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A comparison of comprehension of rate controlled speech by young aphasic and normal children

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A COMPARISON OF COMPREHENSION OF RATE CONTROLLED SPEECH BY YOUNG APHASIC AND NORMAL CHILDREN

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CHAPTER I

INTRODUCTION

The congenitally aphasic child's ability to process auditory signals has been extensively explored by speech and language pathologists. This child appears to be unable to pick up the auditory cues from the environment which are essential for learning language (Eisenson, 1972). Marsh (1961) defines aphasia in children as an inability "to receive language with meaning". Education of these children has usually attempted to improve their ability to process auditory cues (Rampp, 1973). Various dimensions of auditory processing have been examined by researchers and educators (Aten, 1973; Chappell, 1972; Rees, 1973; deHirsch, 1967; Eisenson, 1973).

Chalfant and Scheffilin (1969), in their review of research in auditory processing dysfunctions in children, note that there are children who have normal hearing and yet cannot process and obtain meaning from auditory stimuli. They state: "There is need to describe disorders in processing and utilizing auditory stimulus in more detail."

Referring to the aphasic child, Chase (1972) states that "one of the most striking clinical features of patients with congenital aphasia is the inconsistent and aberrant manner in which auditory input, particularly speech, is dealt with". He also notes that speech sounds do not elicit the imitative effort that is required for normal language learning. He further emphasizes that future knowledge in the area of the physiology of the auditory system should provide more evaluation of the hypothesis that congenitally aphasic children have a significant pathology involving the central auditory nervous system. Chase also observes that for some children with congenital aphasia "speech may be understood if sentences are simple, spoken slowly, and efforts are made to avoid distractions while speech is being exchanged."

An important dimension in comprehending spoken utterances is rate. Studies involved with increasing the rate of a spoken message (Foulke, 1969; Stroud, 1967; Jester, 1966) have shown that increased rapidity of the speech signal negatively influences comprehension. On the other hand, researchers (Thompson, 1969; Berry, 1971; Berry and Erickson, 1973) have observed that decreasing the rate of the speech signal appears to aid comprehension for some subjects.

Eisenson (1973) believes that the aphasic child's primary auditory deficit is influenced by rate. He states: "With only rare exception, we consider the aphasic child's basic perceptual impairment to be one for auditory perception for speech at the rate at which speech is normally presented." This statement implies that normal speech may be too fast for the child with auditory processing difficulties.

Hirsh (1967) has commented on rate and its influence on auditory processing. He suggests that the basis for auditory processing is the dimension of time. He states that auditory processing consists of events "whose qualities and cues for recognition depend upon what it is that changes, by how much, and how fast in time." Thus, Hirsh supports Eisenson's observations that the rapidity of speech has an important effect on auditory comprehension.

Referring to adult aphasics who also exhibit auditory processing difficulties, Efron (1963) states that: "When the speech rate exceeds the capacity of the aphasic to properly sequence, complete failure of communication might result on the receptive side." In other words, increased rate leads to difficulties in comprehension.

Few researchers have examined the effects of rate-controlled speech on the comprehension abilities of aphasic children. Thompson (1969) presented linguistic material to aphasic children at five rates: two expanded (slow), two compressed (fast), and one normal. Her results suggested that comprehension of linguistic structure may improve for young aphasic children (ages five to seven) when it is presented at an expanded rate of speech.

Studies involving rate manipulation have been done with other populations. Results of a study by Berry and Erickson (1973) indicated that young normal (non-language impaired) children had improved comprehension at two slower rate conditions when compared to a normal rate condition. Parkhurst (1971) experimented with the ability of the adult aphasic to follow commands when presented at expanded, compressed and normal rates of speech. Results demonstrated that the subjects performed more poorly under the compressed condition and performed about the same under normal and expanded rates. Parkhurst stated, however, that the aphasic adults' behavior in response to the expanded rate suggested that they might have possibly benefitted from more time in processing the first part of a long speech stimulus.

It is obvious that the effect of speaking rate on the ability of aphasic children to comprehend verbal material has not been extensively researched. The studies cited above suggest that an increase in rate adversely affects comprehension by various subjects, while a decrease in rate may improve comprehension by certain subjects. Therefore, the present study attempted to examine the effects of the rate at which an auditory stimulus is presented to aphasic and normal children.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter presents previous research concerned with the following areas:

1. auditory processing and the aphasic child
2. effects of rate-controlled speech on comprehension
3. methods of altering rate of speech
4. comprehension of specific linguistic structures

Lastly, the statement of the problem is posed.

<u>Auditory processing and the aphasic child</u>

For purposes of this study, it appears important to examine specific definitions and descriptions of the auditory processing ability of the aphasic child, as discussed by various theorists and researchers in the profession of speech and language pathology. The congenitally aphasic child has been variously labelled as "perceptually impaired", "brain-damaged", "receptively aphasic", and "language disordered". The term "aphasia" as used in terms of this study refers to the child who exhibits a delay in language development, with no family history of language disorder, and no evidence of peripheral deafness, mental deficiency or psychological disorder (Chase, 1972).

Auditory processing by the aphasic child has been a focus of study by Eisenson (1966). He noted that this special population of children possess disturbances in the following basic functions of language learning:

1. The capacity to receive stimuli that are produced in sequential

order;

2. The capacity to hold the stimuli in mind, to hold the sequential impressions so that its components may be integrated into some pattern;

3. The capacity to scan the pattern from within so that it may be compared with other impressions or remembered patterns; and

4. The capacity to respond differentially and meaningfully to the perceptual impression.

He remarks that an alternative term for the auditory disturbance is "non-specific language disability" as this "refers to those who have an impairment of a variety of vaguely defined linguistic functions." (Eisenson, 1966).

Aten (1970) states that: "the all-important ingredient in auditory perception is the ability to perceive temporal relationships and to retain rapid incoming signals that are brief and frequently occurring." The aphasic child's difficulty in receiving the language stimuli appropriately is also noted by Myklebust (1956). He states: "If the central nervous system is impaired, a symbolic language disorder might ensue, which is referred to as aphasia. In children, the condition in which the comprehension and/or expression of the spoken word is affected is called aphasia." He defines auditory perception as the ability to "structure the auditory world and select those sounds which are immediately pertinent to adjustment." It is an impairment in auditory perception and auditory processing which characterizes the aphasic child as "brain-different". (Eisenson, 1966) As noted above, these researchers agree that the aphasic child exhibits an impairment with the auditory processing system and that his/her perception of the speech stimulus is thereby affected.

Rate-Controlled Speech

Jester (1966) observed that increased intelligibility of spoken sentences occurred when speaking rate was slowed. Other studies have revealed that comprehension appears to be adversely affected when speaking rate is increased (Foulke, 1969; DeHoop, 1965; Goldstein, 1940).

Little research has been conducted with the aphasic child's ability to comprehend rate-controlled speech. Thompson's study (1969) appears to be the only published one. Her study involved twenty children with auditory processing difficulties. They ranged between five and seventeen years of age. The experiment required the subjects to listen to 50 declarative sentences (Noun Phrase plus Verb Phrase construction). These were presented at five different rates, including one normal rate, two expanded rates, and two compressed rates. Rate was altered mechanically by an Electro-Rate Changer. Each subject was presented with ten sentences at each rate. Comprehension was determined by selecting a corresponding illustration (from a choice of three) that best depicted the spoken utterance. Results indicated that there was no significant difference in comprehension across the five rates for the group as a whole. However, it was revealed that some significant differences occurred for the ten youngest subjects (ages five to seven). It appeared that comprehension was improved at the expanded rate for these young subjects. Thompson suggested that the expanded rate may not hinder comprehension as she previously believed it might.

Berry and Erickson (1973) studied the effects of speaking rate on comprehension by normal children. The subjects in their study were ten kindergarten children and ten second grade children who were at various levels of linguistic development. The receptive portion of the Northwestern Syntax Screening Test (Lee, 1969) was used as the stimulus material. The material was presented at five different rates. The rates were altered by a live voice. The results indicated that correct scores tended to decrease as rate increased and that comprehension varied as a function of sentence length at the compressed rates. Comprehension was better at the two expanded rates than at the three faster rates, including the normal rate. The authors concluded that there is little doubt that deceleration of speaking rate may facilitate comprehension for those children who have not yet reached linguistic maturity.

Stroud (1967) experimented with rate alteration using normal speaking children and children with articulation disorders as subjects. His study revealed significant differences in comprehension at the compressed rate and no differences at the expanded and normal rates. Those children with deviant articulation scored significantly lower in comprehension at the compressed rate than did their normal speaking counterparts at the compressed rate.

DeHoop (1965) conducted a study which compared the abilities of cerebral palsied and other physically handicapped children to comprehend speech which was presented at two speaking rates: one normal rate and one faster rate. These were altered by a live voice. Results revealed that the normal rate appeared to improve comprehension of running speech for both groups. From her experiment, DeHoop hypothesized that auditory perceptual disturbances in the cerebral palsied make it more difficult to comprehend a listening selection when the stimulus conditions are unusual. While DeHoop's study involved only normal and compressed rates, her hypothesis may have some bearing on the comprehension of speech that has been slowed or expanded, as it too is an unusual stimulus.

Studies of rate-controlled speech by aphasic adults have been completed by DeRuyter (1973) and Parkhurst (1971). These studies led to similar conclusions: that aphasic adults performed poorer on tasks involving speech that had been either expanded or compressed. However, Parkhurst (1971) indicated that adult aphasics may benefit when speech is expanded. Her study involved the comprehension of verbal commands by the adult subjects. DeRuyter's research (1973) involved the correct discrimination of paired nonsense words containing one different distinctive feature. Word lists were presented at three rates: expanded, compressed and normal. Results indicated poorer discrimination by the aphasic adults at the two experimental rates. However, later examination of the equipment used for rate alteration revealed that three filters of the expanded mode had caused a distortion in that rate of presentation. DeRuyter hypothesized that this could be a reason for the subjects' poorer scores at the expanded rate.

In an experiment by Sheehan (1975) involving a listening task with aphasic adults, he noted improvements on the second day as contrasted with the first day of exposure to the experimental condition. He pointed out that no improvement in comprehension of the material occurred from day one to day two with the normal listening condition. Sheehan concluded that novel and foreign material needs an introduction and that learning how to listen appears to be important for the aphasic adult.

Compressed speech has been studied extensively by Foulke (1969). His studies of rate-alteration indicated that normal adults perform more poorly on comprehension tasks as rate is increased. Goldstein (1940) also found a linear loss in comprehension as speed of meaningful discourse was increased with normal adult subject. However, in a study by Jester (1966) the experimenter noted similar effects as Sheehan (1975). Jester's study showed that comprehension of material was better at a compressed rate, when presented twice, than at a normal rate presented once. A possible interpretation for this could be that subjects respond better to the second presentation of an experimental condition due to a learning factor.

It is apparent from the studies cited above that compression of the speech stimulus appears to adversely affect comprehension. It also appears that the expansion of speech may have a beneficial effect on the comprehension abilities of young children, particularly those with auditory processing difficulties.

Method of Alteration

A review of the literature on rate-controlled speech reveals three primary methods of alteration:

1. Timing of live voice
2. Speech sampling
3. Pitch Normalizer

It appears important to note that differences in the methods of rate alteration can greatly affect results of the study dealing with the effects of rate-controlled speech on comprehension.

The Berry studies (1971; 1973) employed the use of live voice. The experimenter practiced the timing of speaking at five different rates (syllables per second) before a final taping was completed. As Berry states: "Precise control of the speaking rate is not easily achieved even with practice."

Foulke (1969), Parkhurst (1971), Stroud (1967) and Thompson (1969) have altered rate by means of an Electro-Rate Changer, a mechanical device which controls rate without disturbing the frequency. The Rate-Changer reproduces brief, periodic samples of a speech signal in order to alter rate without affecting the pitch. For this reason, the incoming speech signal must be sufficiently short, as to not delete critical features of the sample. While this machine is an electronic one and alters rate without affecting pitch, only short segments of on-going speech can be altered at a time.

Work done at the University of the Pacific with rate alteration (DeRuyter, 1973) has been done with the Pitch Normalizer, an electronic device which alters rate without affecting pitch. It is a machine

> "which allows expansion to $\frac{1}{2}$ the normal rate or compression by a factor of 2. It has bands of narrow bandpass filters, the output of which is either frequency doubled (in the case of expansion) or frequency halved (in the case of compression). For example, in the twice-rate

mode, a voice spectrum which is normally between 100-3500 Hz is doubled so that it enters the speech processor at 200-7000 Hz. This spectrum is then presented to thirty-six 100 Hz filters spaced 100 Hz apart. The frequency of the output of these filters is divided by 2 to correct for the pitch change and the result is then summed in an amplifier and presented to the listeners." (Harris, 1972)

Because this machine is able to change an ongoing signal, it presents less limitation for use than does the speech sampling method. While both the speech sampling method and the Pitch Normalizer limits frequency band width to some extent, the speech sampling also limits speech input to short segments. It is apparent that further research needs to be done comparing the quality of various machines designed to alter rate.

Comprehension of specific linguistic structures

Studies by Thompson (1969) and Berry and Erickson (1973) with aphasic and normal children involved the comprehension of sentences under altered rate conditions, and it was observed that expanded rate appeared beneficial to comprehension. Berry suggested that length of utterance and grammatical complexity, as well as rate, appear to influence comprehension.

In Berry's study (1971) both groups of subjects examined revealed a difficulty in comprehension of the following contrasting structures (in order of difficulty): question versus statement; direct versus indirect object; and who versus what. In addition, specific structures were more difficult for the kindergarten subjects (in order of difficulty): this versus that and active versus passive roles within a sentence. Comparatively, the fourth most difficult structure for the second grade subjects was irregular noun with verb agreement.

Other research has dealt with the comprehension of specific linguistic structures by normal children. Fay (1972) states: "In language development, shifting the character of pronominal word forms, their referents, case and number, pose special problems for all children". In his discussion of personal pronouns, he states that difficulty exists in the comprehension of heard pronouns and decoding the message in which they are embedded. For example, Fay makes reference to discriminating between the pronoun "you" and "I" in sentences. He adds that often interrogative verbs and wh-question forms act as auditory clues for better understanding of what answer is required by normal children.

Fraser, Bellugi, and Brown (1964) discuss structures which are difficult for the child with auditory processing problems to comprehend at a normal rate of speech. They note that structures presenting least difficulty are: affirmative versus negative; subject versus object in the active voice; and present progressive and future tenses. According to these authors, the most difficult contrasts appear to be: indirect versus direct object; subject versus object in the passive voice; and singular versus plural marked by inflectional endings. These observations are in agreement with the findings of Berry (1971) in her study of comprehension of structures by normal children.

Chappell (1972) offers further information regarding the comprehension breakdown experienced by children with receptive language problems. He reviewed previous research and noted that often these children experience difficulty with: homonyms, words for concepts of modality specific experiences, words for spatial relation concepts, quantitative words, words centering around temporal relations, concepts of similarity and differences, and question forms.

Under normal rate conditions, Semel and Wiig (1975) have observed the comprehension abilities of normal and learning disabled children for specific linguistic structures. They used the Assessment of Children's Language Comprehension (Foster, 1972) and the receptive portion of the Northwestern Syntax Screening Test (Lee, 1969) as their test instruments. Their results showed that the learning disabled subjects appeared to have a reduction in comprehension of linguistic concepts requiring logical operations and simultaneous analysis. Using the Assessment of Children's Language Comprehension, it was observed that the learning disabled group scored approximately the same as the normal group on one-word vocabulary items. Their scores on the test decreased as more critical elements were added to the previous structures. The results of the Northwestern Syntax Screening Test presentation showed that overall, the learning disabled group scored six percent lower than the normal group. The following structures appeared particularly difficult for the learning disabled group: who versus what; question versus statement; this versus that; direct versus indirect object. Results of the administration of the Assessment of Children's Language Comprehension also suggested difficulty with possessive relations and spatial relations for the learning disabled group.

Another study by Wiig and Semel (1973) looked at the comprehension of linguistic concepts which require logical operations. They compared the comprehension of learning disabled and normal achievers, between the ages of seven and eleven years of age. Their comprehension test was developed from both the Minnesota Test for Differential Diagnosis of Aphasia (Schuell, 1965) and from a language assessment battery by Luria (1966). They examined five relationships: comparative relationships, passive constructions, relationships between sequential events, spatial relations, and familial relationships. Their results indicated that the learning disabled group comprehended less across all five areas than did the normal achievers. Further, the most difficult category for the learning disabled group was familial relationships; the least difficult category was comparative relationships. The normals, on the other hand, had the most difficulty with the relationships between sequential events, and least difficulty with comparative relationships and familial relationships. These results seem to indicate a difference in comprehension between learning disabled and normal achievers, as well as a reduction in comprehension between the two groups. The authors quote Goodglass and Kaplan (1972) who state that the discrimination and interpretation of familial relationships depends entirely on word order. Semel and Wiig therefore conclude that the last word in a sequence could assume primary importance. They further suggested that learning disabled children react to the sequence of the critical elements rather than the syntax, as evidenced by results of reactions to passive constructions. Thus, it can be noted that for both the Berry (1971) and Semel and Wiig studies (1973;1975), it appears that the same structures are more difficult for young normal and learning disabled children.

The above studies appear to have various implications concerning the breakdown in comprehension by the aphasic child. While not many studies have dealt directly with the comprehension of linguistic structures by aphasic children, it appears evident that there are various factors of the spoken message which influence the aphasic child's understanding of it. It appears that their systems lose many of the linguistic cues within sentences that are vital to understanding their semantic purpose. Perhaps an expansion of the rate of the presented stimuli may enhance comprehension of more difficult structures.

STATEMENT OF THE PROBLEM

This study was designed to determine if there was a significant difference in the comprehension of rate-controlled speech by young aphasic and normal children; and if comprehension of specific linguistic structures was affected by the rate of presentation.

It was hypothesized that the aphasic children would better comprehend linguistic structures which were presented at the expanded rate of speech, as compared to the normal and compressed rates.

It was further hypothesized that the normal children would comprehend structures better at the expanded rate than at the normal rate.

It was also hypothesized that the compressed rate of speech would be more difficult to comprehend by both groups of children.

CHAPTER III

PROCEDURE

The purpose of this study was to determine if the comprehension of specific linguistic structures by young normal and aphasic children would vary when they were presented at three different speaking rates. The rates were 45 w.p.m., 90 w.p.m. and 180 w.p.m. The study was also designed to determine which linguistic structures would present the most difficulty for the subjects under each rate condition.

Subjects

A total of sixteen subjects were initially chosen to be included in the study. Subjects were children whose ages ranged between 5-0 years and 7-0 years. Mean age in both groups was 6-0 years. Sex was not consisered a variable. Another requirement for inclusion in the study was that the subject would be willing to wear a set of headphones for a ten to fifteen minute period on three separate occasions, and would be able to attend to the task presented for that period of time. One subject was excluded due to an inability to attend to the task.

