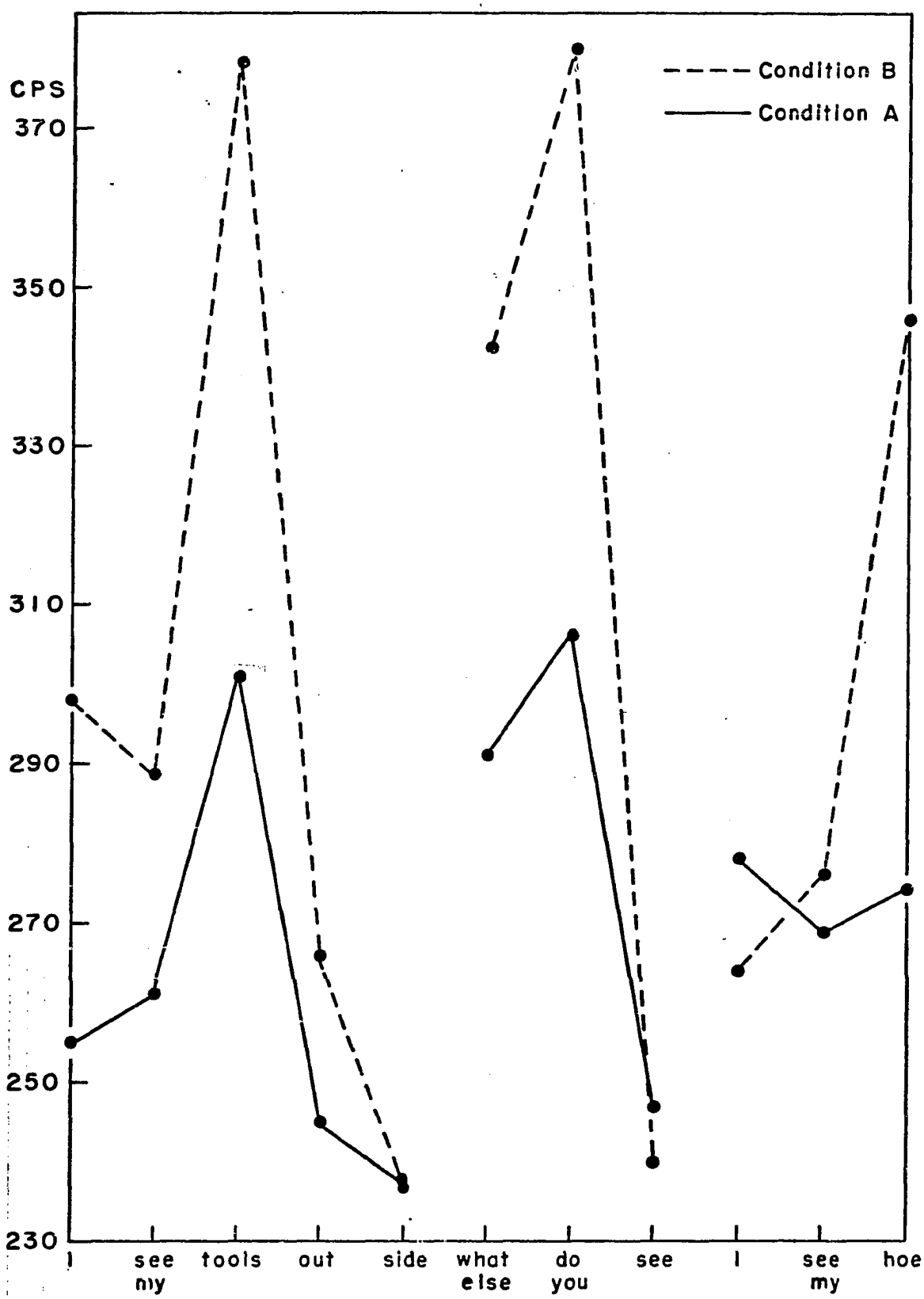

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Figure 2
Maximum Fundamental Frequencies of Sentence Segments

