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THE UNIVERSITY OF ALBERTA

Communication Modes and Recall of Hearing-Impaired Students

by

Erika Sonnenberg-Winnick

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF EDUCATION

IN

SPECIAL EDUCATION (HEARING-IMPAIRED)

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

FALL, 1989

ISBN 0-315-70209-5

THE UNIVERSITY OF ALBERTA

RELEASE FORM

NAME OF AUTHOR: Erika Sonnenberg-Winnick

TITLE OF THESIS: Communication Modes and Recall of Hearing-Impaired Students

DEGREE FOR WHICH THESIS WAS PRESENTED: Master of Education

YEAR THIS DEGREE GRANTED: FALL, 1989

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Date: October 12, 1989

ABSTRACT

The following study investigated hearing-impaired students' comprehension and recall of stories presented through three communication methods: total communication (TC), print (P), and a combination of total communication and print (TCP). Six students who had moderately-severe, severe, or profound hearing losses, and who were presently enrolled in an educational setting that advocated the use of total communication, participated in the study. Eighteen, short, narrative stories were presented to the students through total communication, print, and a combination of total communication and print. Following the presentation of each story, the students answered questions pertaining to recall of the stories. It was hypothesized that the combination of both total communication and print would improve the students' recall and comprehension over that achieved by either print or total communication used in isolation.

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation and gratitude to Dr. David Baine, my thesis advisor, for his encouragement, patience, guidance, and assistance during the preparation and completion of this thesis.

I would also like to thank Dr. Dick Sobsey for his advice in the statistical analysis and to both Dr. Dick Sobsey and Dr. Gary Holdgrafer for participating as my committee members and for their suggestions and constructive criticisms. In addition I would like to thank Dr. Fegen and his research assistant, Margaret Brimacombe, for their assistance in choosing a readability formula, and an informal reading inventory.

Furthermore, I would like to extend my sincere appreciation to Mr. Ron McMullen, principal, for his permission and assistance while I conducted by research at Lendrum Elementary School, to the six students who participated in the study, to their teachers who allowed the children to leave their classrooms, and to the parents who gave me permission to work with their children.

A special thank you is given to my husband Loren Winnick, for his patience, understanding, and encouragement to finish my thesis, and for his assistance in setting up the computer and purchasing supplies.

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I. INTRODUCTION

Research has recently shown that for hearing-impaired students, information presented in the form of print is recalled and comprehended more effectively than when the same information is presented through either signs, speech or total communication (a combination of signs, fingerspelling, gestures, and speech). Next to print, total communication is the second most effective method of presenting information to students with hearing impairments. Unfortunately, with these students, neither total communication nor print produces high levels of comprehension and recall.

The present study compared the relative recall and comprehension of narrative stories presented by either a) total communication (TC), b) print (P), and c) a combination of both total communication and print (TCP). It is hypothesized that the combination of both total communication and print will improve hearing-impaired students' comprehension and recall over that achieved by either print or total communication used in isolation.

In the TCP method, the entire narrative story was presented to students with hearing impairments through total communication; selected information from the story was also presented sequentially in printed form.

The review of the literature that follows examines research describing the efficacy of various methods of communicating with students who have hearing impairments,

the effectiveness of various methods by which persons with hearing impairments encode information for recall, the effectiveness of various methods of cueing to enhance recall of good and poor readers, and the linguistic and short-term memory skills of students with hearing impairments. The evidence derived from this review forms the basis for the design of the TCP method used in the present study. Section D in the methodology section describes the TCP method in detail.

II. REVIEW OF THE LITERATURE

A. Hearing-Impaired Students' Linguistic Skills

The first section of the literature review, concerned with the language skills of students who are hearing-impaired, indicates why continued research is needed in deaf education and why current techniques need to be improved upon to help hearing-impaired students comprehend and recall more information.