The experimental population consisted of ten children with receptive language disorders. The control group consisted of five children without language disorders. The criteria used for being placed in each group follows.

The aphasic group, those with receptive language disorders, was composed of ten children currently enrolled in an Aphasia/Severe Oral

Language Handicap program of the Stanislaus County Department of Education. As part of the selection of subjects for the present study, the requirements for admittance into the Aphasia/Severe Oral Language Handicap program were used. Stanislaus County uses the State of California guidelines for determining placement criteria. These guidelines are:

1. has a severe disability in the comprehension and/or expression of oral language.

a. The minor shows normal intellectual potential as measured by instruments that do not require oral directions or oral expression.

b. Scores on auditory-verbal scales on one or more standard tests or sub-tests of language assessment fall two standard deviations below the mean for the minor's mental age as indicated in (a), except that any minor above the two standard deviations but below one standard deviation may be designated as an aphasic and/or severe oral language handicap if agreed upon with the unanimous decision of the administrative committee.

c. The minor is non-verbal or when spontaneous language sample of at least 50-100 utterances can be obtained, the sample shows development judged clearly inadequate for the minor's age in at least two of the following areas of language development: syntax, semantics, morphology, phonology.

2. The disability is of such severity as to require enrollment in a special day class, intensive remedial instruction, or an integrated program of instruction.

3. Aphasia and/or Severe Oral Language Handicap is evidenced by the

written statements certifying that the minor has a severe speech and/or language disorder, not due to deafness, mental retardation, or autism (Stanislaus County Department of Education, 1975).

In addition, a further criteria for inclusion in the experimental population was the judgment on the part of the classroom teacher that the child had a language disorder which was primarily receptive in nature rather than expressive. Each participating classroom teacher held a credential in speech and hearing, and it was believed that their judgments would insure that children with normal comprehension abilities would not be included in the aphasic group.

The control group was composed of five children enrolled in a normal first grade classroom in the Stockton Unified School District. Criterion for selection of the control group was as follows:

1. Enrollment in a normal classroom

2. Currently not receiving any form of remedial education or special services in the area of reading, mathematics, or speech.

The criterion were developed in order to insure that the subjects were at least of average intelligence and did not have any type of learning disability that would interfere with normal comprehension of speech.

Stimulus material

The stimulus material used in this study consisted of 38 sentences and four single words. Each sentence was characterized by a specific linguistic structure ranging from three to ten words in length and with varying complexity. Each structure (or word) was selected in accordance with previous research which had determined that aphasic, normal and learning disabled children experience difficulty in the comprehension of these structures. The stimulus material is listed by structure in Appendix D. Each structure is defined below, according to Watkins (1971). Also included is the number of sentences used in the test stimuli which represented these structures.

Pronouns. Four structures involving pronouns were included in the test stimuli. Two involved number-gender distinction in pronouns, which distinguished the number of persons and their sex within a structure. One structure involved distinguishing the pronoun "you" within a structure, and is referred to as a pronoun reference. The fourth involved a demonstrative pronoun, which points out an individual or idea.

Subject-object reversal. The subject of a sentence is the one performing the action (verb), and the object is the one affected by the action of the verb. Reversal occurs when the subject and object of a sentence are interchanged within the sentence. Two examples of subject-object reversal occur in the test stimuli.

Possessive case noun is defined as the use of the possessive form (denoting ownership) before a noun. One example of this structure was included.

Negation is the nullification of the sentence or parts of the sentence. In the test stimuli, examples of negation of the noun phrase were used and two sentences representing negation of the verb were used.

Future tense denotes a verb which is subsequent in time to the present. One example of future tense was used in the test stimuli.

Subject-verb agreement. The number indicated by the noun in the sentence must agree in number with the verb of the same sentence. Two examples of this construction were included.

Active-passive voice; embedded active-passive clause. A transitive verb is either active or passive. When the subject acts, the verb is active. When the subject is acted upon, the verb is passive. In the test stimuli, two active-passive voice structures were used. The embedded clause is that which is an inclusion within a sentence. Two examples of this construction were used in the test material.

Comparative. It expresses an increased or less diminished degree or amount of quality or manner of an adjective or adverb, denoted by the simple form. Two comparative structures were in the test stimuli.

Quantity denotes amount in the case of this test, when referring to a noun. One structure was included.

Time relation refers to the concept of succession of events. One sentence represented this structure.

Spatial relation refers to the position, place or direction of objects in space. Three examples of this were used under the headings spatial relation, preposition of place, and order in series. Preposition of place refers to a prepostional phrase which indicates the place of an object in space. Order in series refers to the postion of an object in a series of objects.

Direct-indirect object. A direct object is a noun, pronoun, or other substantive receiving the action of the verb. An indirect object is the word which indirectly receives the action of the verb. Two sentences involving both of these were included in the test material; one uses the indirect object as a recipient of an action and the other uses a prepositional phrase (as an indirect object) as receiver of the action.

Question form. In this study's test, questions involved either what, who or where. Three sentences of this form were used.

Perfective aspect indicates time or action completed before another time or action. One sentence represented this structure in the test.

Past tense denotes action that has been completed. One sentence in the test represented this structure.

Noun marker is an addition to a noun which demotes a quality of the noun. One adjective noun marker was included in the test.

Adjective attribute. An adjective modifies a noun or pronoun. In constructions, the term attribute is used for the modifier. In the test material, three sentences represented this.

Pun is defined as one word with two or more meanings. One pun was included in the test material.

Object of embedded verb is psuedo-subject. In this structure, the direct object of the verb acts as the subject of the sentence.

Four of the sentences were taken from the Northwestern Syntax Screening Test (Lee, 1969) and represented the following structures: question form, demonstrative pronoun, and possessive case noun. Four sentences were taken from the Test for Auditory Comprehension of Language (Carrow, 1973) and represented these following structures: future tense, adjective noun marker, and spatial relation (preposition of place). The remaining sentences were designed by the experimenter.

The three graded vocabulary items used in the test were selected from the Dolch Reading List (1936) and the Slosson Oral Reading Test (1973), in accordance with a specified order of acquisition in the reading process.

Recording process

The stimulus material was divided into three different lists. Each list contained all 42 stimuli, but in a different, random order. Each list was recorded by a native North American female speaker. The recording was done in a soundproof room on a Sony-Matic T-104 taperecorder, at the speed of 3-3/4 cps.

The speaker practiced each list so that the sentences were spoken at a normal rate of speech (90 w.p.m.) and without noticeable inflection of key words within the sentence, which might give clues as to the correct response. The speaker also observed the VU meter of the taperecorder to insure that each utterance was fairly consistent in volume.

List 1, which was later used as the expanded rate, was recorded with a three second pause between utterances; this produced a six second pause after time alteration. List 2, used for the compressed rate, was recorded with a ten second pause between utterances, to insure a five second pause in the final compressed tape. List 3, used for the normal rate, was recorded with a five second pause between utterances.

Time alteration

In order to alter the rate of the recorded stimuli, the LM-312 Pitch Normalizer was used. The Pitch Normalizer is an electronic device which alters rate without affecting the pitch. It is capable of changing the rate of an ongoing speech signal.

The machine was on loan to the University of the Pacific by Lockheed Missiles and Space Company. At the time of its use for this study, it had just returned from the company after being serviced. Because of this the quality of the recordings was satisfactory.

The process of rate alteration for each recording involved the use of two taperecorders (TC-540 Sony Solid State) which were connected to the Pitch Normalizer. The original recording was played from Machine 1 into the Pitch Normalizer and the time-altered tape was recorded directly onto a tape of the second recorder. In order to expand List 1 the original tape was fed into the Pitch Normalizer at 1-3/4 cps. Compression was done by feeding the original recording (List 2) into the Pitch Normalizer at 7½ cps. List 3 was run through the machine as well, at 3-3/4 cps at the normal mode of the machine. The normal mode filters the speech sample, limiting certain frequency band widths, as it does at the expanded and compressed rates. It does not, however, alter the rate at this mode. The end result of the rate alteration was: 90 w.p.m. (normal), 45 w.p.m. (expanded), and 180 w.p.m. (compressed).

Response mode

A non-verbal response mode was employed. Each child was required to point to one of three pictures that they believed best illustrated the sentence they heard through the headphones. The subjects were shown one set of three pictures with each auditory presentation.

Forty-two sets of three 3½" by 9" black and white drawings were used to correspond to the 42 items of the auditory stimulus. Each set of drawings was taped to a 15" by 9" piece of blue cardboard that could be easily handled without its bending.

Each set of drawings consisted of the following:

1. A drawing depicting the structure/word presented auditorily.
2. A drawing depicting a contrasting structure/word
3. A miscellaneous drawing

Appendix B presents the drawings.

Subject instructions

Each subject was given the following instructions:

> You are going to hear me talking on these headphones. When you hear what I say I want you to point to the picture that I am talking about. Listen carefully because sometimes I will sound different. You don't have to hurry, so take your time.

The subject was then given two trial sets of pictures. The examiner used a live voice at normal rate to determine if the child understood the instructions. If no response was made, or if an incorrect response was made, the examiner repeated the sentence using a carrier phrase "Show me ________".

Presentation of stimuli

The three tapes were presented to the subjects with an interval of two weeks between each presentation. This period of time was selected in an effort to reduce learning. Each subject was presented with the experimental rate conditions on the first and second presentations. All subjects were presented with the normal rate condition on the third presentation.

Each subject was seated in a quiet room, facing a wall, to prevent visual distractions. The subjects were required to wear a set of binaural headphones (KOSS KO-727B) for receiving the auditory stimulus. A TC-540 Sony Solid State taperecorder was used for presenting the taped lists. The examiner also monitored the stimuli through a set of headphones.

The 42 sets of drawings were placed in a pile in front of the subject. The examiner was seated next to the child and turned each card after a response was made. If no response was made, or if responses were made slowly, the examiner stopped the recording. At no time was a subject allowed to hear the auditory stimulus twice. The examiner recorded the subject's response on a score sheet.

CHAPTER IV

RESULTS AND DISCUSSION

This study was designed to determine the effects of rate-controlled speech on the comprehension of specific linguistic structures by young normal and aphasic children. In addition, the study was intended to determine if comprehension of specific linguistic structures varied across rate conditions.

It was hypothesized that:

1. The expanded rate of speech would aid comprehension by the aphasic children, when compared to the normal and compressed rates;

2. The control group would comprehend the structures better at the expanded rate than at the normal rate condition; and

3. The comprehension of linguistic structures would be more difficult at the compressed rate, when compared to the normal and expanded rates for both groups.

All responses were recorded by this experimenter and then analyzed statistically. Further analysis was done in terms of percent correct. The raw scores for each subject appear in Appendix C.

The Mann-Whitney U Test (Siegel, 1956) was selected as an appropriate non-parametric measure for related samples with small numbers of subjects. A statistical analysis of correct scores for subjects within each group was performed, at the three rate conditions. For purposes of this study a .05 level of confidence was used as the upper limit to consider significant differences. This analysis revealed the following results:

1. A significant difference in comprehension was revealed between the aphasic and control groups at the expanded rate, with the control group obtaining higher scores.

2. A significant difference in comprehension was revealed between the aphasic and control groups at the compressed rate, with the control group demonstrating significantly higher scores.

3. A significant difference in comprehension was revealed between the aphasic and control groups at the normal rate, with the control group demonstrating significantly higher scores.

Further analyses were completed to test the hypothesis that the expanded rate would aid comprehension by the aphasic group. The Mann-Whitney U Test was performed to compare the scores of the aphasic group at the expanded, normal and compressed rates. The following results were observed:

1. For the aphasic group, a significant difference in comprehension was revealed between the expanded and normal rates, with higher scores at the normal rate.

2. For the aphasic group, a significant difference in comprehension was revealed between the expanded and compressed rates, with higher scores at the expanded rate.

3. For the aphasic group, a significant difference in comprehension was revealed between the normal and compressed rates, with higher

scores occurring at the normal rate. Therefore, the normal rate was the mode of presentation which produced higher overall comprehension by the aphasic subjects.

Similar statistical analyses were performed to compare the scores at each rate for the control group. The following results were obtained:

1. For the control group, no significant difference in comprehension was revealed between the expanded and normal rates.

2. A significant difference in comprehension between the normal and compressed rates was revealed, with the controls as a group demonstrating higher scores at the normal rate.

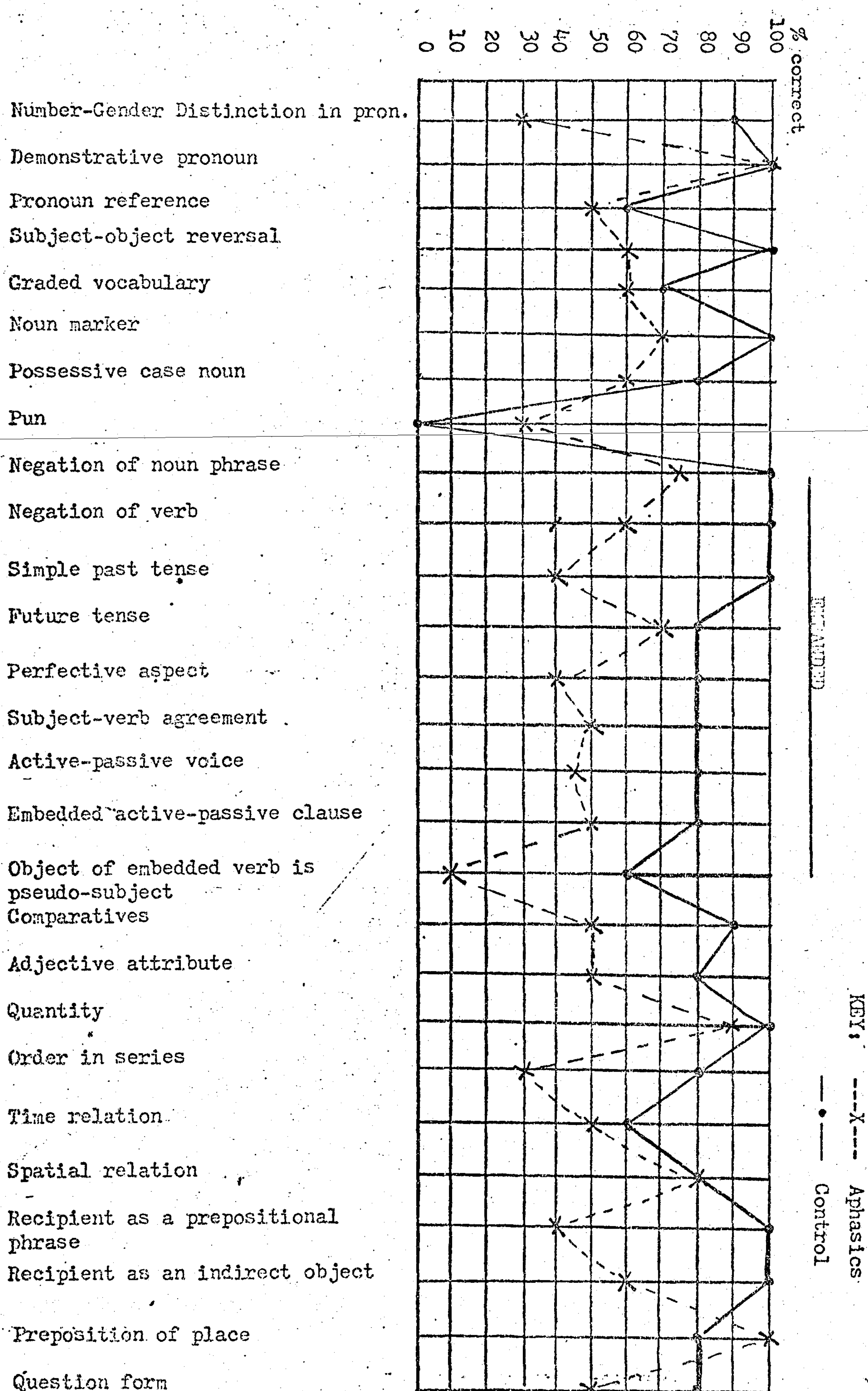
3. For the control group, a significant difference in comprehension was revealed between the compressed and expanded rates, with higher scores being demonstrated at the expanded rate.

Therefore, the normal and expanded rates were revealed to be the modes of presentation which produced higher comprehension scores by the control group, when compared to the compressed rate. Any difference between comprehension at the expanded or normal rates did not attain the level of significance established.

A further purpose of this study was to determine if comprehension of any specific linguistic structure was altered by the rate of presentation. Therefore, further observation was made of responses by the two groups of subjects under the three rate conditions to individual linguistic structures. Appendix D lists each structure, its corresponding sentence(s) and the percentage of correct responses by the groups of subjects under each rate condition.

It was observed that differences in comprehension of certain linguistic structures occurred between the two groups as well as across the three rate conditions. These observations are summarized on the following three pages. Table 1 illustrates responses by each group to the linguistic structures at the expanded rate. Table 2 illustrates the responses of each group to the structures at the normal rate. Table 3 illustrates the responses made by each group to the structures at the compressed rate. It must be remembered throughout this chapter that results refer only to the small population of children used in this study and cannot be applied to a general population of children.

TABLE 1. PERCENTAGES OF CORRECT RESPONSES BY SUBJECTS AT EXPANDED RATE CONDITION.