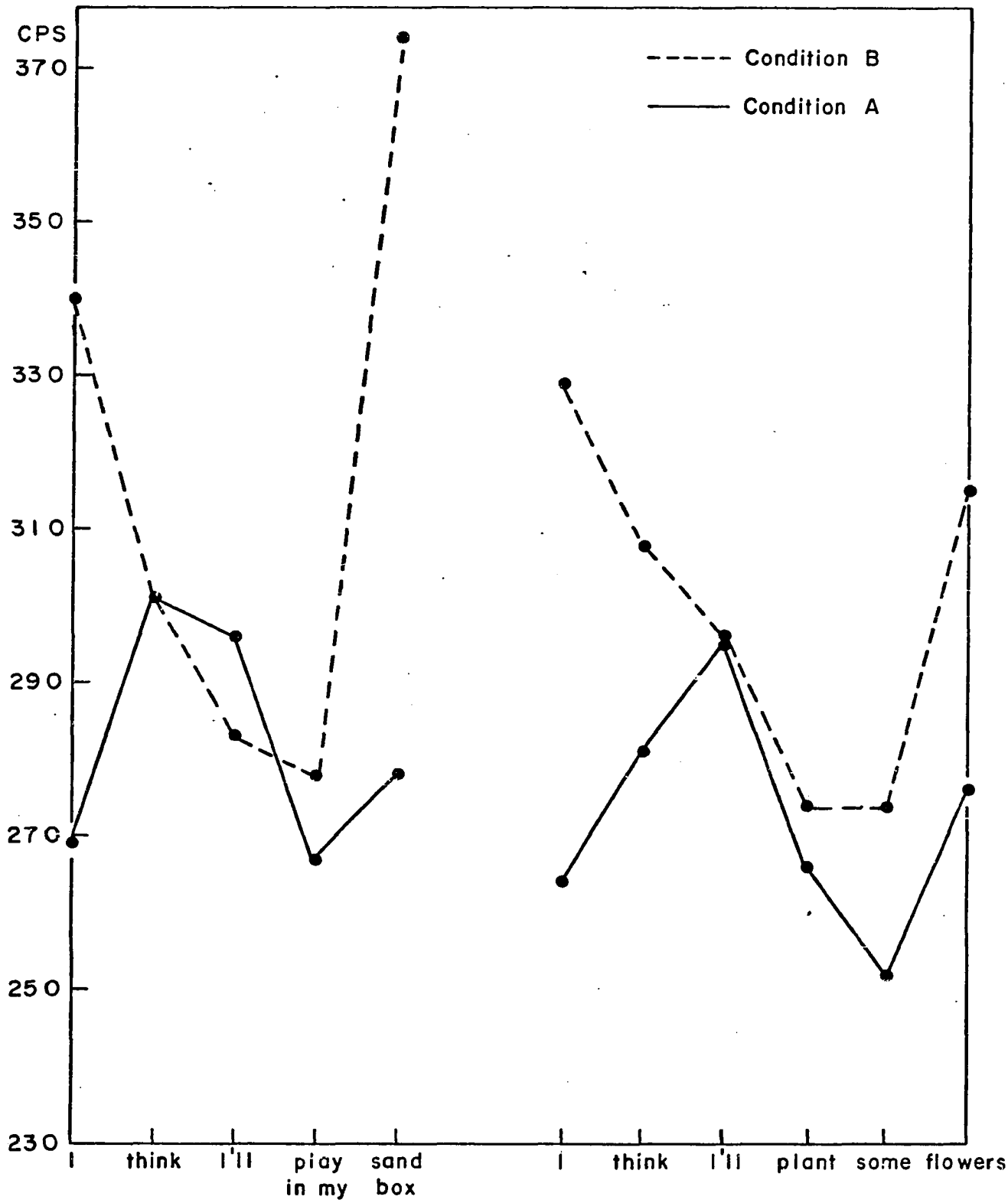

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Table 10

Results of the Intonation Study

Measure	Sentences				
	I see tools out side	I see my hoe	I think I'll plant some flowers	What else do you see	I think I'll play in my sandbox
Mean ff	p<.031	x	x	p<.016	p<.047
Standard deviation of ff	p<.016	x	p<.047	p<.031	p<.047
Range of ff	p<.016	x	x	p<.047	p<.016
Maximum ff	p<.016	x	x	p<.031	x
Minimum ff	---	x	x	---	---
Total time	p<.016	---	p<.016	x	p<.016
Phonated time	p<.016	---	p<.047	x	p<.031
Unphonated time	x	x	p<.016	x	x
Number of inflections	x	x	p<.031	p<.031	p<.016
Extent of inflections	p<.047	x	x	x	p<.016
Duration of inflections	p<.016	x	---	x	---
Rate of change of inflections	x	x	p<.031	x	p<.016

Note.-Significance has been tested by the Walsh test. Probabilities greater than .05 have been omitted; instead, a difference in the expected direction is indicated by "x", a difference in the reverse direction by "---".

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A typical stressed segment is seen in the word "flowers" in the spectrograms in Appendix 5. The ff in the B-speech spectrogram rises and falls in an almost symmrtrical curve; in contrast, the ff in the A-speech spectrogram falls off evenly from a slight peak. Even when a word is stressed strongly in A-speech, the symmetrical curve does not appear; at best the right-hand half of it is seen.