It is disheartening to see that after years and years of research, many deaf children still experience considerable difficulty in mastering the English language. Quigley, Wilbur, Power, Montanelli, and Steinkamp (1976) have shown that the average 18 year-old deaf student cannot understand or use many of the syntactic structures an average 10 year-old hearing child understands and uses easily. In 1916, Pintner and Patterson found that 14 to 16 year-old deaf children had median reading scores equivalent to those of seven year-old hearing children. More recently, numerous investigators (e.g., Goetzinger & Rousey, 1959; Myklebust, 1960; Pugh, 1946) have also found a significant delay in the reading ability of deaf students. Even after the Office of Demographic Studies (ODS) at Gallaudet College rearranged items on the Stanford Achievement Test, to make the test more suitable for deaf students, the same reading retardation cited earlier was found (Quigley & Kretschmer, 1982). One of the more recent ODS studies, conducted by Trybus and Karchmer

(1977), reported that at age 20 years the average reading score of deaf students was a grade equivalent of 4.5.

One should note though that in some programs higher reading levels have been found. Lane and Baker (1974) found that students from the Central Institute for the Deaf (CID) improved their reading scores by 2.5 grades within a four-year period, whereas the national data analyzed by Furth (1966) showed only a 0.8 grade increase. "Lane attributed the higher reading scores of the CID students to continuous education in the same school with the same educational philosophy, maximum use of residual hearing, and oral communication" at home and at school (Quigley & Kretschmer, 1982, p.68). Quigley and Kretschmer (1982) also stated that an additional factor could be the socioeconomically elite nature of the students as described by Ogden (1979).

Wood, Wood, Griffiths, and Howarth (1986) discussed a school for the deaf where higher reading levels were found. They felt that the quality of teaching found in this school contributed to the higher academic achievement. In this particular school, formal reading lessons did not start until the child's "language met the demands of the text" (Wood et.al, 1986, p. 109). In this program reading lessons usually started when students were approximately eight years of age. Prior to reading instruction, the children "experienced, regular intensive concentration on conversation and a great deal of emphasis on listening to

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hearing student scored higher than the average 18 year-old deaf student in comprehension of various syntactic structures. Ten to 19 year-old deaf students had more difficulty than eight to 10 year-old hearing children on the following structures (listed in order of increasing difficulty): negation, conjunctions, questions (wh-, yes/no, and tag questions), pronominalization (personal pronouns, backward pronomimalization, possessive adjectives, reflexivization), verbs (verb auxiliaries, tense sequencing), complementation (infinitives and gerunds) and relativization, and disjunction and alternation (Quigley & Kretschmer, 1982); (please see Appendix I "Definitions" for an explanation of the grammatical categories). The most common problem found was the tendancy of deaf students' to impose a subject-verb-object pattern on sentences and to read linearly instead of hierarchially (e.g., the students interpreted sentences as having a subject-verb-object sequence without focusing on the underlying meaning). When deaf students interpreted simple declarative sentences as having a subject-verb-object sequence, no misunderstanding resulted. However, when this same rule was applied to more complex sentences, a misinterpretation resulted. For example, the sentence "The boy who kicked the dog ran away", would be interpreted as "The dog ran away" rather than "The boy ran away." The noun that is closest to the verb is connected with it.

Besides having difficulty with interpreting sentences, hearing-impaired children also had difficulty with certain word classes. The children had less difficulty in learning content words (nouns, verbs, adjectives) than function words (conjunctions, determiners, prepositions, auxiliary verbs, pronouns, and adverbs) (Brannon, 1968; MacGinite, 1964). Idioms also created problems for deaf children (Shulman & Decker, 1980).

In addition, comprehension of questions was also found to be difficult for individuals who are deaf. Research has shown that hearing-impaired children follow a similar developmental pattern in question comprehension as hearing children do, only at a much slower pace (Quigley, Wilbur, & Montanelli, 1974). Quigley, Wilbur, and Montanelli (1974) studied the ability of 422 deaf students (aged 10 to 19 years) and 60 hearing children (aged eight to 10 years) to respond and judge the grammaticality of yes/no questions, wh-questions and tag-questions. Yes/no questions were the first to be understood, followed by wh-questions and lastly by tag questions. Of the wh-questions, "who" as the subject was the easiest, followed next by "who" as the object, "where" and "when." The researchers found that the major stages in the development of question forms were the same for both hearing and deaf students.

Shulman and Decker (1980) in their review of the literature, found that like hearing children, individuals who are deaf acquire "where, what, and who" questions

first, followed by "whom" and "why" questions, and lastly by "how" and "when" questions. The development of comprehension of wh-question forms by hearing children is not as clear cut as Shulman and Decker (1980) imply. Varying results have been found.