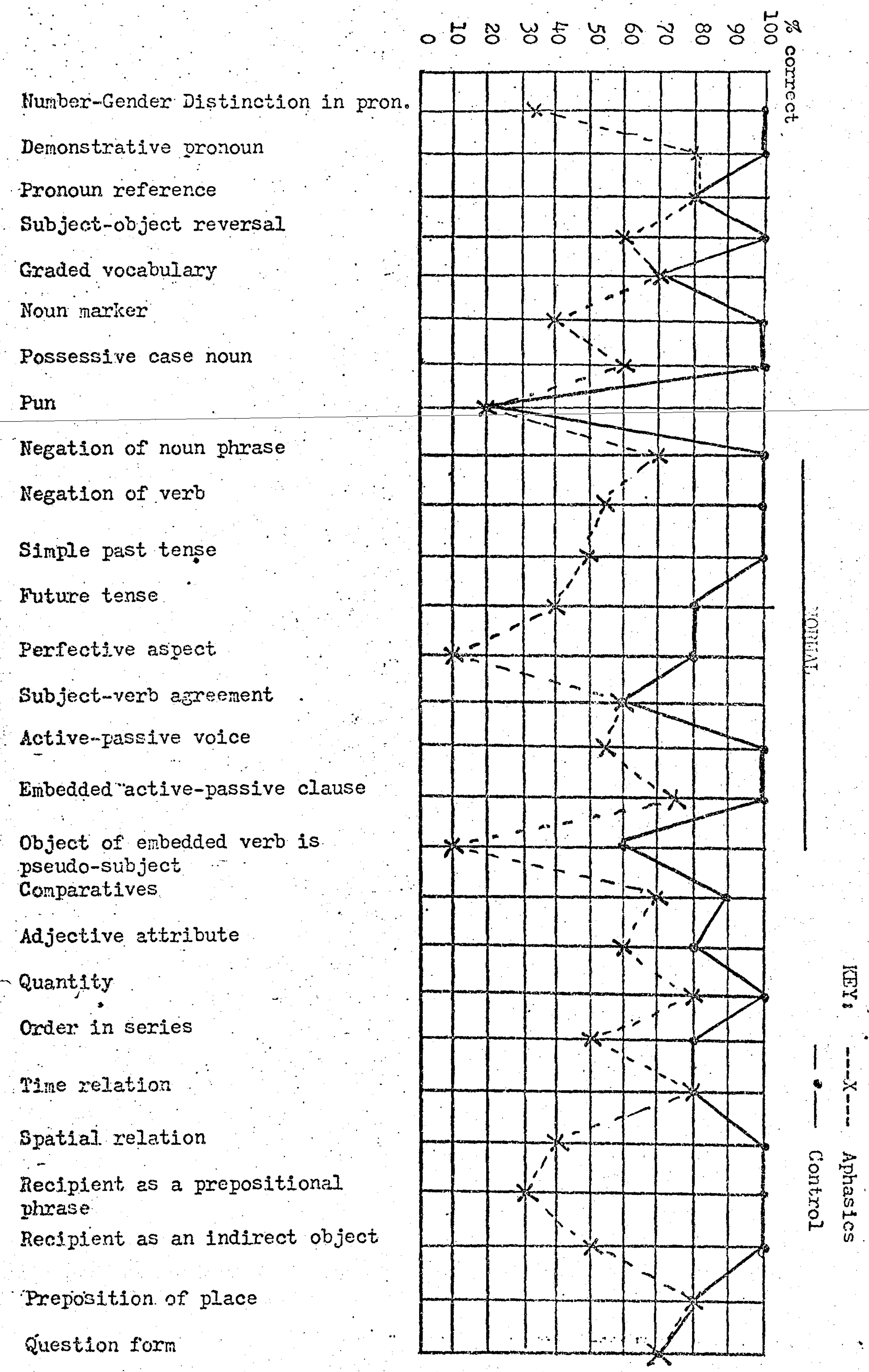


TABLE 2. PERCENTAGES OF CORRECT RESPONSES BY SUBJECTS AT NORMAL RATE CONDITION.

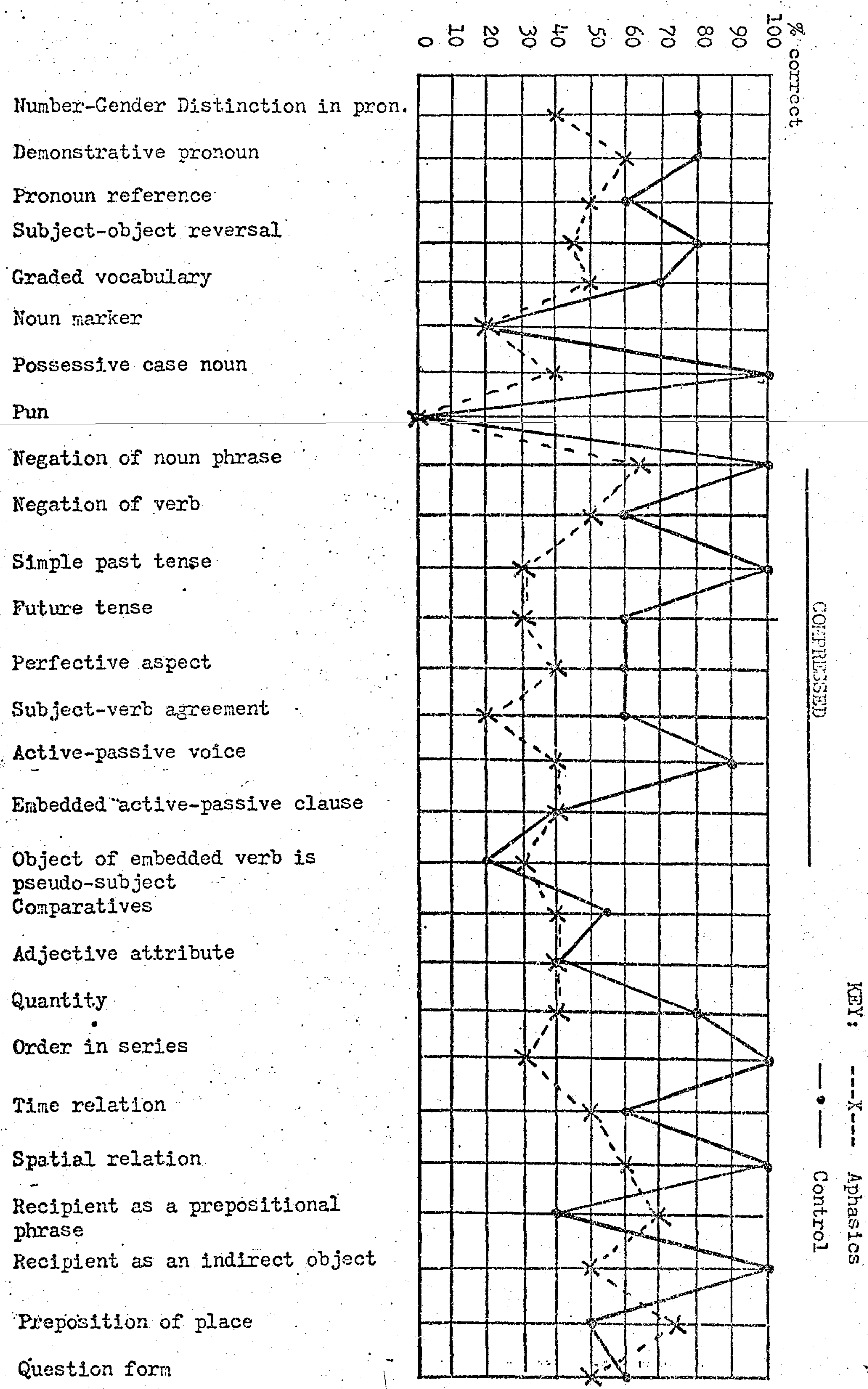


TABLE 3. PERCENTAGES OF CORRECT RESPONSES BY SUBJECTS AT COMPRESSED RATE CONDITION.

Discussion of the Data

It was expected that the aphasic group would demonstrate poorer comprehension of verbal information when compared to their normal counterparts, due to their known auditory processing deficit. Statistical analysis supported this expectation: the control group demonstrated higher comprehension scores than did the aphasic group at all rates.

The results of this study did not support the hypothesis that comprehension would be improved for the aphasic group at the expanded rate, as compared to the normal rate. Thompson's study (1969) had suggested that younger aphasic subjects might benefit from speech presented at an expanded rate. Parkhurst (1971), too, had stated that aphasic adults appeared to benefit when speech was presented at an expanded rate on comprehension tasks. A possible explanation for the apparent disparity between the results of the present study and the studies just cited may be that the expanded rate condition was perceived as an unusual stimulus by the subjects. This was suggested by DeHoop's (1965) observations that auditory perceptual disturbances may make it more difficult to comprehend a listening selection when the stimulus is unusual. Jester (1966), in his work with normal adult subjects, noted that comprehension of material was better when the experimental condition was presented twice. Sheehan (1975) also observed that training in learning how to listen appears important for subjects with auditory processing difficulties. He stated that novel and foreign material may require an introduction. His study revealed an overall improvement in comprehension of an interpolated tape on the second day of its presentation. He pointed out that improvement occurred only for younger aphasic adults, and that under normal (non-experimental) listening conditions no significant increase in learning occurred. Since no pre-training with either the expanded or compressed rates occurred in the present study, the subjects were not prepared for this particular stimulus. Accordingly, their performance showed no improvement under the expanded condition. It appears, then, that the amount of exposure is a factor to be taken into consideration when analyzing the results of this and other studies which deal with rate modification.

The second hypothesis, that the expanded rate would improve comprehension by the control group as compared to the normal rate, was not supported by the results of the study. Analysis of the results for both the expanded and normal rates revealed no significant differences in comprehension by the control group. This result runs counter to the results reported by Berry and Erickson (1973) involving a normal population of children. Their study indicated better comprehension occurred at the two expanded speaking rates. One explanation for this disparity could be the fact that their subjects, like the aphasic subjects mentioned previously, were not prepared for the unusual stimulus. Another reason could be that the Berry and Erickson study used live voice. The authors noted that it is difficult to control speaking rate even with practice. Their experiment produced speech that was altered to the rates of 2.6, 3.4, 4.7, 5.3 and 6.3 syllables per second, while the present study altered a normal rate of 90 w.p.m. to 45 w.p.m. and 180 w.p.m. respectively and was done electronically.

Results of the present study supported the hypothesis that, for both groups, there would be better comprehension at the expanded and normal rates as compared to the compressed rate. This finding is in agreement with previous research (Berry, 1971; Stroud, 1967; DeHoop, 1965; Foulke, 1969; Jester, 1966) which revealed that, for both children and adult subjects, there was a linear loss in comprehension as speech was compressed.

In summary, results of this study did not support the first two hypotheses, that comprehension of linguistic material by both groups of children would improve when speech was expanded. Results did support the third hypothesis, that both groups would comprehend speech presented at the expanded and normal rates more readily than they would speech presented at the compressed rate.

Facilitation of comprehension at the expanded and normal rates

Although the overall results did not indicate that either group's comprehension was enhanced by expanding the material, it is interesting to note that certain specific linguistic structures appeared to be better comprehended by both groups at the expanded rate as compared to the normal rate. The aphasic group showed improved comprehension of five structures; the control group of one. The structures which the aphasic group understood more readily at the expanded rate were: noun marker, demonstrative pronoun, future tense, spatial relation and perfective aspect. Fraser, Bellugi and Brown (1964) and Chappell (1972) noted that spatial relation is a structure presenting particular difficulty for the aphasic population. On the other hand, future tense was noted by Fraser, Bellugi and Brown (1964) as being least difficult for children with auditory receptive difficulties. Therefore, the expanded rate facilitated the comprehension of other structures not previously noted as being of special difficulty to this population.

It should be noted that, at the normal rate as contrasted with the other two rates, the aphasic group received higher comprehension scores on five of the structures: time relation, pronoun reference, embedded active-passive clause, comparative, and question form. Chappell (1972), Fay (1972), and Fraser, Bellugi and Brown (1964) pointed out that these particular structures present difficulty in comprehension by normal children as well as to those with auditory processing difficulties.

The control group demonstrated higher scores at the expanded rate on only one structure, in constrast to all other structures: subject-verb agreement. At the normal rate, this group showed better comprehension of two structures, in contrast to all other structures: active-passive voice and time relation.

Inconsistent responses made by individual subjects to structures

Differences between the two groups in comprehension of certain structures may be explained by the fact that some structures were represented by more than one sentence. It is important to note that even within groups, subjects responded inconsistently. Sentences representing a particular structure were often not responded to in the same way. Evidently, some sentences featuring a particular structure were more difficult to comprehend than others with the same structure. For the aphasics, inconsistent responses were noted for the following structures: subject-object reversal; embedded active-passive clause; comparative; negation of verb; negation of noun phrase; question form; and preposition of place. For the control group, inconsistent responses were observed for these structures: graded vocabulary; comparatives; question form; negation of verb; and preposition of place. It should be noted that the last four of these structures were inconsistently responded to by both groups. Possible reasons for this may be that the pictures representing the structures were not adequately clear to the children, or that the length of some of the sentences demonstrating a particular structure was greater than others. However, within only one structure, the comparative, was there notable difference in length of utterance, eight words as compared to five. Other structures demonstrated lengths of three or four words. The possible influence of length on comprehension is discussed further in a later section.

Difficulty in comprehension at all rate conditions

The aphasic group experienced difficulty in comprehension at all rates for the following structures, in order of difficulty: pun, object of embedded verb is pseudo-subject; perfective aspect; number-gender distinction in pronouns; and recipient as prepositional phrase. They experienced special difficulty with certain structures at the expanded rate which hadn't occurred at the normal rate of presentation. These were: order in series and active-passive voice. They showed frequent errors in comprehension at the normal rate for the following structures, in order of difficulty: noun marker, future tense, and spatial relation. Moreover, the subject-verb agreement structure was difficult for aphasics at the compressed rate. It is interesting to note that this same structure was more easily comprehended by the control group at the expanded rate. This could indicate that comprehension of this structure, which is ordinarily difficult, can be improved by slowing its rate of presentation.

The control group experienced difficulty with the pun at all rates of expression. Moreover, when the compressed rate was introduced they had increased difficulty comprehending the following structures, in order of difficulty: pun, noun marker, object of embedded verb as pseudo-subject; and recipient as prepositional phrase. Since these structures are similar to those which presented difficulty to the aphasic group at all rates, it appeared that, when subjected to the compressed rate, the control group experienced a comprehension deficit similar to that of the aphasics. This supports Aten's observation (1970) that the difficulty the aphasic experiences has to do with time, since given less listening time (compressed rate), the normal group shared this problem.

Chappell (1972) observed that children with receptive language problems often experience comprehension breakdowns with words of spatial relation, temporal relation and quantitative words. In the present study, the aphasic group seemed to have no difficulty comprehending time relation or quantity, but they did demonstrate difficulty with the spatial relation structure across rate conditions.

Question forms did not appear to pose particular difficulty for the control group at the normal or expanded rate, but did for the aphasic group at all rates. Fay (1972) believes question forms and interrogatives often serve as auditory cues for better understanding by normal subjects, and

Chappell (1972) listed the question form as difficult for those children with auditory processing disorders. The present study supported their observations.

Semel and Wiig (1973) viewed comparatives as presenting difficulties for children with learning disabilities. In this study, the aphasic group had trouble with one sentence used to demonstrate the comparative structure: "This is bigger and heavier than a dog." This was the longest sentence within that structure, and that the group had difficulty with it bears out Berry's (1971) suggestion that length of utterance may influence comprehension just as do grammatical complexity and rate. Semel and Wiig also noted that learning-disabled children appear to react to the order of words rather than to syntax, as evidenced by their reactions to passive constructions. Neither the aphasic nor the control group in the present study seemed to have difficulty with the active-passive voice at the normal rate, but the aphasic group did experience more difficulty with it at the expanded rate. Possibly the reason was that, with the expanded rate, the child is required to retain information a longer time from the beginning to the end of the utterance. This may indicate that longer sentences are more difficult to comprehend at the expanded rate. A short memory span is a characteristic of the aphasic child mentioned by both Aten (1970) and Eisenson (1966). The retention of lengthy structures at the expanded rate may negatively influence comprehension.

A final observation based on the results of this study may be made by examining the individual scores of the subjects on each presentation. Four of the ten aphasics and three of the five controls actually obtained higher scores at the expanded rate than at the normal rate. This may indicate that some young subjects perform better on comprehension tasks at an expanded rate, as suggested by Thompson (1969) and Parkhurst (1971).

Throughout this discussion, it is important to realize that due to the small population of subjects used in the study, it is difficult to make generalizations about the comprehension abilities of the aphasic population as a whole. Further, the small number of structures tested limits the inferences that can be made concerning comprehension of specific linguistic structures by normal or aphasic children. What is important to note is that the subjects' comprehension was affected by the rate of presentation. Also, results between the two groups appear to be both quantitatively and qualitatively different. This is supported by the fact that the aphasic group demonstrated poorer comprehension across rates, and results revealed that comprehension of linguistic structures was variously affected at the different rates between the two groups.

CHAPTER V

SUMMARY AND SUGGESTIONS FOR FURTHER RESEARCH

The aphasic child often exhibits breakdowns in comprehension of spoken utterances. It has been noted by researchers (Chase, 1972; Eisenson, 1966) that often comprehension is aided by simplifying the spoken sentence or speaking more slowly. The use of rate control as an aid to comprehension of specific linguistic structures has been a focus of research with young normal and aphasic children (Thompson, 1969; Berry and Erickson, 1973). These researchers suggest that comprehension is aided by expanding the rate at which the speech signal is presented. Other research (Foulke, 1969; Stroud, 1967; Jester, 1966) supports the idea that comprehension decreases as rate is increased.

Based on this, the present study was designed to answer the following questions:

1) what effect does rate-controlled speech have on the comprehension abilities of young normal and young aphasic children? and

2) are specific linguistic structures more readily comprehended by young normal and young aphasic children when rate is controlled?

Method

Fifteen children, between the ages of five and seven years, were divided into two groups. The aphasic group was comprised of ten children diagnosed as aphasic/severe oral language handicapped by the Stanislaus Department of Special Education. This diagnosis included: normal intelligence, as determined by a non-verbal intelligence scale; normal hearing; and a language delay in either the comprehension and/or expression of language which warrants remedial education. An additional criterion was a judgment on the part of the special class teacher that the child experienced an impairment primarily influenced by an auditory processing disorder. The five normal (non-language impaired) subjects were of normal intelligence, of normal hearing, enrolled in regular classrooms, and currently not receiving remedial educational services.

The stimulus material consisted of 38 linguistic structures and four single words which were presented to each subject auditorily through headphones. Responses by the subjects involved pointing to one of three pictures which they believed best represented the sentence they heard.

Each child was presented with all 42 stimulus items under three rate conditions: expanded, compressed and normal. Presentations were at a two week interval for each subject, to reduce the learning effect.

The compression and expansion of the stimulus material was done by means of the Pitch Normalizer, an electronic device which alters rate without affecting pitch. The responses of the subjects to the stimulus presentation were analyzed statistically.

Results and Conclusions

The Mann-Whitney U Test was performed, revealing the following:

1) Significant differences in comprehension occurred between the two groups for all rate conditions.

2) Significant differences in comprehension of linguistic structures occurred within the control group, the normal and expanded rate conditions benefitting comprehension above that of the compressed rate.

3) A significant difference in comprehension was observed between the normal and expanded rate conditions for the aphasic group, with higher scores occurring at the normal rate.

Although expansion of speech did not appear to aid comprehension for either group of subjects, it was observed that certain structures were comprehended better at the expanded rate. Also, some individual subjects obtained higher comprehension scores when speech was slowed. The length of utterance, however, must be considered as having influenced the comprehension of certain structures at the expanded rate. The reason for this could possibly be that it is difficult for the aphasic child to retain lengthy units of information due to a short memory span. Therefore, perhaps expansion of speech only aids in the comprehension of short utterances. Due to the small population used in the study, it is difficult to make any conclusions regarding the auditory processing abilities of young normal and aphasic children based on the results obtained.