Summary of Results

	Expected	Observed
Measures of syntax		
1. Number of words per utterance.	B<A;8<18<28.	B<A;8=18<28.
2. Number of verbs per utterance.	B<A;8<18<28.	B<A;8=18<28.
3. Number of modifiers per utterance.	B<A;8<18<28.	B<A;8=18<28.
4. Proportion of function words.	B<A;8<18<28.	B<A;8=18<28.
5. Proportion of content words.	B>A;8>18>28.	B>A;8=18>28.
6. Number of verb forms.	B<A;8<18<28.	B<A;8=18<28.
Measures of vocabulary		
7. Type-token ratio.	B<A;8<18<28.	B<A;8=18<28.
8. Concreteness of nouns.	B>A.	B>A.

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9.	Proportion of Old English verbs.	B>A;8>18>28.	B>A;8=18=28.
10.	Proportion of weak verbs.	B<A;8<18<28.	B<A;8=18=28.

Measures of prosodic features

11.	Mean fundamental frequency.	B>A.	B>A.
12.	Variance of ff.	B>A.	B>A.
13.	Range of ff.	B>A.	B>A.
14.	Maximum ff.	B>A.	B>A.
15.	Minimum ff.	B>A.	B=A.
16.	Number of inflections.	B>A.	B>A.
17.	Mean extent of change in ff during inflections.	B>A.	B>A.
18.	Mean duration of inflections.	B>A.	B=A.
19.	Mean rate of change of ff during inflections.	B>A.	B>A.
20.	Length of time taken to utter sentence.	B>A.	B>A.
21.	Amount of time when no voicing occurs.	B>A.	B>A.
22.	Amount of time when voicing does occut.	B>A.	B>A.

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Conclusions

We have found significant differences between speech addressed to children and speech addressed to an adult in a laboratory setting. These differences include aspects of syntax, vocabulary, and intonation patterns. There is a change in syntactic complexity as reflected in length of utterance, number of verbs and modifiers per utterance, and proportion of function and content words. Vocabulary in speech to the child is less varied more concrete and more tied to the here-and-now. Intonation in speech to the child is more exaggerated, and articulation is more deliberate. We have found, moreover, that some of these differences change regularly with the age of the child addressed. In general, as the child grows up, speech addressed to him becomes less stereotyped, less circumscribed, and less repetitious as it approaches the style of adult conversation.

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Appendix 1

Deletions

Certain categories of speech were deleted from the transcription before the words were coded. This appendix describes the nature of the deletions and gives the frequencies with which they occurred in the six age by addressee conditions.

1. Repeated material. Any material which was repeated for reasons extraneous to the structure or content of the speech was deleted. If the speaker was interrupted and repeated part of her previous speech before completing the utterance, the repeated portion was deleted.

Example: He usually plays with.....[with]
the pots and pans.

The bracketed section would be deleted.

2. Corrected material. If the speaker repeated part of what she was saying and changed some words in the repetition, the original speech segment was deleted.

Example: I went to the store [on Monday]
on Tuesday.

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3. Fill. Any vocalization or word which was uttered not as part of speech but merely to fill silence was deleted. This included mainly "uh" and "um" sounds but also "and" and "but" when appropriate.

4. Unclear utterances. If any part of an utterance could not be heard distinctly, the utterance was deleted entirely.

5. Incomplete utterances. If the speaker left an utterance unfinished for any reason, the utterance was deleted.

6. Imitation. Baby sounds which the mother mimicked were deleted. This did not include words which are not standard English but are a regular part of the mother's vocabulary when she speaks to the child (e.g. pet names for animals, grandmothers, etc.), even though originally these may have been imitations of the child's effort to say a name or a word.

7. Onomatopoeia. Any sound made by the mother which was not a speech sound was deleted. This included primarily animal sounds, sounds imitating cars, and other mechanical noises.

A tabulation of the occurrences of all types of deletions is given in Table A. No hypotheses were based on these data; certain things can be learned,

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however, from this table. The tabulations are based on the entire transcription. The transcriptions are not equal in size. Some have 300 words but more than 75 utterances, while others have 75 utterances but more than 300 words, depending on the mean length of utterance. All A-speech samples have more than 300 words per transcription, since the average utterance is about 8 words long. Most B-speech samples have more than 75 utterances per transcription since the average utterance is about 3 words long. Speech addressed to 28-month children has about 4 words per utterances, which is about 300 words in 75 utterances.

Inspection of Table A shows that B-speech was almost devoid of deletions classified as fill, repeated material and corrected material. The number of deletions of these types which occurred in A-speech far exceeded the number which could be explained by the unequal number of words in the two types of speech sample. B-speech had many fewer utterances deleted due to incompleteness, in spite of the fact that B-speech samples include more utterances. Onomatopoeia and imitation deletions were confined to B-speech and decreased as the age of the child increased. The majority of deletions due to onomatopoeia occurred in speech addressed to 8-month children.