Suggestions for further research

The following topics have been suggested for further research by this study.

1) A study involving a larger population of aphasic children is needed to determine what percentage of these children could benefit from expanded speech.

2) A study is needed to expand the rate of speech to even more than 50%, as was done in the present study. Perhaps comprehension would be aided by even greater expansion. Also, an observation made by this

experimenter was that some shorter sentences appeared to be more easily comprehended at the expanded rate. It is suggested that because a shortened memory span is one characteristic of the aphasic child (Eisenson, 1966; Aten,1972) that this may negatively influence comprehension of lengthy structures at the expanded rate. Therefore, if the rate was further expanded, results might reveal that the auditory processing system of the aphasic child cannot deal with longer durations of time in processing lengthy utterances.

3. More research is needed in the area of comprehension of linguistic structures at all rates of speech, by both normal and aphasic children.

4. Finally, if aphasic subjects were exposed to several presentations of the expanded rate, perhaps differences in comprehension would be evident. This would analyze the effect of learning on this type of stimulus.

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APPENDICES

LIST OF TEST STIMULI

APPENDIX A

#	Structure (word)	Sentence	Additional sentences suggested by drawings
1	Number-gender distinction in pronouns.	She is sleeping.	He is sleeping; they are sleeping.
2	Subject-object reversed with same surface structure	The wolf bites the duck.	The duck bites the wolf; wolf bites the log.
3	Embedded active-passive clause	The duck is glad to eat.	The duck is good to eat; the duck runs.
4	Adjective noun marker	Farmer	Farm; city
5	Graded vocabulary	Architecture	Art; armadillo
6	Passive-active voice	The boy is pushed by the girl.	Girl is pushed by the boy; boy is pushing the door.
7	Adjectives: two co-ordinate modifiers for one noun head (comparative)	This is bigger and heavier than a dog.	This is a dog; this is smaller and lighter than a dog.
8	Wh-question form for location	Where is the girl?	The girl is looking for the lady; The boy and girl are sitting down.
9	Time relation	The dog will eat after the cat.	The dog is eating first; the dog and cat are eating together.
10	Two non-co-ordinate modifiers for one noun head (absolute)	A large red ball.	A small red ball; a large blue ball.

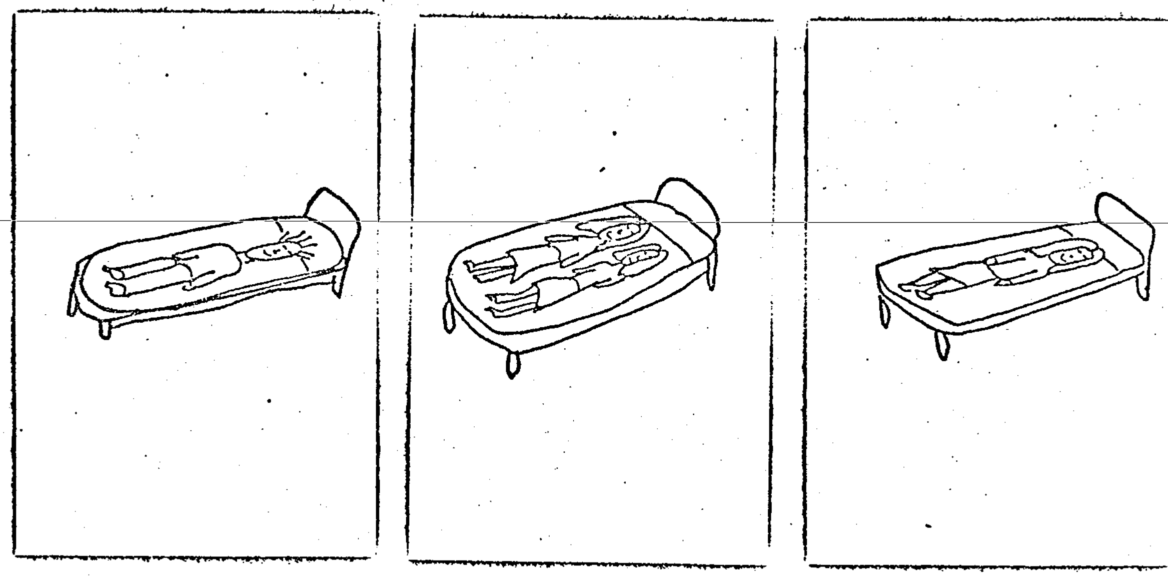
#	Structure	Sentence	Additional sentences suggested by drawings.
11	Recipient as prepositional phrase	He gives the block to Father.	Father gives the block to him; she gives the block to Father.
12	Subject-verb agreement (irregular noun)	The deer are eating.	The deer is eating; the deer are running.
13	Noun in possessive case	This is mother's cat.	This is a mother cat; this is Father's cat.
14	Adjective attribute.	Fast.	Slow-stationary
15	Quantity	She has more blocks.	She has no blocks; he has fewer blocks.
16	Uncontracted negation of verb	She is not smiling.	She is smiling; he is smiling.
17	Preposition of place	The cat is under the chair.	The cat is beside the chair; the cat is on the chair.
18	Perfective aspect (past participle)	Mother has done the work.	Mother is doing the work.
19	Graded vocabulary	Where is the dog barking?	Where is the dog standing? Where is the dog eating?
20	Comparative	This is colder than milk.	This is milk; this is hotter than milk.
21	Pronoun reference	The boy is looking at you.	The boy is looking away; the boy is looking at her.
22	Same as #2	The duck bites the wolf.	

#	Structure	Sentence	Additional sentences suggested by drawings.
23	Same as #3	The duck is good to eat.	
24	Graded vocabulary	Empty	Full; half full
25	Same as #6	The girl is pushed by the boy.	
26	Spatial relation	The girl is on top.	The boy is on top; the boy and girl are on top.
27	Wh-Question form for human referent	Who is at the door?	What is at the door?; a door.
28	Wh-Question form for object referent	What is in the box?	Who is in the box?
29	Order in series	The ball is last.	The ball is first; the ball is second.
30	Recipient as indirect object	He gives Mother the cat.	Father gives him the cat; Mother gives him the cat.
31	Demonstrative pronoun	This is my dog.	That is my dog; this is my bird.
32	Pun-two meanings for one word	This is not a match.	This is a match (pair of mittens) (match aflame).
33	Preposition of place (direction)	The cat is running through the hoop.	The cat is running under the hoop; the cat is running over the hoop.

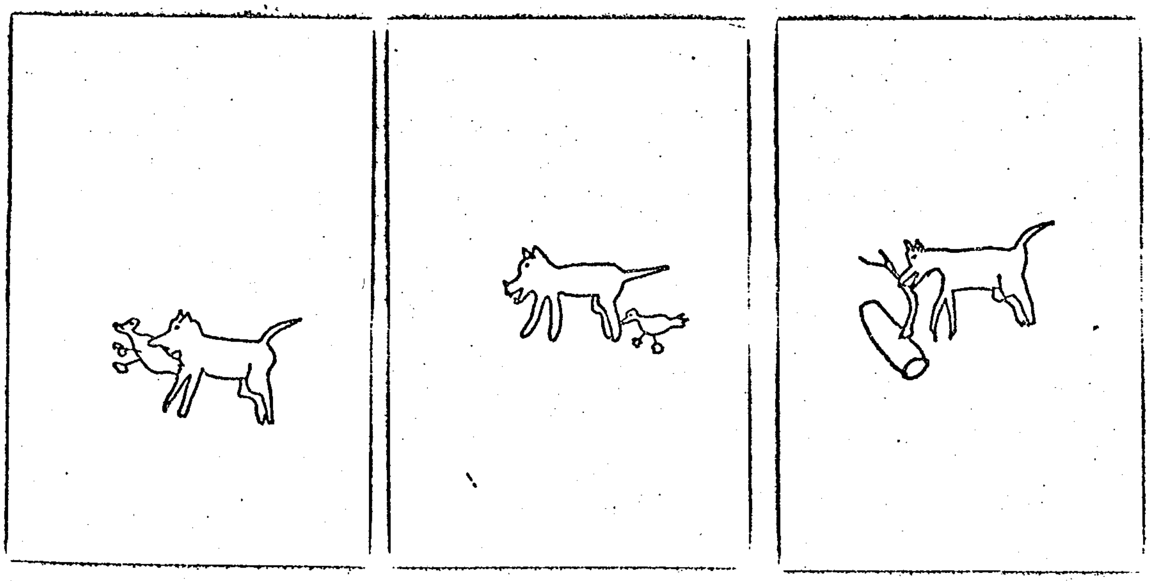
#	Structure	Sentence	Additional sentences suggested by drawings
34	Number distinction in nouns (plurality)	The boys are climbing trees.	The boy is climbing trees; the boys are climbing a tree.
35	Negation of noun phrase	The man has no children.	Children; the man has children.
36	Future tense (uncontracted)	The boy will jump.	The boy isn't jumping; the boy is jumping.
37	Simple past tense	Father made it.	Father is making it; Father will make it.
38	Object of embedded verb is pseudo-subject	The doll is hard to see.	The doll is having a hard time seeing; a doll.
39	Two modifiers for two nouns (absolute)	The large brown elephant steps on the small white ball.	Large brown elephant steps on large white ball; Small brown elephant steps on small white ball.
40	Negation of noun phrase	No one is happy.	Everyone is happy; someone isn't happy.
41	Number-gender distinction in pronouns	He gives her a box.	He gives him a box; he gives them a box.
42	Contracted negation of verb (copula)	Someone isn't happy.	Everyone is happy; someone isn't happy.

APPENDIX B

PICTURES USED AS RESPONSE MODE

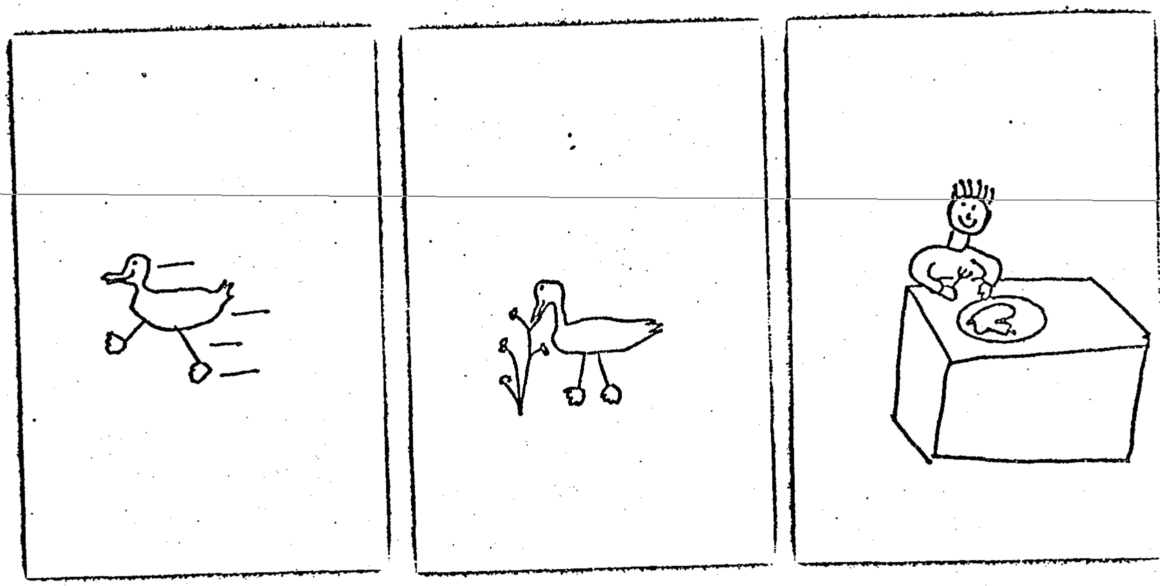


1. She is sleeping.



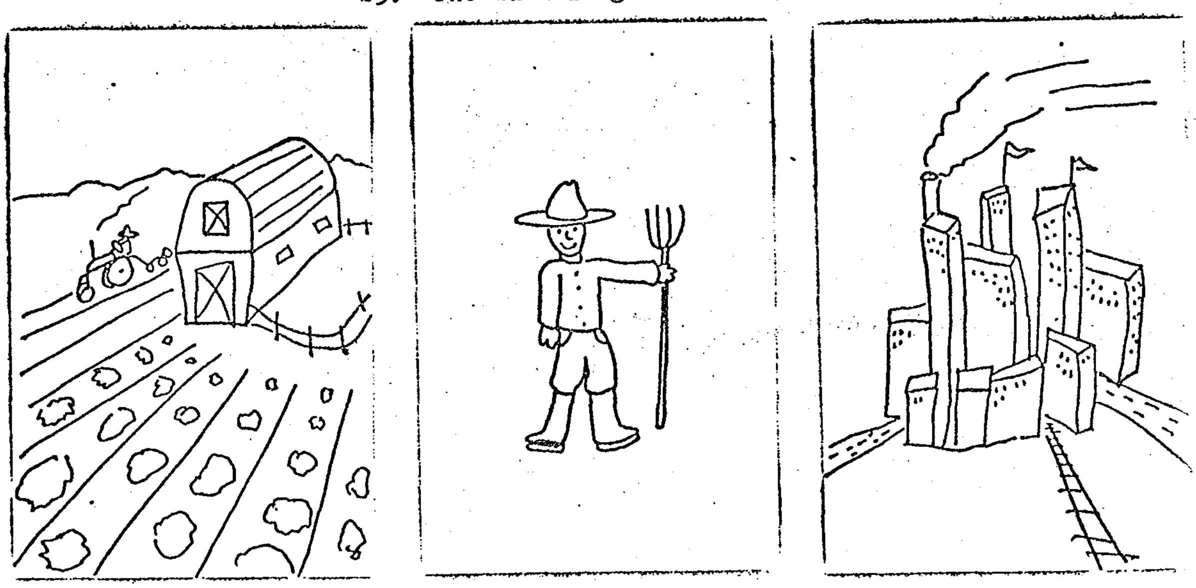
2. The wolf bites the duck.

22. The duck bites the wolf.

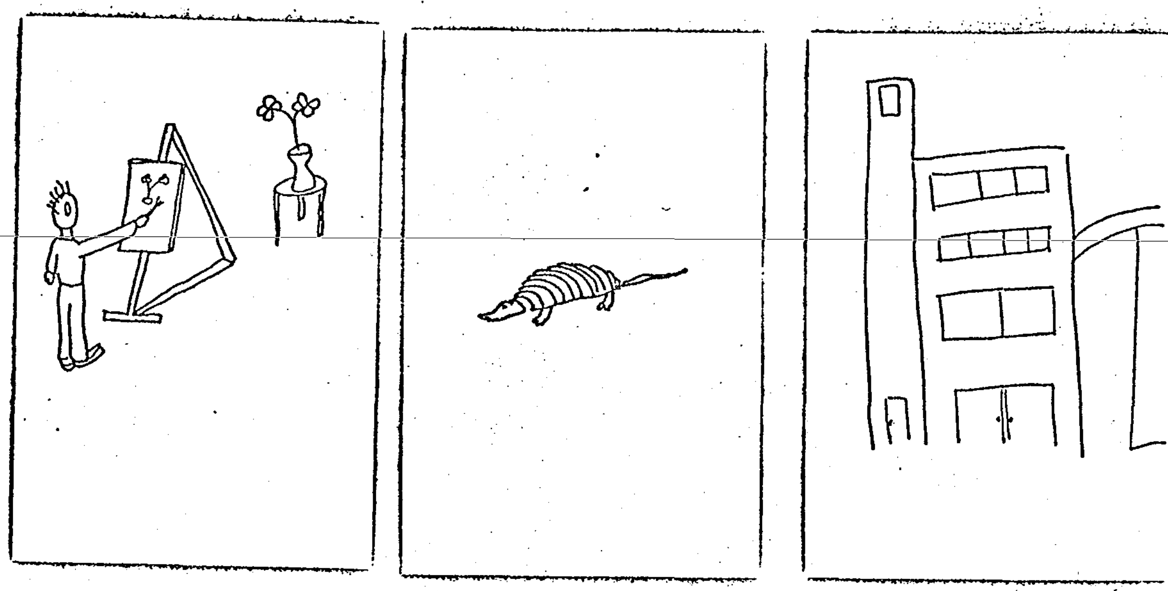


3. The duck is good to eat.

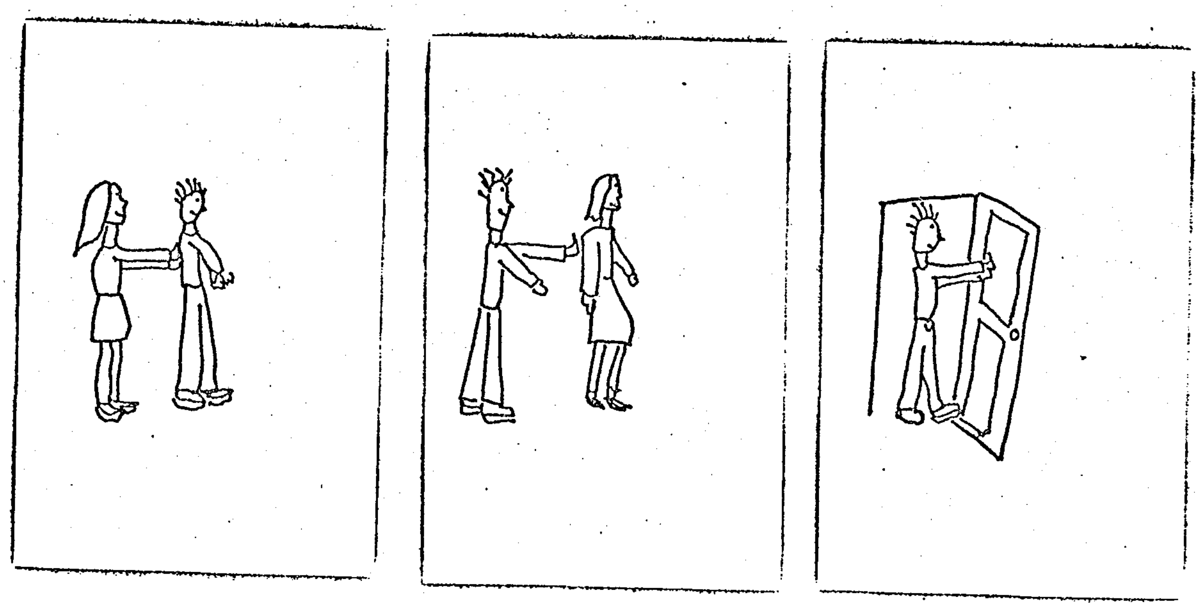
23. The duck is glad to eat.