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Altogether, the number of deletions in A-speech was far greater than the number in B-speech. This observation is consistent with the contention that B-speech is more readily understood than A-speech, because it is less broken up by repetitions, corrections, and hesitations, and it is produced more deliberately.

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Table A

Distribution of Deletions

Type of deletion	Age by addressee conditions					
	8 months		18 months		28 months	
	B	A	B	A	B	A
unclear	28	10	34	19	22	16
incomplete	2	48	14	95	26	105
imitation	9		5			
onomatopoeia	95		13		2	
fill 1 word		86	1	75		88
2 words		20		16		12
3 words				1		1
repeated 1 word		38	1	37		36
2 words		14		10		13
3 words		2		4		5
4 words				1		
corrected 1 word		15	2	11	1	15
2 words		14		5		14
3 words		4		8		3
4 words				4		1
5 words				5		1
6 words						1

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Appendix 2

Word Coding

After a transcription was completed, each word was assigned a code number corresponding to its grammatical function. The coding system was adapted from P. G. Perrin, The Writer's Guide and Index to English (1959). It consists of ten categories which are composed as follows.

1. Noun.

   Noun: I saw a cat.

   Proper noun: I saw Jerry.

   Nounal: The poor get poorer.

   Adverbial: He went home.

   Gerund: Walking is fun.

2. Adjective.

   Adjective: I saw a black cat.

   Possessive noun: I have Jerry's hat.

   Numeral adjective: I have one cat.

   Demonstrative adjective: I want that hat.

   Interrogative adjective: What hat do you have?

   Possessive noun: Here is your hat.

   Adjectival: This is your house mother

3. Article.

   Article: a, an, the

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4. Verb.

Verb: I see a cat.

I have seen many cats.

Infinitive: I want to see one.

Verbid: Walking to school made me hungry.

I saw her walking to school.

5. Auxiliary.

Auxiliary: I have done it.

I should have been shovelling snow.

Infinitive "to": Do you want to leave?

6. Adverb.

Adverb: He was walking quickly.

Interrogative adverb: Where are you going?

Assertive adverb: Surely you don't mean it.

Temporal adverb: You can do it now.

Demonstrative adverb: Put it here.

Negative adverb: You don't understand.

7. Preposition.

Preposition: I feed him at eleven.

The man in the blue coat came in.

8. Conjunction.

Conjunction: Paul and Mary came.

He went to the window and looked out.

I won't go if he doesn't.

Conjunctive adverb: He hung up, so I forgot about it.

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Relative pronoun: He brought the box that I wanted.

9. Pronoun.

Personal pronoun. I saw a cat.

Interrogative pronoun: What are you doing?

Reflexive pronoun: He did it himself.

Reciprocal pronoun: They like each other.

Numeral pronoun: I have one.

Demonstrative pronoun: Do you like that?

Indefinite pronoun: I don't have any.

Impersonal pronoun: It seems that way.

10. Exclamatory words.

Exclamations: Oh look!

Interrogative exclamation: What?

Independent words: Yes, I do. No, I don't. Well, I don't know. Hello. Okay.

The examples given above provide adequate models for much of the transcription encountered in this study. There was however a sizeable body of utterances which required further decision in assigning word codes. Some of these occurred frequently; others were isolated examples. The list below gives examples of the most common problems encountered and the solutions found for them. In some cases the

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solution was not perfect. Consistency was judged to be of paramount importance, however, and a coding procedure, once established, was used in all transcriptions.

The first problem encountered was the presence of modifiers other than those falling into categories 2, 6, and 7. Since we wanted to indicate in some countable fashion every word, phrase, or clause which performed a modifying function, we had to devise another system to pick up these lost modifiers. The system consisted simply of checks in the margin.

Will you go if I go?	x
The boy I saw had a red hat.	x
I went this morning.	x
This is a red letter day.	x

Additional problematic sequences are illustrated below. The number under each word represents the grammatical category to which the word has been assigned.

I prefer New York City 9 4 1 1 1	
He is four years old 9 4 2 1 2	x
He is a four year old 9 4 3 2 1 1	x
I have fifty five 9 4 9 9	
I have fifty five horses 9 4 2 2 1	