4. Farmer

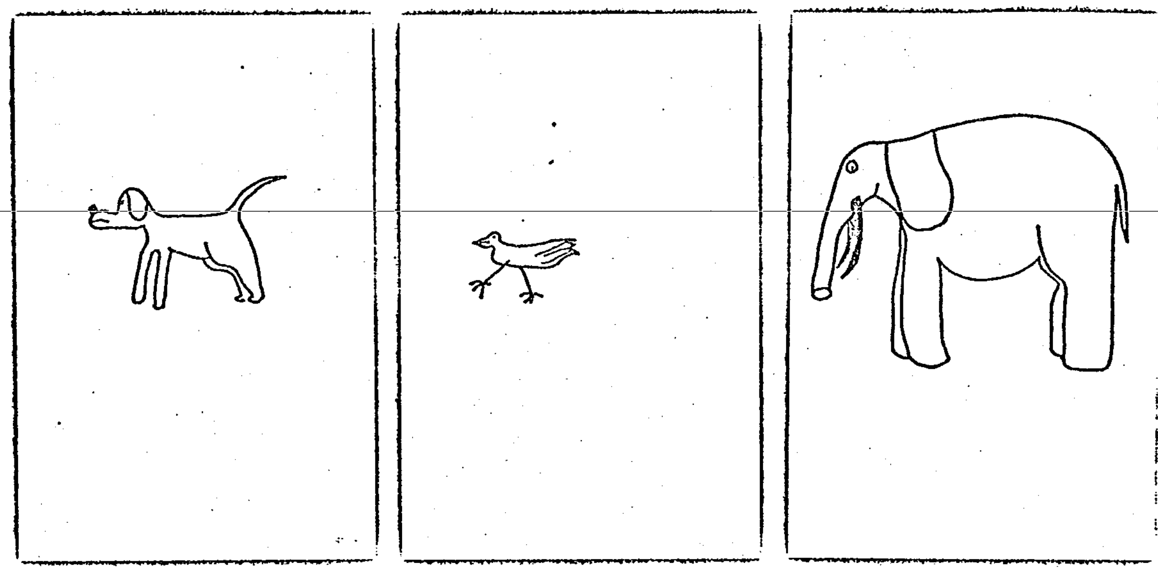


5. Architecture

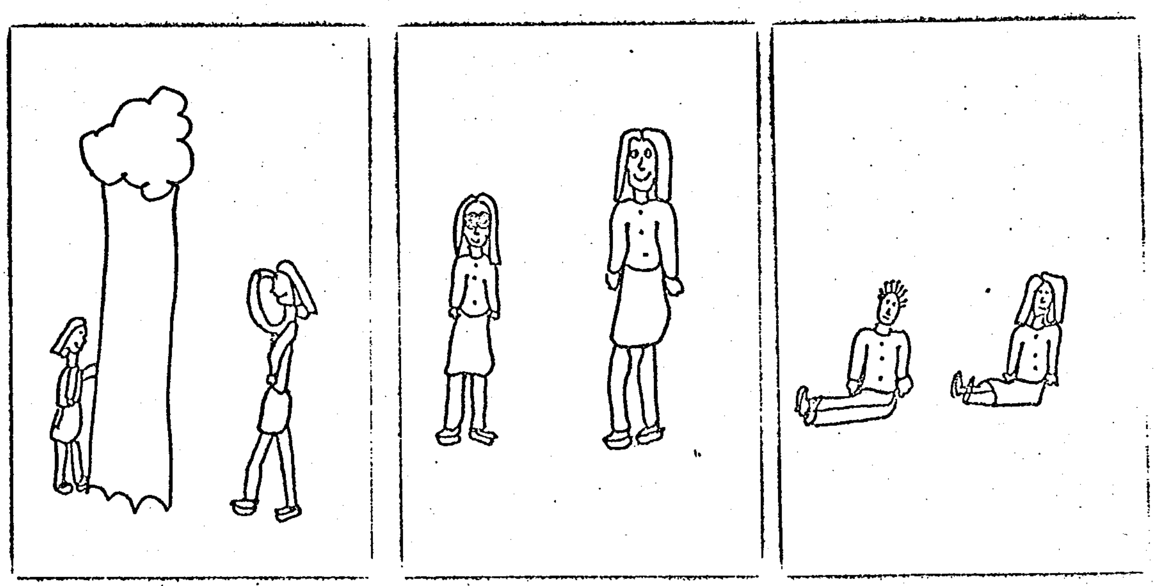


6. The girl is pushed by the boy.

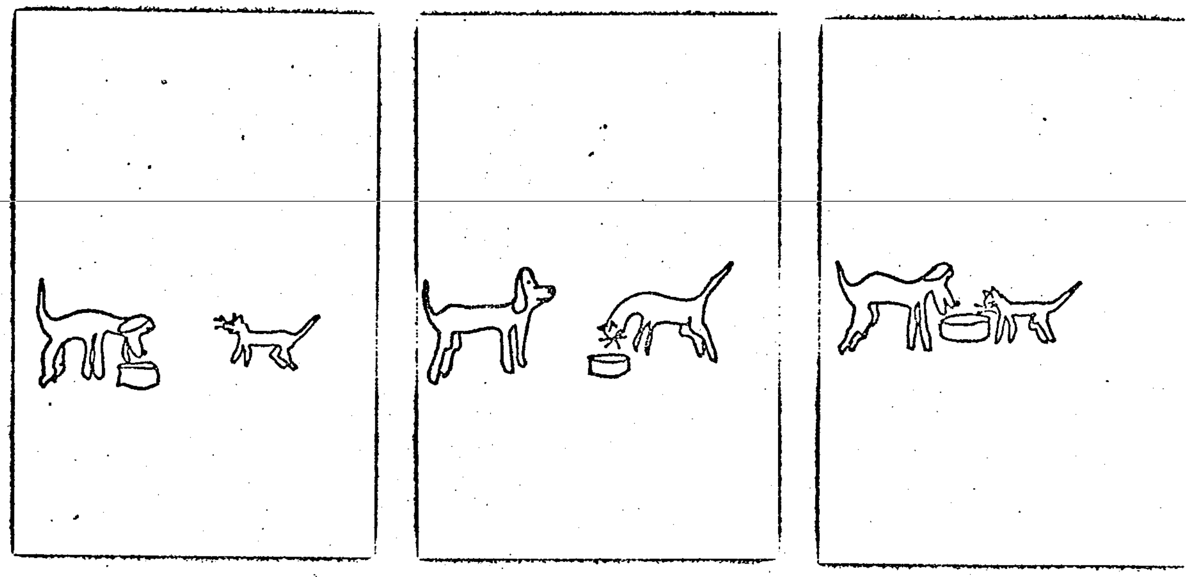
25. The boy is pushed by the girl.



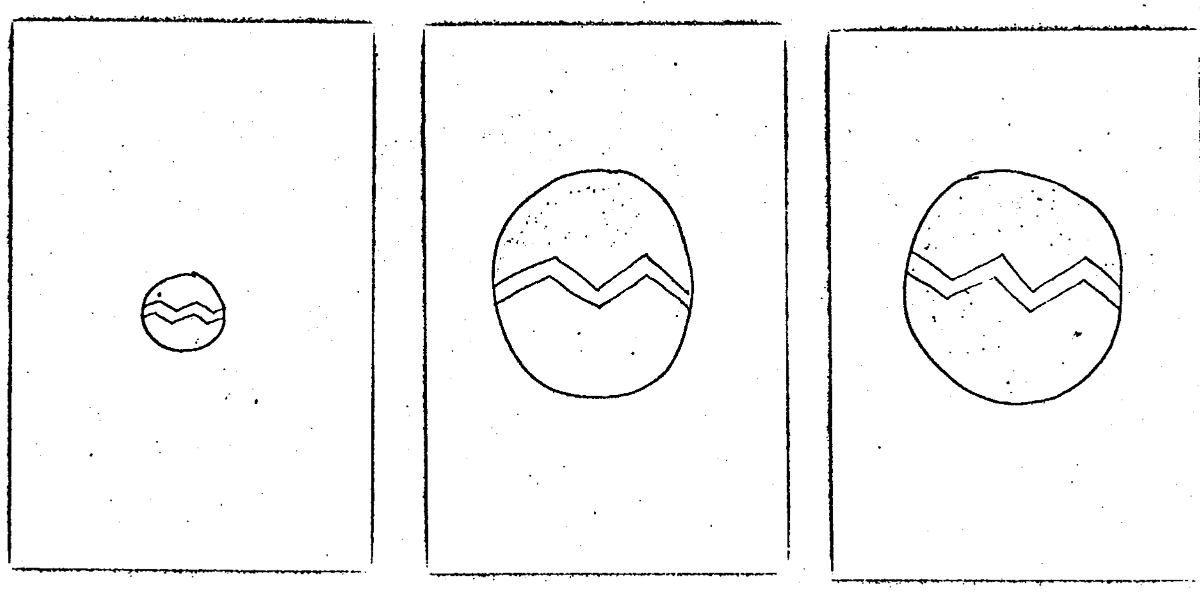
7. This is bigger and heavier than a dog.



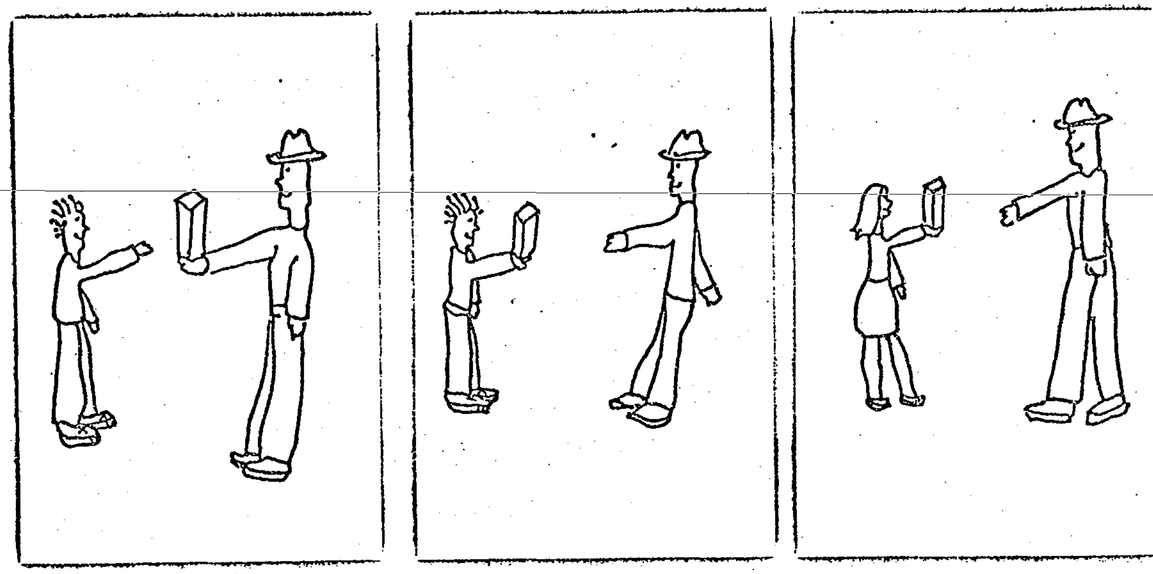
8. Where is the girl?



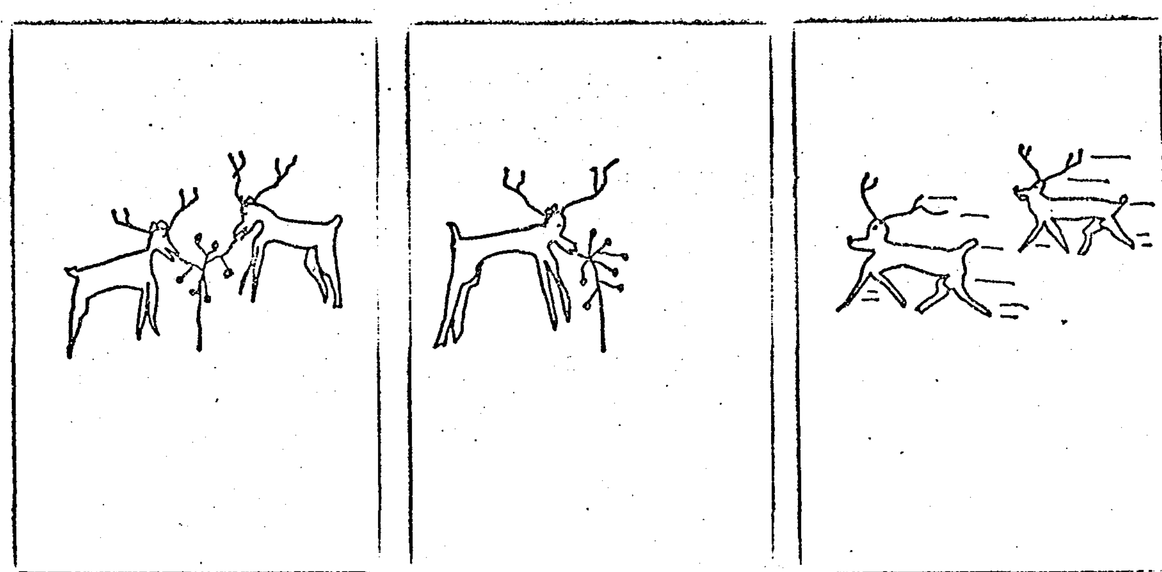
9. The dog will eat after the cat.



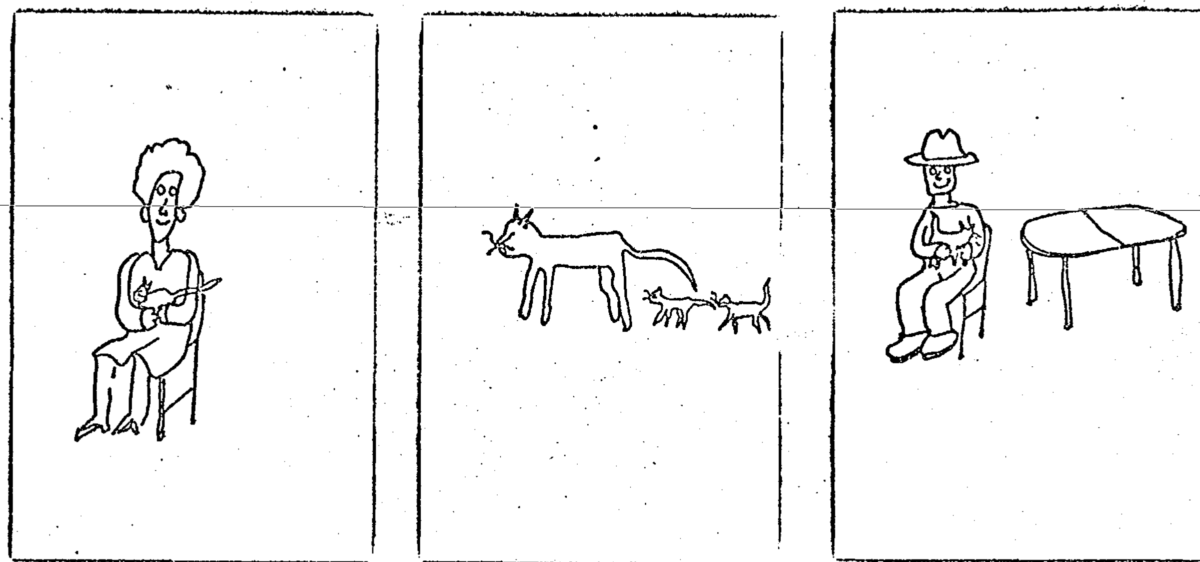
10. A large red ball.



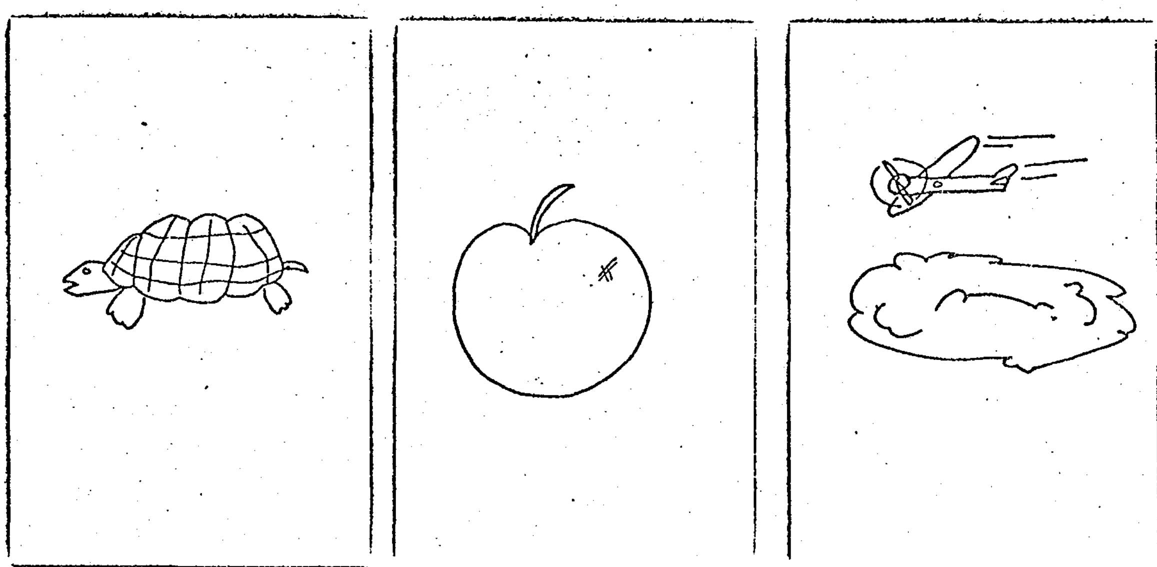
11. He gives the block to Father.



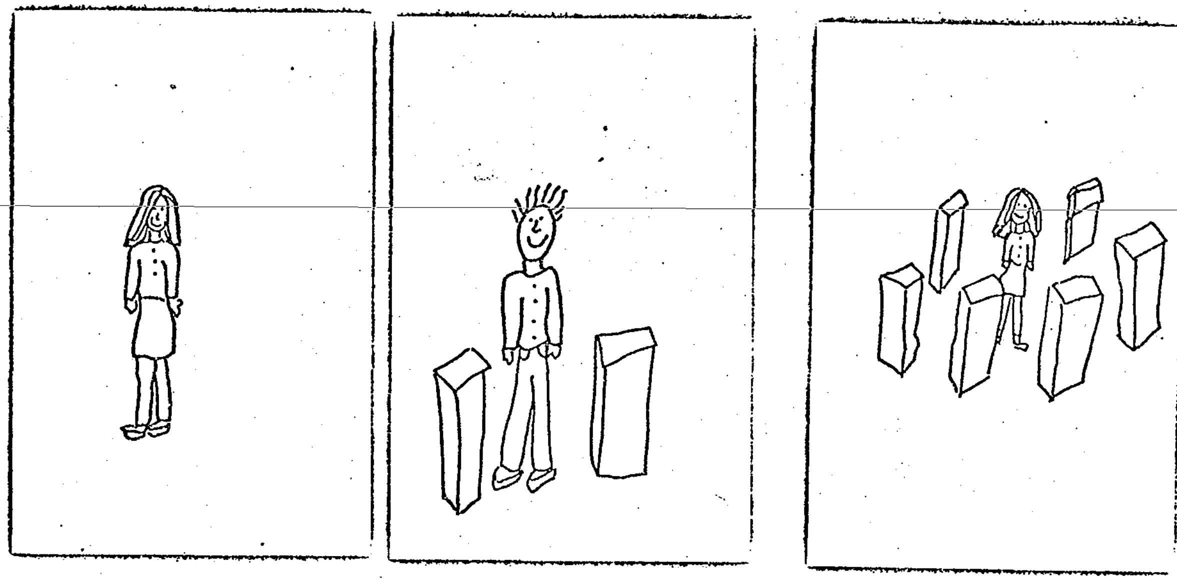
12. The deer are running.



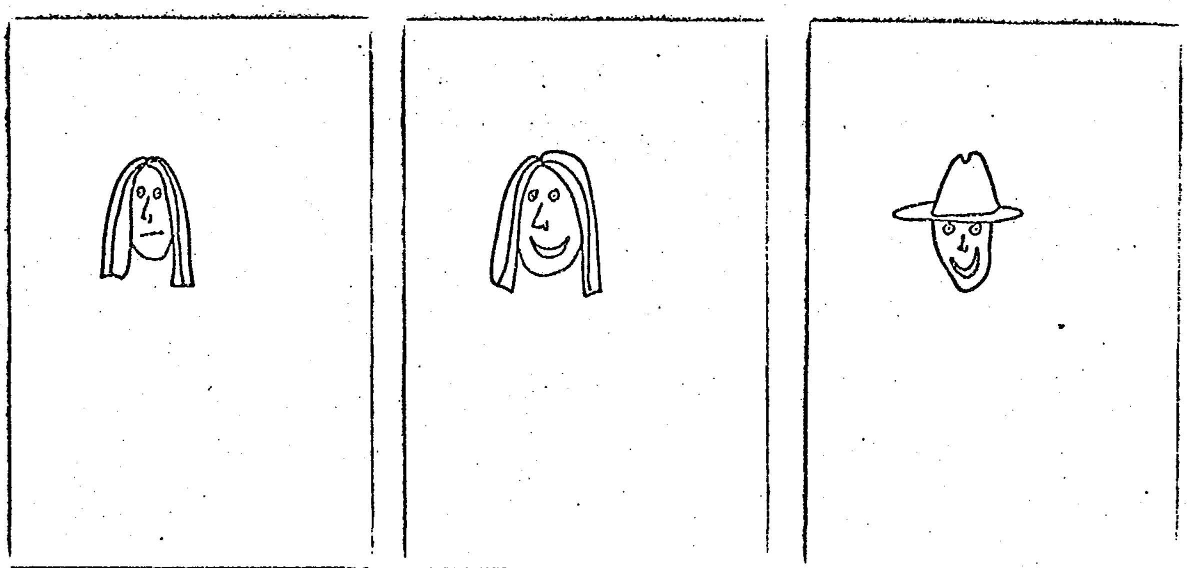
13. This is Mother's cat.



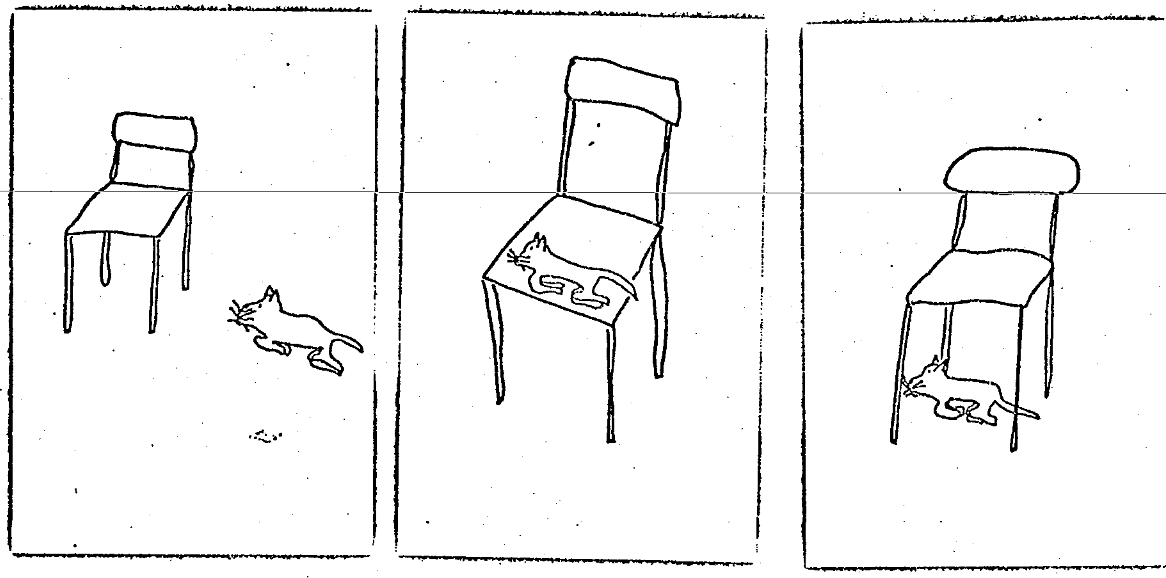
14. Fast



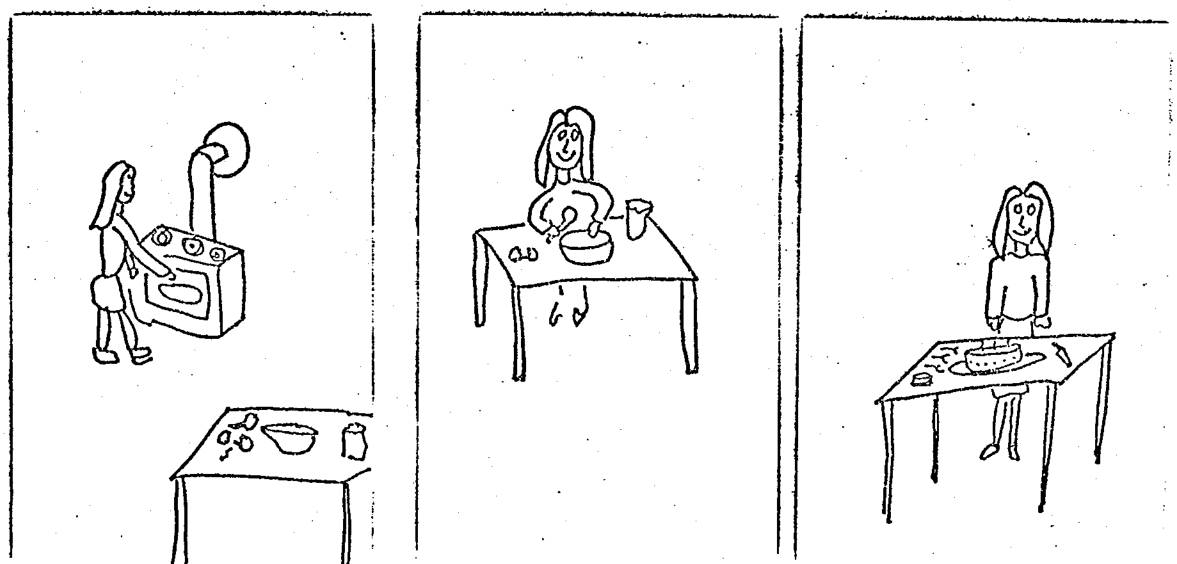
15. She has more blocks.



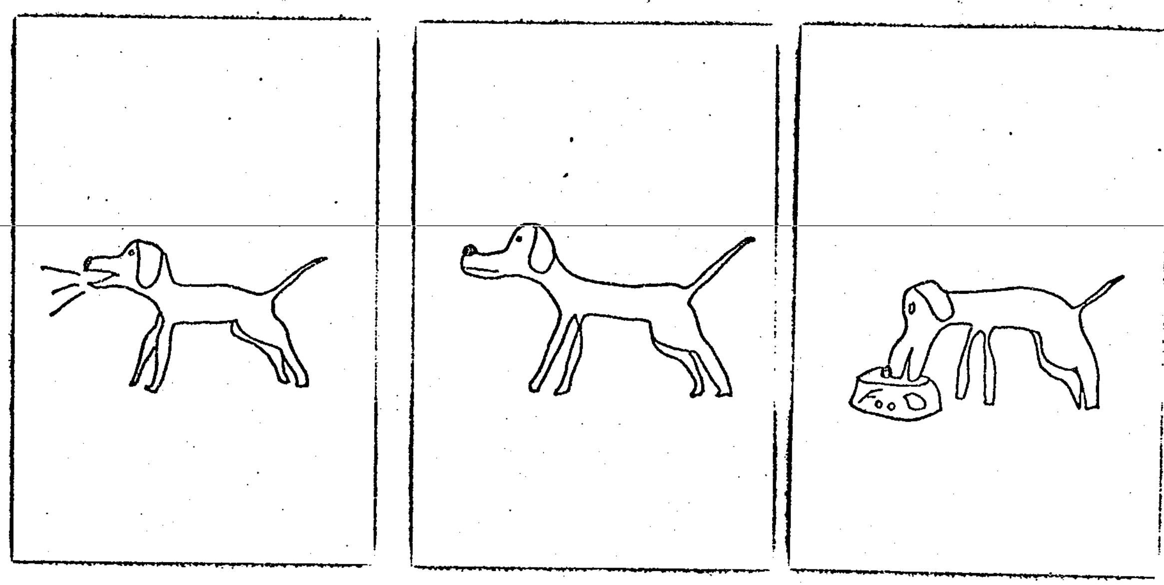
16. She is not smiling.



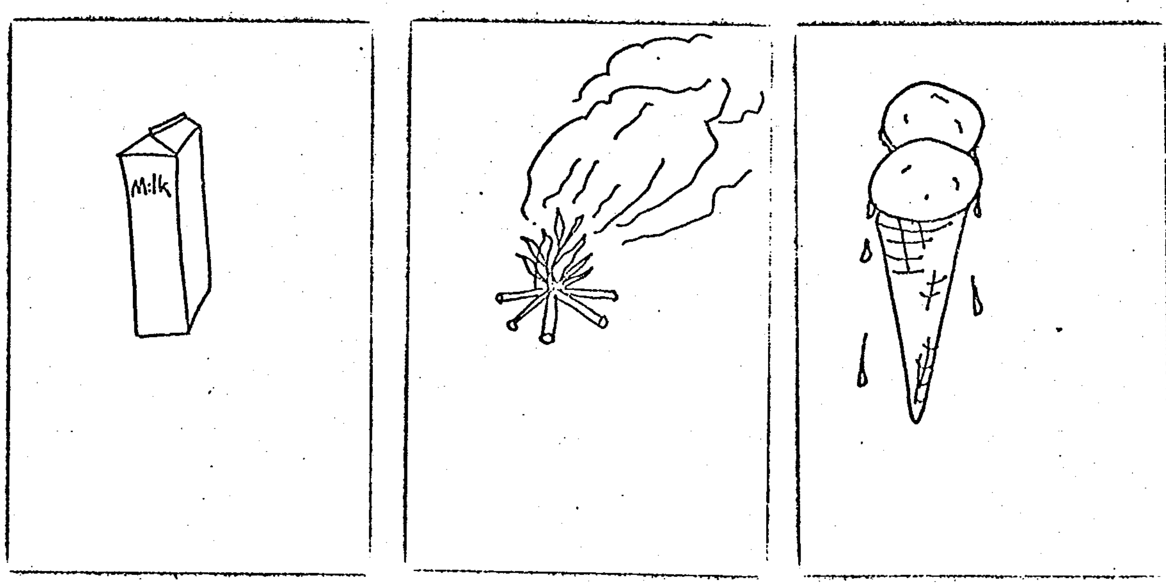
17. The cat is under the chair.



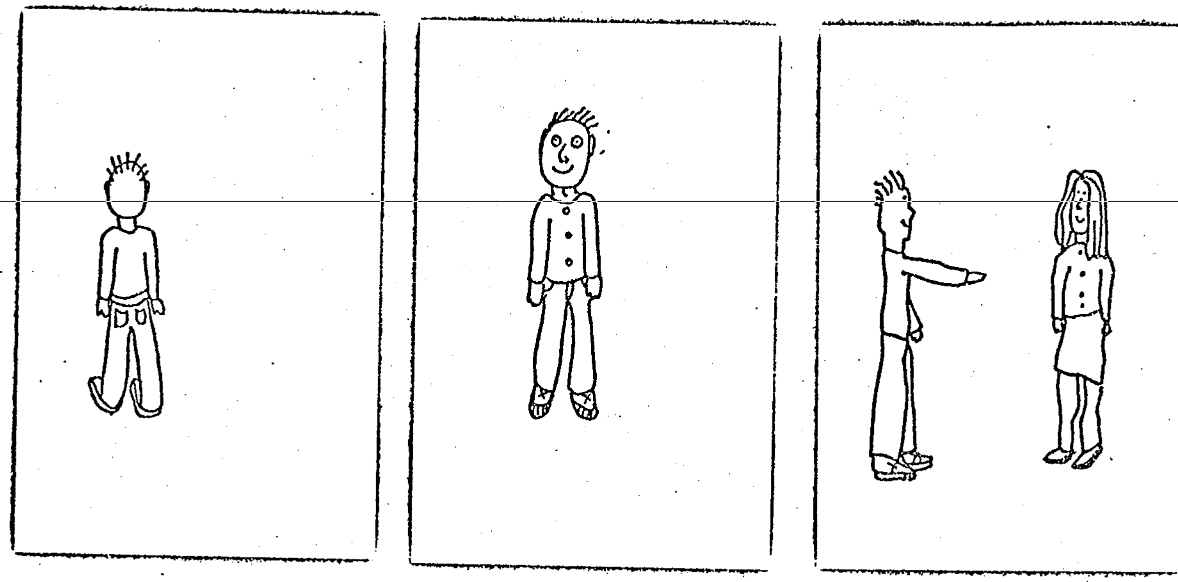
18. Mother has done the work.



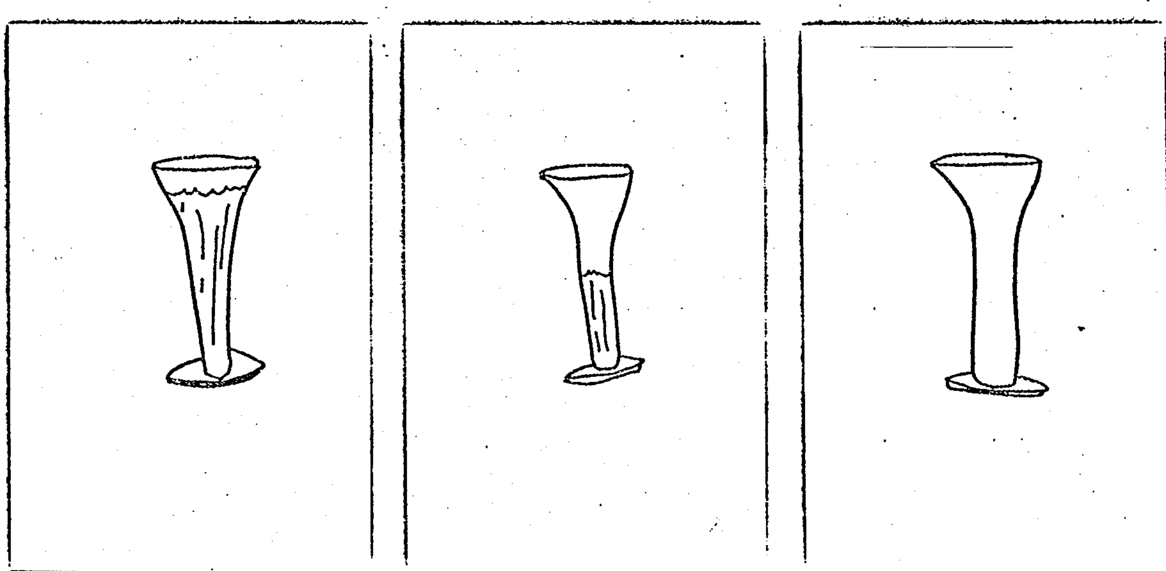
19. Where is the dog barking?



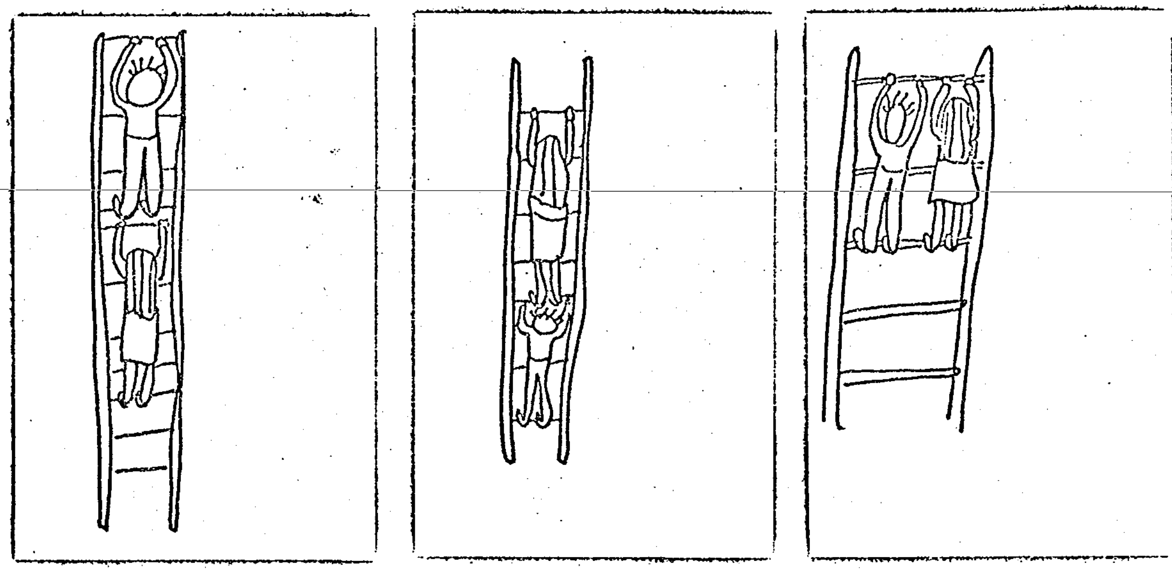
20. This is colder than milk.