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I want to go
9 4 5 4

I am going to go
9 5 4 5 4

Let me go
4 9 4

What is it
9 4 9

You know what I mean
9 4 9 9 4

Where is it
6 4 9

Put it where it belongs x
4 9 8 9 4

Put it here
4 9 6

Bring it over here
4 9 7 9

I went home x
9 4 1

Even though you do n't want to
8 8 9 5 6 4 5

Children his age are like that x
1 2 1 4 7 9

Look at all the balls x
4 7 9 3 1

I want some more cookies
9 4 2 2 1

We talked some more
9 4 6 6

I want some more
9 4 9 2

I want some
9 4 9

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I want more
9 4 9

What else is there
9 2 4 6

See what else there is
4 8 2 6 4

I see something else
9 4 9 2

I like it except that it is blue
9 4 9 7 8 9 4 2

They go pop
9 4 1

Put it in
4 9 6

That is why I did it
9 4 8 9 4 9

It is broken
9 4 2

It is kicked
9 5 4

All right
6 2

We live at Five Fifty
9 4 7 1 1

I had it cut at Barbara's
9 4 9 4 7 1

x

bye bye
0 0

Right
2

It 's kind of nice
9 4 6 6 2

I am used to it
9 4 2 7 9

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It is fun
9 4 1

She works as hard as she can x
9 4 6 6 8 9 5

It 's as hard as nails
9 4 6 2 7 1

You did n't throw it away did you
9 5 6 4 9 6 5 9

It is June thirtieth
9 4 2 1

It is the thirtieth of June
9 4 3 1 7 1

It is a simple type life x
9 4 3 2 1 1

He talks quite a lot x
9 4 6 3 1

He only has one
9 2 4 9

He only wants to pet it
9 6 4 5 4 9

He has a little more candy x
9 4 3 1 2 1

Not too many do
6 6 9 5

They all do it
9 2 4 9

Below are two samples of transcription. They are taken from the B-speech and A-speech, respectively, of the mother of one of the 18-month boys.

Sample of B-speech to an 18-month boy.

take your finger
5 2 1

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(go like) incomplete

whale
1

here 's the whale's mouth
6 4 3 2 1

cow
9

(moo) onomatopoeia

see
4

thank you
4 9

(do you want mommy to do) unclear

he 's opening up his mouth
9 5 4 6 2 1

where 's your mouth
6 4 2 1

Sample of A-speech from the same mother.

he usually goes for books first
9 6 4 7 1 6

that was the thing he wants the most xx
9 5 3 1 9 4 3 9

cars
1

(there is a) incomplete

tootsie makes a carrier that comes x
1 4 3 1 8 4

comes attached to it
4 2 7 9

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and you put all the little cars x
8 9 4 9 3 2 1

on there and the little people
7 9 8 3 2 1

fit in there and a school
4 7 9 8 3 2

bus and a lawn mower he x
1 8 3 2 1 9

loves to push and make the
4 5 4 8 4 3

lawn mower go
2 1 4

which is sort of interesting
9 4 6 6 2

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Appendix 3

Verb Form Tabulation

Tables B-D illustrate the chart used for classifying verbs by form. Each of the first 40 verbs and its auxiliaries in each transcription was tabulated in the box which describes it. Not all possible verb forms of English are included, but all verb forms encountered in the speech samples were accomodated. Some boxes are impossible or improbable in English; this has no effect on the sample measures.

It happened regulary, though at a low rate, that an auxiliary was omitted where it was clearly indicated by the grammar of the sentence. In this case the verb was classified as if the auxiliary were present and the occurrence noted on the line marked "I have drunk and eaten". Another example of an occurrence which would be entered here is "Want to go now?" Similarly, the auxiliary was sometimes used without the verb. The verb was classified as if it were present, and the occurrence noted on the line marked "You've eaten, haven't you?"

The entries in Tables B-D are the sums of verb form frequencies for mothers within age by addressee conditions. Inspection of the tables shows several marked differences among the conditions. B-speech

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verbs were mainly in the present tense. The simple present predominated. The "do" form and the imperative were next in frequency. The use of the "do" auxiliary was due mainly to the tendency of the mothers to ask questions of the children. "Can" was another auxiliary often used in asking questions. Much use was made of the infinitive form, as in "Do you want to play with this?" The present progressive was also found, often in the form "Are you going to do that?" A-speech verbs were distributed somewhat differently. The simple present predominated here too, but many fewer "do" and "can" auxiliares were used. The imperative was conspicuously absent. Use of the infinitive and the present progressive were about the same as in B-speech. The categories which changed the most in frequency of use from B-speech to A-speech were the past tenses and the future tense. The forms which changed the number of different verb forms the most were the verbals, past progressives, the passives, and other forms which require unusual or multiple auxiliaries.