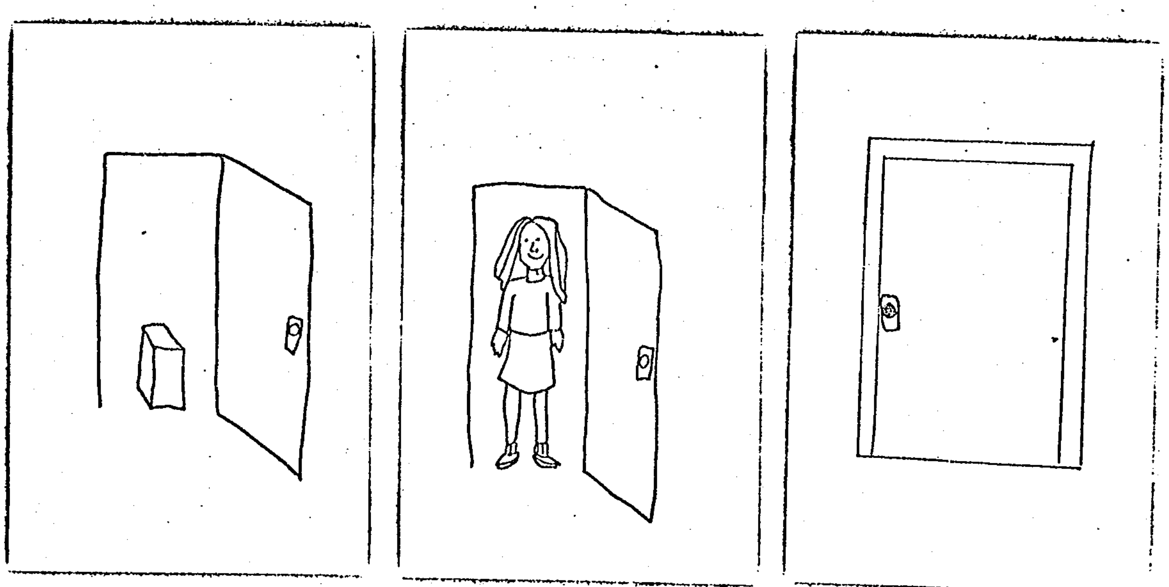
21. The boy is looking at you.



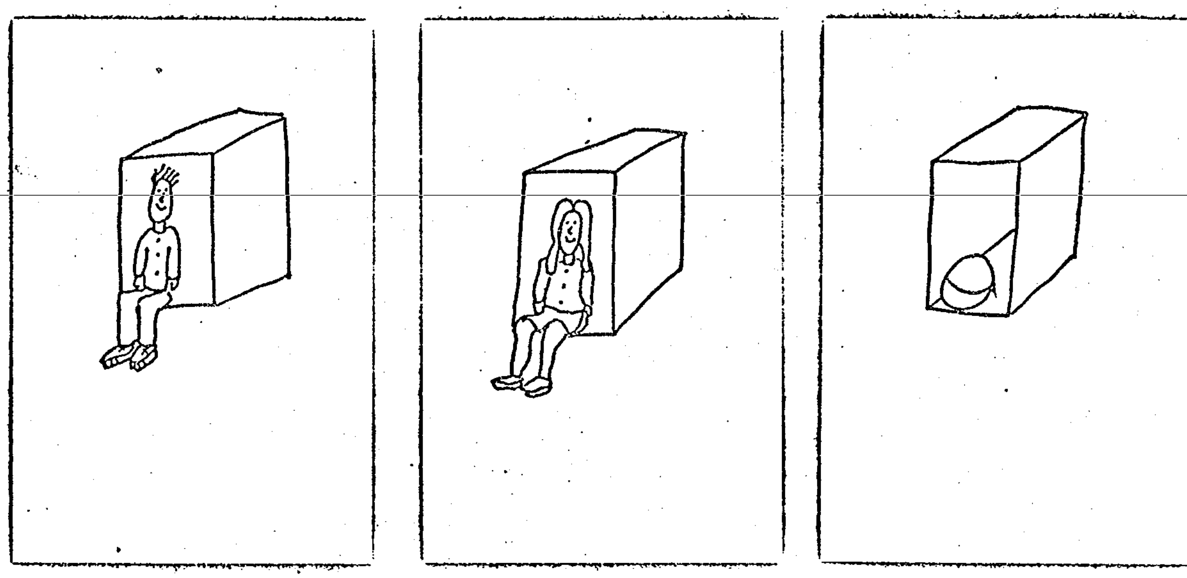
24. Empty



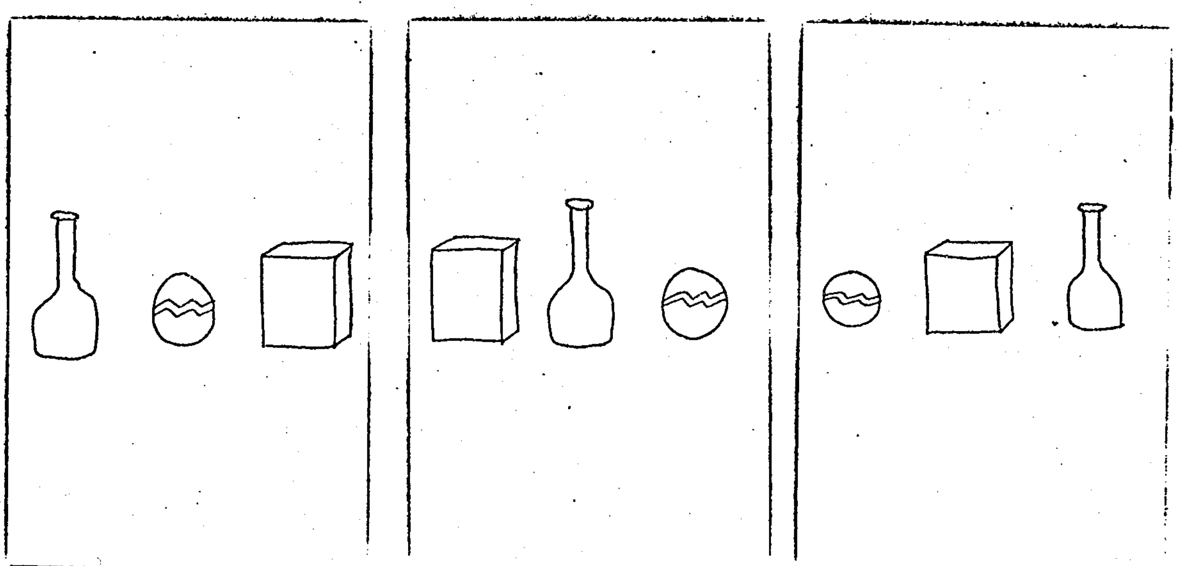
26. The girl is on top.



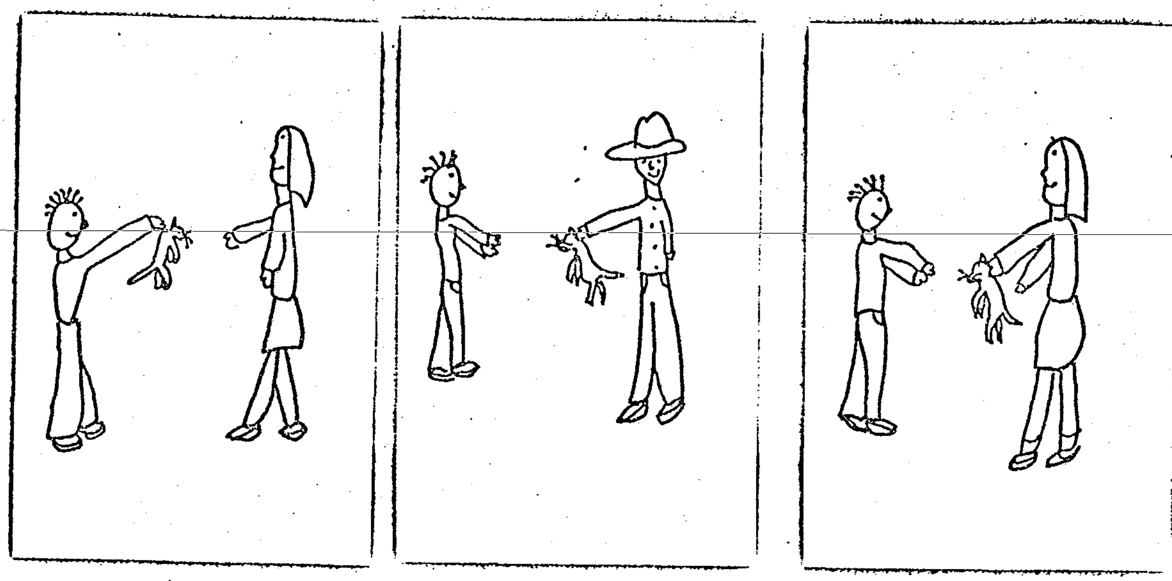
27. Who is at the door?



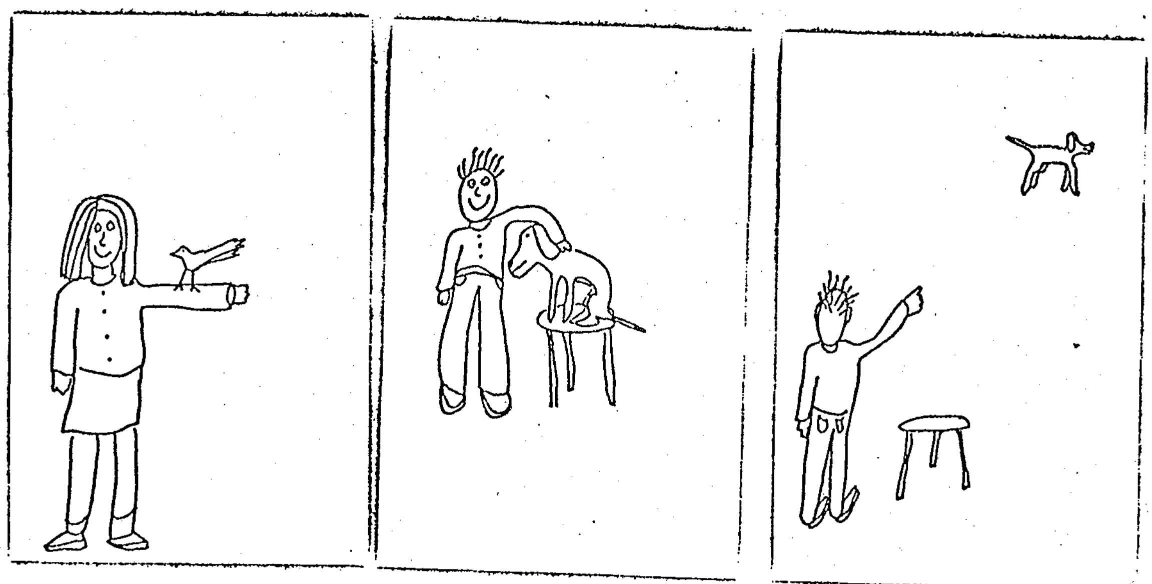
28. What is in the box?



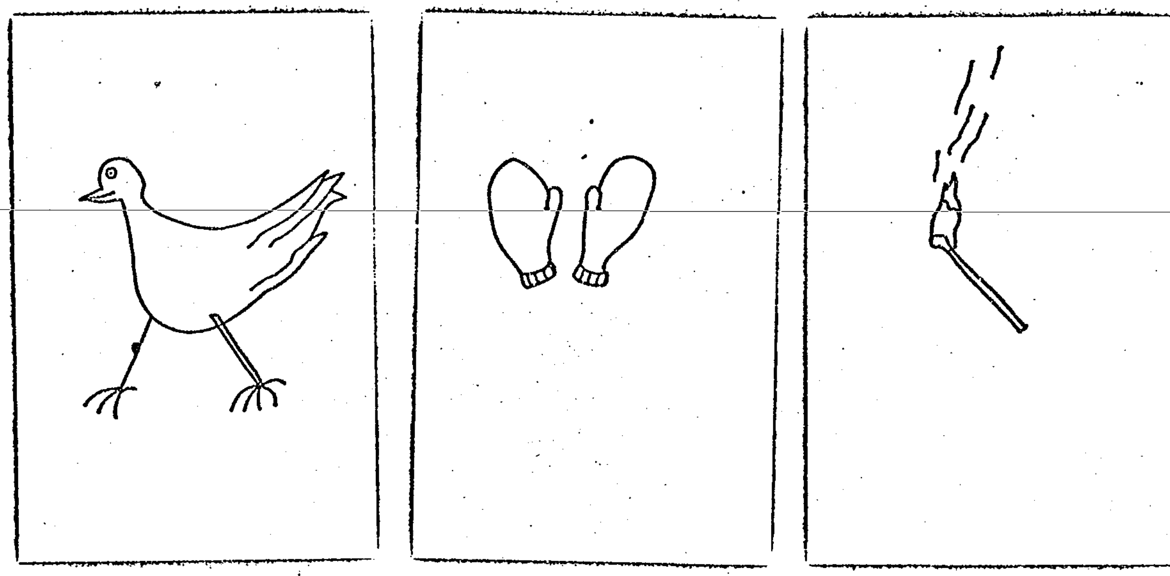
29. The ball is last.



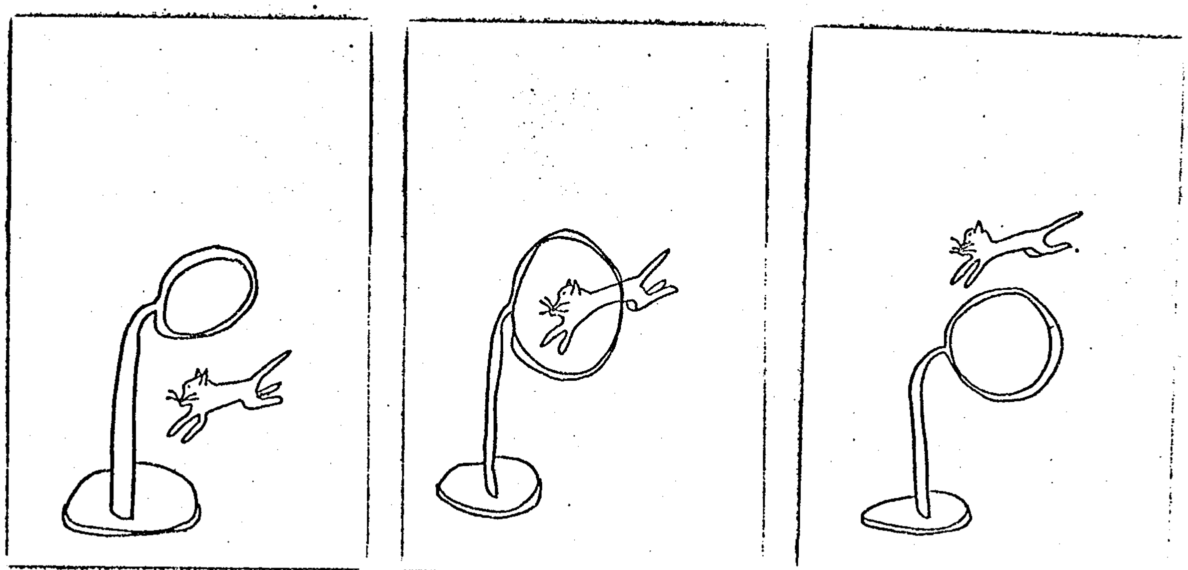
30. He gives Mother the cat.



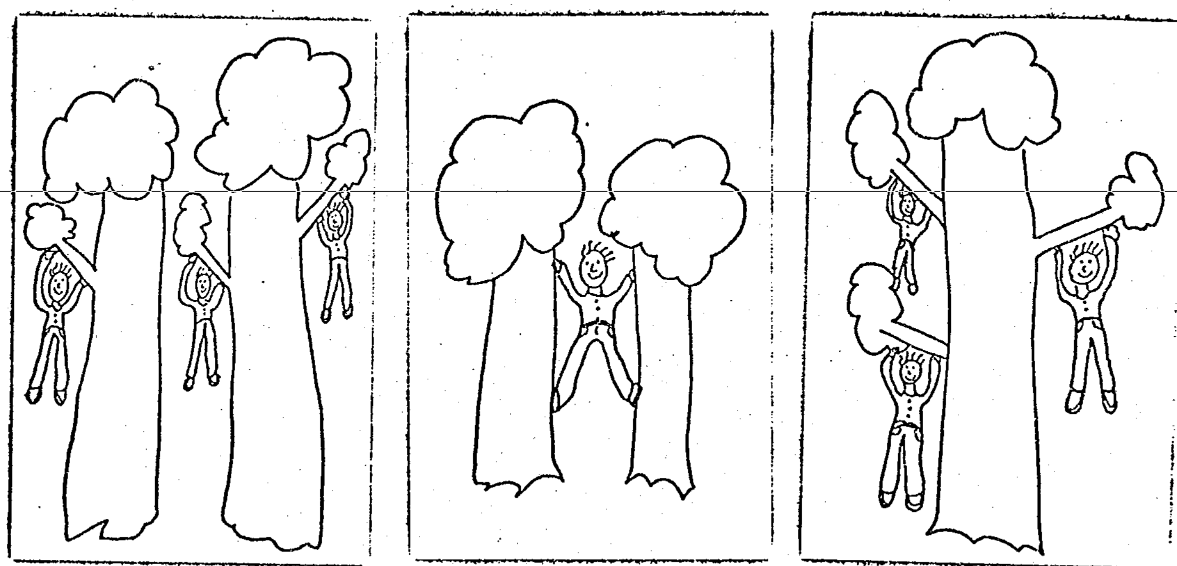
31. This is my dog.