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Table B

Distribution of Verb Forms: 8 Months

	SIMPLE		PROGRESSIVE		PASSIVE	
	B	A	B	A	B	A
I eat	90	204	30	19	2	8
I do eat	84	29				
I can eat	19	15				2
I may eat						
I might eat		1				
I should eat		1				
I would eat	3	3				
I could eat		1				
Eat!	83	3				
Do not eat!	2					
I ate	10	24		2		2
I did eat	7	1				
I have eaten	3	17		8		
I had eaten						
I could have eaten						
I might have eaten						
I should have eaten						
I may have eaten						
I would have eaten						
I will eat	8	16		1		
I will have eaten						
I want to eat	59	27				
Eating is fun		13				
They saw corn eaten		1				
They saw men eating		2				
If he were eating						
You've eaten haven't you	11	7				
I have drunk and eaten	48	12				

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Table C

Distribution of Verb Forms: 18 Months

	SIMPLE		PROGRESSIVE		PASSIVE	
	B	A	B	A	B	A
I eat	164	197	8	16	2	2
I do eat	52	21				1
I can eat	31	7				
I may eat						
I might eat		1				
I should eat		1				
I would eat	2	5		2		
I could eat		2				
Eat!	79	2				
Do not eat!						
I ate	4	47		2		2
I did eat	9	4				
I have eaten	4	13		1		
I had eaten		2				
I could have eaten						
I might have eaten						
I should have eaten						
I may have eaten						
I sould have eaten		1				
I will eat	1	13				
I wil have eaten						
I want to eat	41	40				
Eating is fun	2	16				
They saw corn eaten		1				
They saw men eating	1					
If he were eating		1				
You've eaten haven't you		5	4			
I have drunk and eaten		18	3			

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Table D

Distribution of Verb Forms: 28 Months

	SIMPLE		PROGRESSIVE		PASSIVE	
	B	A	B	A	B	A
I eat	177	198	16	12	4	8
I do eat	48	21				
I can eat	20	10				
I may eat	2					
I might eat						
I should eat	1					
I would eat	2	13				
I could eat	1					
Eat!	63	1				
Do not eat!	1					
I ate	5	44	2	1		1
I did eat	3	9				
I have eaten	1	17		1		
I had eaten		2				
I could have eaten						
I might have eaten						
I should have eaten						
I may have eaten						
I would have eaten						
I will eat	13	7		1		1
I will have eaten						
I want to eat	37	37		1		
Eating is fun	3	13				
They saw corn eaten		1				
They saw men eating	1	1				
If he were eating						
You've eaten haven't you		5		7		
I have drunk and eaten		22		7		

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Appendix 4

Method of Establishing the Concreteness Ratings

Paivio, Yuille and Madigan (1968) established a method for obtaining reliable concreteness ratings for single nouns. That method was adopted, with appropriate modifications for the purposes of the present task. The first 30 nouns in each transcription of the 28-month group were extracted, along with their contexts. Of these 600 nouns, there were 289 nouns differing from one another in form, denotation, or both. Differences in number were ignored; the singular was used whenever possible. A preliminary study showed that people's first names are rated the same (e.g. John, Mary, Susie, Adam), so only one of these was included. These 289 nouns, embedded in sentences which preserved the denotation of the words in their original context, composed the stimulus materials for the following brief study.

The sentences were printed on 8 1/2 x 11 sheets of paper, 25 sentences per page, in random order. A seven-point scale was printed after each sentence. The low end of the scale was labelled "abstract" and the high end "concrete". Thirty students in an

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introductory psychology class were given a copy of the entire set of 289 sentences and were asked to circle the appropriate scale number representing the degree of concreteness-abstractness of each noun. (For the specific instructions and a sample of the test stimuli, see Figures A and B.) The results of these 30 ratings were collated and mean rating obtained for each noun. A few raters accidentally missed a sentence, so some ratings were based on 29 figures instead of 30. The mean rating for a given noun was applied to each occurrence of that noun in the speech samples. The 30 ratings in each subject-condition were then averaged, producing an overall concreteness rating for the nouns in that subject-condition.

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Figure A

Instructions for Concreteness Ratings

Nouns may refer to things that can be seen, heard, felt, tasted or smelled, or they can refer to more abstract things that cannot be experienced by the senses. The purpose of this experiment is to rate a list of nouns with respect to concreteness and abstractness in terms of sense experience. In each of the sentences listed below there is one underlined noun. Rate the noun on the scale which follows the sentence by circling the number you feel is most appropriate to that noun. For example

	abstract						concrete
He sat on a chair.	1	2	3	4	5	6	(7)

A rating of "7" indicates that the noun is very concrete.

	abstract						concrete
He took it with fortitude.	(1)	2	3	4	5	6	7

A rating of "1" indicates that the noun is very abstract.

Be sure to put a rating next to each sentence.