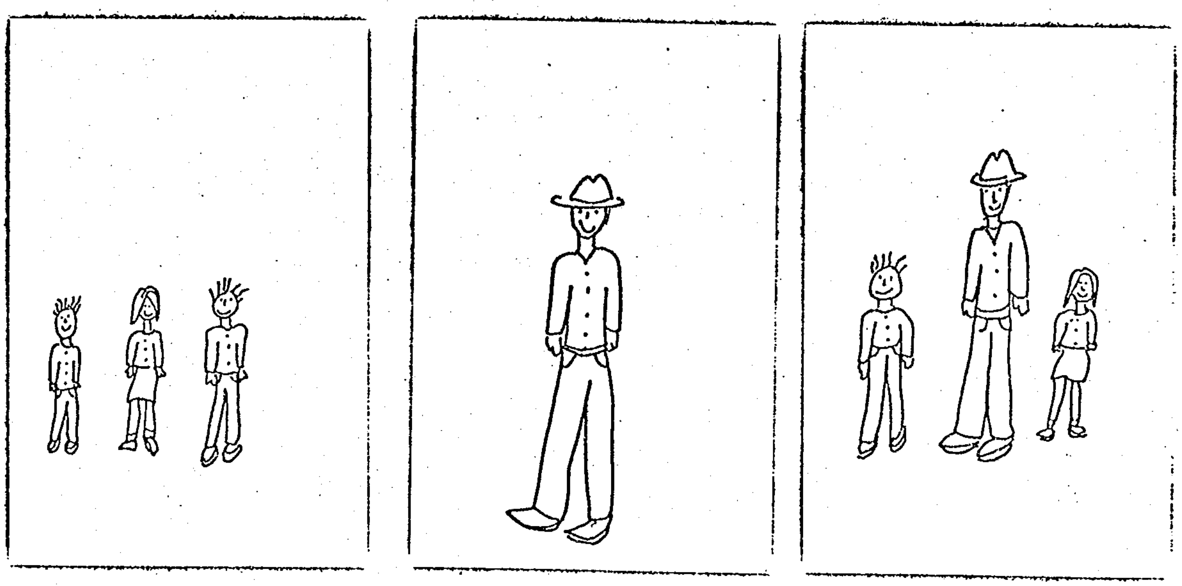
32. This is not a match.



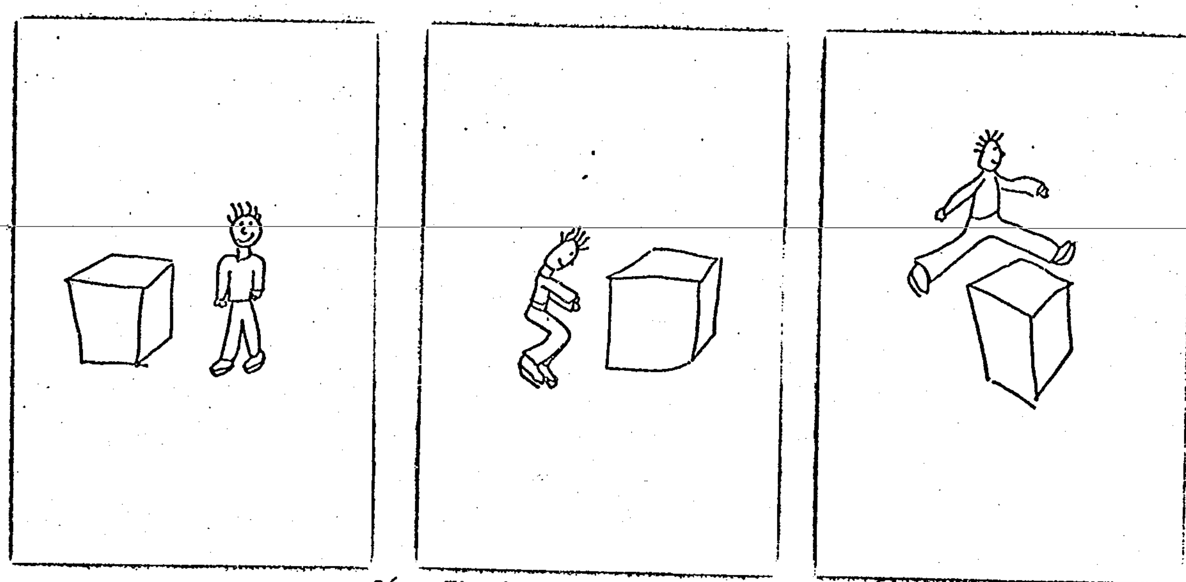
33. The cat is running through the hoop.



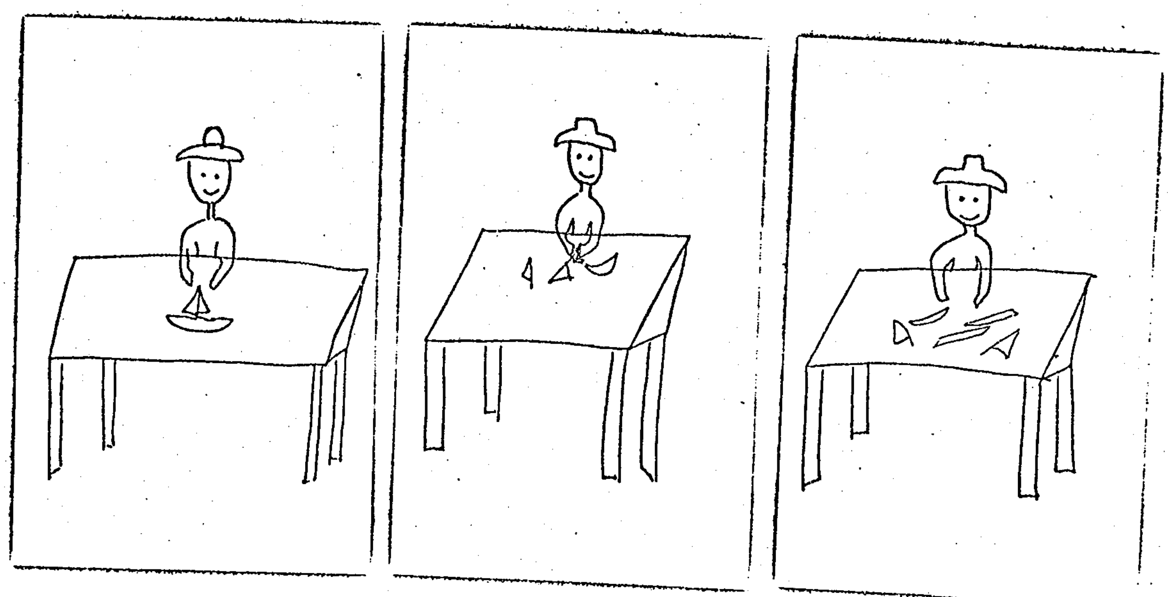
34. The boys are climbing trees.



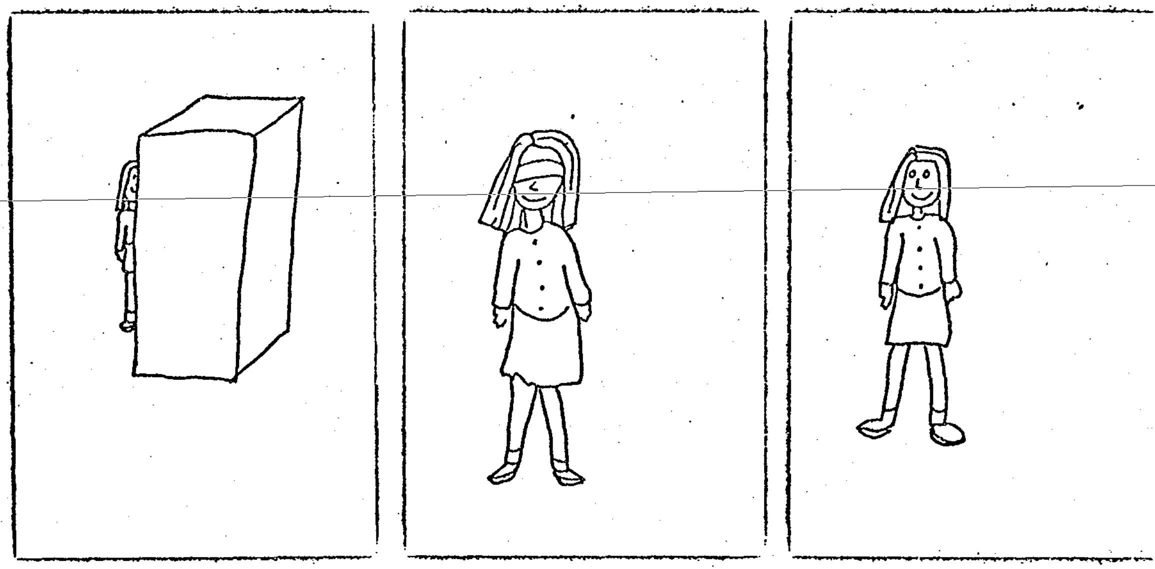
35. The man has no children.



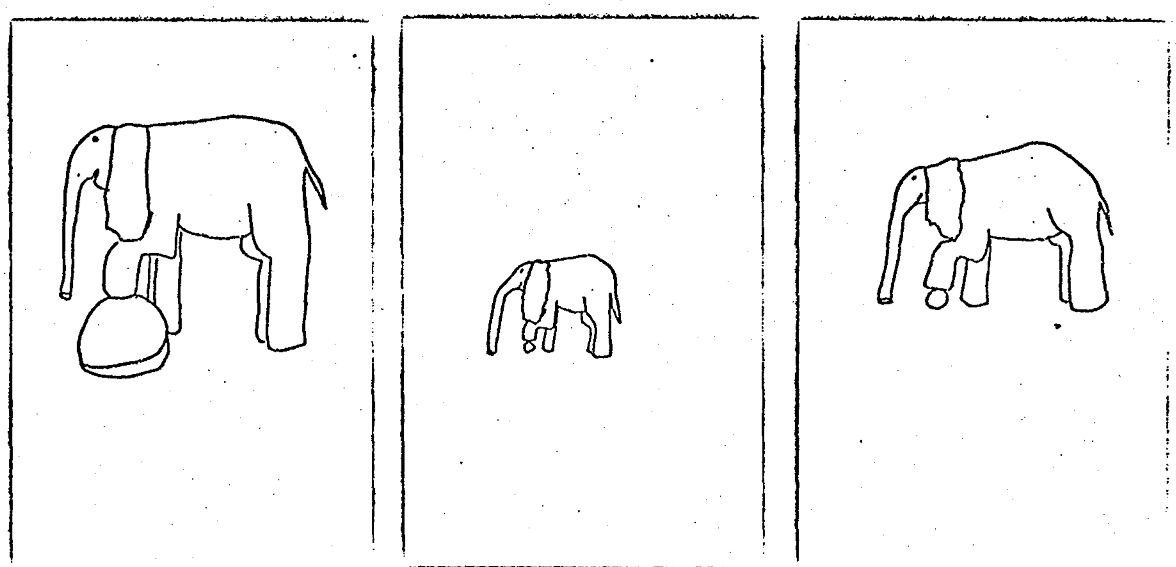
36. The boy will jump.



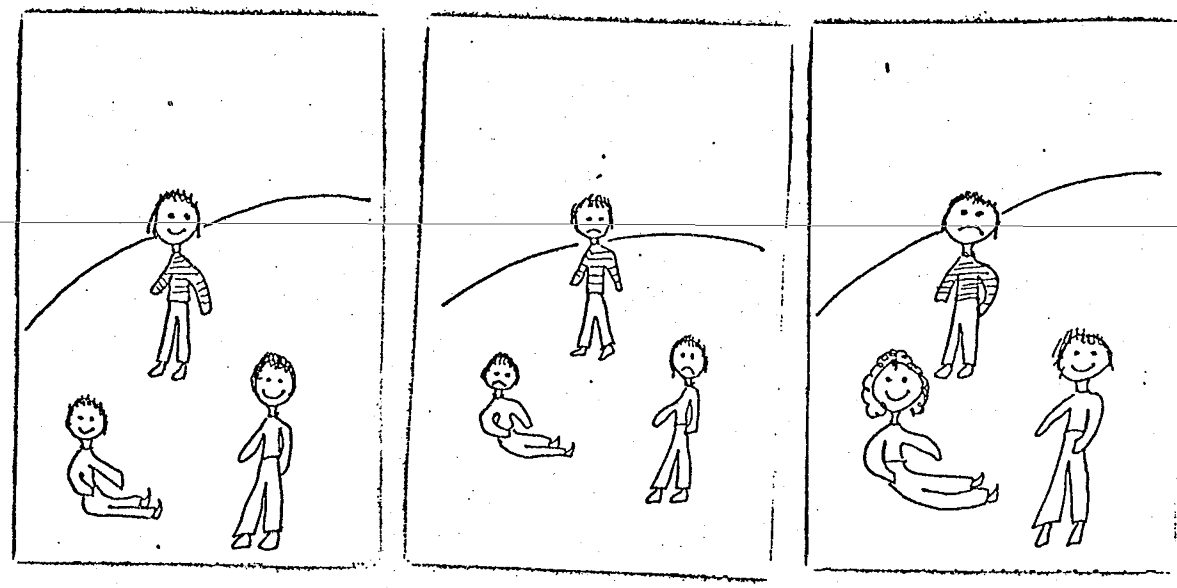
37. Father made it.



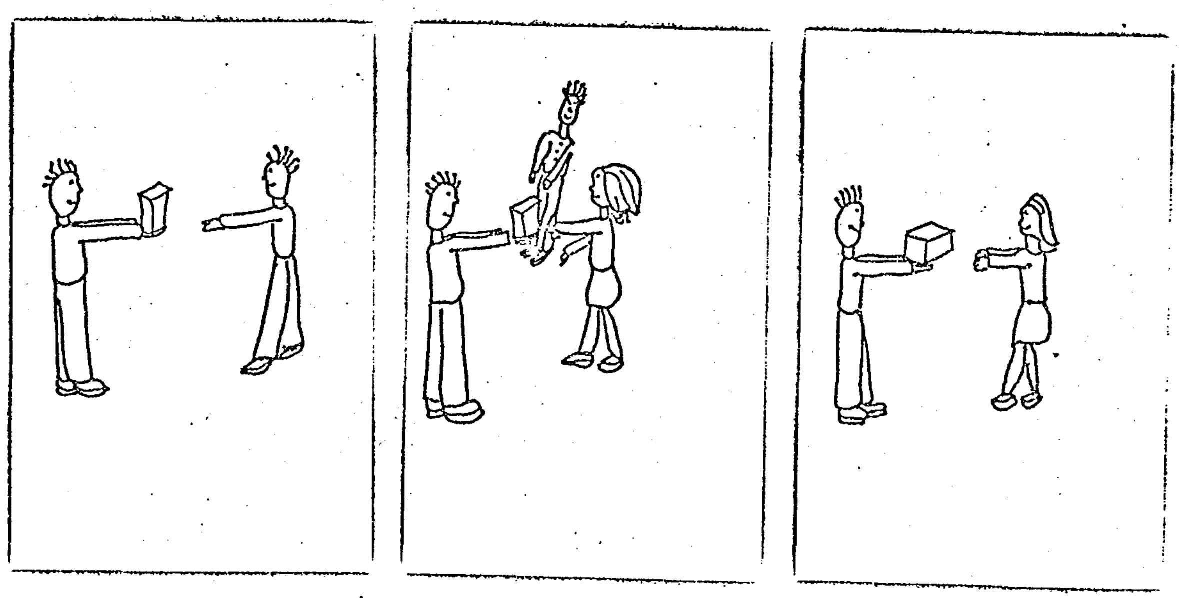
38. The doll is hard to see.



39. A large brown elephant steps on a small white ball.



40. Someone isn't happy.
42. No one is happy.



41. He gives her a box.

APPENDIX C

NUMBER OF CORRECT RESPONSES OUT OF TOTAL OF 42 AT EACH RATE CONDITION.

SUBJECTS	RATES		
Aphasic	Expanded	Compressed	Normal
1	27	18	21
2	24	15	30
3	31	34	34
4	19	14	19
5	19	13	17
6	27	13	24
7	26	18	22
8	15	13	19
9	20	21	22
10	27	28	31
Control			
1	37	30	36
2	36	28	35
3	35	27	36
4	34	28	39
5	34	28	33

APPENDIX D

Percentages of correct responses made by groups to sentences of each structure at each rate condition.

STRUCTURE (WORD)	SENTENCE (S)	APHASICS			CONTROLS		
		Expanded	Compressed	Normal	Expanded	Compressed	Normal
Number-Gender distinction in pronouns	She is sleeping.	50	40	60	100	100	100
	He gives her a box.	30	40	20	80	60	80
Demonstrative pronoun	This is my dog.	100	60	80	100	80	100
Pronoun reference	The boy is looking at you.	50	50	80	60	60	80
Subject-object reversal	The wolf bites the duck.	70	30	80	100	100	100
	The duck bites the wolf.	50	60	40	100	80	100
Graded vocabulary	Where is the dog barking?	100	60	100	100	100	100
	Empty	70	70	100	100	100	100
	Architecture	20	10	20	0	0	20
Adjective noun marker	Farmer	70	20	40	100	20	100
Adjective attribute	Fast	50	40	60	80	40	80
	A large red ball.	70	50	90	100	100	100
	The large brown elephant steps on the small white ball.	40	30	50	80	0	60

STRUCTURE (WORD)	SENTENCE (S)	APHASICS			CONTROLS		
		Expanded	Compressed	Normal	Expanded	Compressed	Normal
Comparative	This is bigger and heavier than a dog.	40	40	80	100	80	100
	This is colder than milk.	50	30	70	100	40	100
Quantity	She has more blocks.	90	40	80	100	80	100
Pun	This is not a match.	30	0	20	0	0	20
Possessive case noun	This is mother's cat.	60	40	60	80	100	100
Negation of noun phrase	No one is happy.	60	70	70	100	100	100
	The man has no children.	90	60	100	100	100	100
Negation of verb	She is not smiling.	90	60	70	100	20	40
	Someone isn't happy.	30	40	30	100	20	40
Simple past tense	Father made it.	40	30	50	100	100	100
Perfective aspect	Mother has done the work.	40	40	100	80	60	80
Future tense	The boy will jump.	70	30	40	80	60	80
Subject-verb agreement	The deer are eating.	50	20	60	80	60	80
	The boys are climbing trees.	20	30	20	100	100	100

STRUCTURE (WORD)	SENTENCE (S)	APHASICS			CONTROLS		
		Expanded	Compressed	Normal	Expanded	Compressed	Normal
Active-passive voice	The boy is pushed by the girl.	30	40	60	80	100	100
	The girl is pushed by the boy.	60	40	50	80	100	100
Embedded active-passive clause	The duck is glad to eat.	70	30	80	100	80	100
	The duck is good to eat.	30	50	70	60	0	100
Object of embedded verb is pseudo-subject	The doll is hard to see.	10	30	10	60	20	60
Time relation	The dog will eat after the cat.	50	50	80	60	60	80
Spatial relation	The girl is on top.	80	60	40	80	100	100
Order in series	The ball is last.	30	30	50	80	100	80
Preposition of place	The cat is under the chair.	100	70	90	100	100	100
	The cat is running through the hoop.	100	80	70	60	20	60
Recipient as a prepositional phrase	He gives the block to Father.	40	70	30	100	40	100
Recipient as an indirect object	He gives Mother the cat.	60	50	50	100	100	100
Question form	Where is the girl?	10	20	50	100	20	100
	Who is at the door?	80	90	90	60	100	60
	What is in the box?	70	40	70	80	60	60