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Figure B

Format for Concreteness Ratings

		abstract						concrete
1.	He stayed an hour.	1	2	3	4	5	6	7
2.	The house has many conveniences.	1	2	3	4	5	6	7
3.	This was his first visit.	1	2	3	4	5	6	7
4.	He's in the hospital.	1	2	3	4	5	6	7
5.	She wore a hat.	1	2	3	4	5	6	7
6.	Lithography is difficult.	1	2	3	4	5	6	7
7.	Wait a minute.	1	2	3	4	5	6	7
8.	The lady took it away.	1	2	3	4	5	6	7
9.	Mommy is leaving.	1	2	3	4	5	6	7
10.	The horse neighed.	1	2	3	4	5	6	7

Appendix 5

Procedures for Obtaining Prosodic Measures

Six mothers were taped reading a short story to their 2 1/2 year old sons (B condition) and later reading the same story to the experimenter (A condition). The story was read twice under each condition. Five sentences (shown in Table E) were then edited from each of the tapes, and narrow-band spectrograms of them were made using a Kay Sonagraph, #7029A. There were 120 spectrograms: two readings in two conditions of five sentences by six mothers. Each spectrogram was sampled at intervals of .10 inch, or 42 milliseconds, starting at the onset of voicing for the first word in each sentence. At each sample point the fundamental frequency (ff) was measured to the nearest half millimeter with a millimeter rule, a procedure accurate to approximately $\pm$20 cycles per second. Since the results are stated in terms of average data, this degree of accuracy is sufficient for our purposes. Figure C illustrates the spectrograms used to obtain the prosodic measures. An arrow points to the onset of the fundamental frequency. Measurements were made down from the 1 KC line.

Measures 11-15 (mean, variance, range, maximum,

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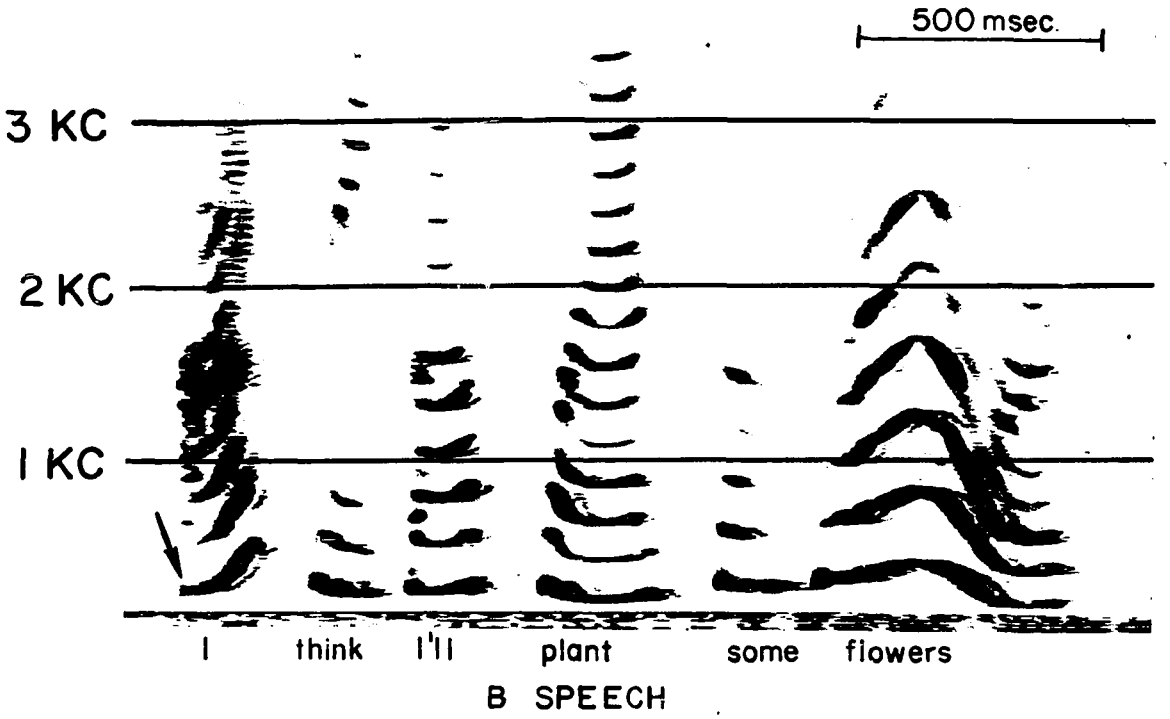
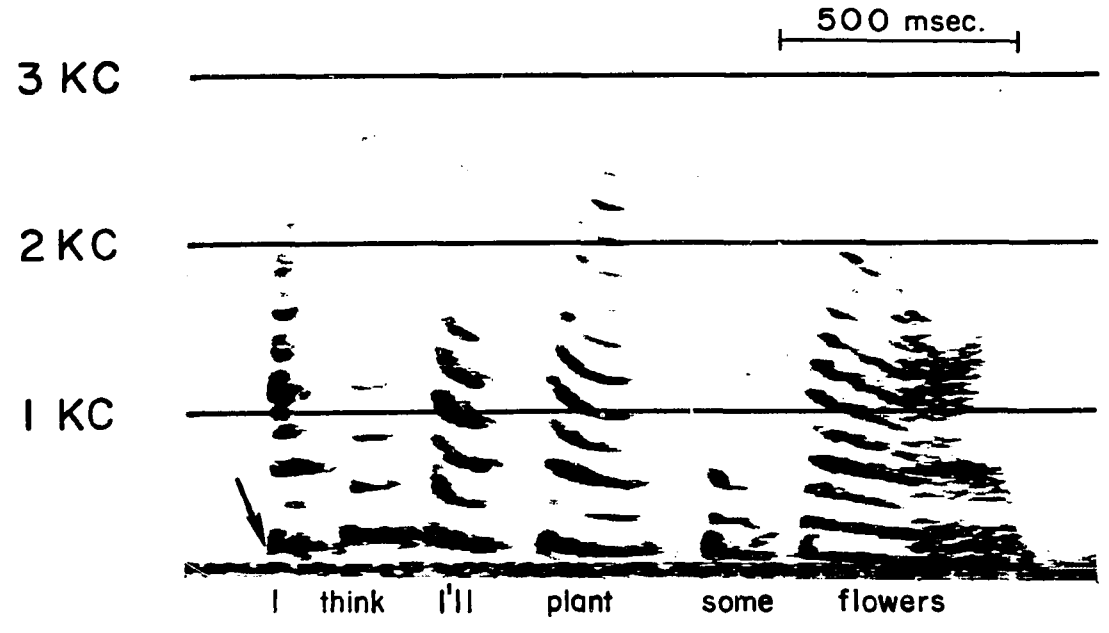
Figure C

Narrow-Band Spectrograms of Sample Sentences



B SPEECH



A SPEECH

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and minimum ff) were based on all the observations on a spectrogram which yielded a measure of fundamental frequency, i.e. samples in which voicing occurred. Each of these measures was calculated separately for each spectrogram.

Measures 16-19 (number, duration and extent of inflections, and rate of change of ff during inflections) were based on the observations during inflections only. An inflection was defined as the stretch of speech between a high point in ff and the next low point, or conversely between a low point and the following high point. It can be seen in Figure C that the fundamental frequency is divided into discrete segments by voicing breaks. These segments were usually clearly defined in B-speech but in A-speech the voicing break was sometimes missing, as it is between "think" and "I'll" in the A-speech spectrogram in Figure C. Inflections were not measured across voicing breaks, so in order to make the measurements comparable between B-speech and A-speech, inflections were counted only within segments, whether the segments were continuous or not. Only inflections greater in extent than 1/2 millimeter, or 20 cps, were included in the measures, because variations of 1/2 millimeter were within the range of error variance. Each of these measures was calculated

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separately for the pooled inflections of the two readings. The extent of an inflection was calculated by counting the difference in cycles per second between onset and completion of each inflection. The duration of an inflection was calculated by counting the number of observations included in any given inflection. The rate of change was obtained by dividing the extent of the inflection by its duration.

Measures 20-22 (length of time taken to utter sentence, total voiced time, and total non-voiced time) were based on all the observations for each sentence.[4] Each of these measures was calculated separately for every spectrogram. The measure of total length of time was the number of sample points. The measure of total voiced time was the number of sample points for which an ff was observed. The measure of total non-voiced time was total time mimus total voiced time.

[4]Although more sophisticated methods of measuring duration are available, the present method seemed adequate for our purposes.

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Table E

Sentences Used in the Intonation Study

1. I see my tools outside.
2. I see my hoe.
3. I think I'll plant some flowers.
4. What else do you see?
5. I think I'll play in my sandbox.

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Appendix 6

Reliability

Double sessions were run and processed for three mothers, one in each age group. Only one of the mothers in the replication sample was included in the concreteness study. The results of these replications are given in Table F. Eight of the ten measures showed substantial reliability with respect to the difference between A-speech and B-speech. For these eight measures, the data in Table H support the contention that the same differences would be found if the study were done over. The number of verb forms and the number of weak verbs were not shown to be reliable by this sample; the very small sample size does not, however, allow us to conclude that these two measures are in fact unreliable.

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Table F

Means of First and Second Replications

Measure	First replication		Second replication	
	A-speech	B-speech	A-speech	B-speech
Number of words in 75 utterances	510.0	304.3	563.7	300.3
Number of verbs in 75 utterances	94.7	71.3	102.3	60.7
Number of modifiers in 75 utterances	147.0	56.7	172.3	64.0
Number of function words in 300 words	79.7	65.3	79.3	62.0
Number of content words in 300 words	94.0	109.0	99.3	103.0
Number of verb forms in 40 verbs	10.3	10.0	9.0	7.7
Mean concreteness rating[a]	5.16	6.07	4.97	6.03
Number of types in 300 tokens	156.0	109.0	166.0	115.3
Number of weak verbs in 40 verbs	14.3	10.7	7.3	10.3
Number of Old English verbs in 40 verbs	36.7	38.3	37.0	38.0

[a] N=1

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