Ervin-Tripp (1970) in a quasi-longitudinal study investigated the question answering ability of hearing children. She observed five children aged one year nine months to two years five months for a period of one and half years and interviewed 24 children at monthly intervals for a period of nine months. The second group of children were between two years six months and three years one month of age. Ervin-Tripp found that the order of development of answering wh-questions were as follows: what, where, what-do, whose, who, why, where-from (e.g., where did the bird fly from?), how and when. However she warned the readers that since there was "so much variability in this order for different chldren, and so few questions in each category, we must be doubtful of the statistical reliability of the order" (p.89).

Tyack and Ingram (1977) found a similar order of comprehesion of wh-questions when they studied 100 hearing children aged three years to five years five months. The following pattern emerged, "ranking from highest percentage of correct responses to lowest...:

1. where-intransitive verb (94%);
2. why-intransitive verb (83%); why-transitive verb

(81%); who-subject (80%);

3. where-transitive verb (67%);
4. what-object (57%); who-object (56%); when-intransitive verb (52%); when-transitive verb (48%).
5. how-transitive verb (38%); how-intransitive verb (35%); what-subject (35%)" (p. 218-219).

The general order of increasing difficulty would be "where (intransitive) < why, who-subject < where (transitive) < what-object, who-object, when < how, what-subject." This order varies slightly from that found by Ervin-Tripp in that Tyack and Ingram found "when" to be easier than "how", and that "why" questions were easier than "who, where (intransitive verb)", and "what" questions. Some of the questions forms used by Tyack and Ingram would probably not occur in real life (e.g., What is riding the boy?). This may have influenced their data.

Cairns and Hsu (1978) investigated the question answering ability of 50 hearing children, aged three years to five years six months. Cairns and Hsu found that the order of answering questions of increasing difficulty was "who-object(do) (e.g., Who did the boy feed?), who-subject, who-object (progressive) (e.g., Who was the Daddy feeding?), why, when", and "how". These researchers found that the questions clustered into three groups, which differed significantly among themselves: Who-object (do), who-subject < who-object (progressive), why < when, and

how. "Who" questions were the easiest for the youngest group of children. This order is similar to that found by Ervin-Tripp except that "how" was found to be slightly more difficult than "when" (though not statistically significant).

Lee and Ashmore (1983) examined the question answering ability of 20 language-delayed hearing children aged four years three months to six years four months. Results showed that the scores from "where, what-do", and "who" questions forms were significantly higher than the scores from "why, how" and "when" questions. This order is similar to that found by Ervin-Tripp (1970) and Cairns and Hsu (1978).

Parnell, Amerman, and Hartig (1986) studied the responses to wh-questions by language-disordered hearing children. The rank order for the questions from easiest to most difficult were: where (89.5%); which (87.70%); what + be (83.90%); whose (77.83%); who (75.73%); what + do (73.0%); what happened (59.83%); why (47.60%); and when (36.73%). The order varied slightly for data obtained from hearing children (Parnell, Patterson, & Harding, 1984): what + be (98,33%); which (96.95%), where (95.57%); who (92.90%); whose (91.25%); what + do (90.43%); why (80.56%); when (78.63%) and what happened (78.50%). "What + be, where", and "which" questions appeared to be the easiest for both normal and language-disordered children, and "why", " when", and "what-happened" were the most

difficult.

Though some inconsistencies exist between the studies, it appears that the ability to respond correctly to "who, what" and "where" questions develops earlier than "why, when", and "how" questions, with "how" and"when" being the most difficult. One study to date, that the present author discovered, stated that deaf children follow a similar order of the major stages in question development as hearing chidren, only at a much slower pace (Quigley, Wilbur, & Montanelli, 1974). One thing is definite, hearing-impaired chldren have difficulty answering questions. Only for yes/no questions do 18 year-old deaf students approach the near 100% comprehension rates evidenced by 10 year-old hearing children (Quigley, Wilbur, & Montanelli, 1974).

Children who are deaf, have difficulty understanding and using the English language. Their poor language skills have a detrimental impact on their ability to read, answer questions, and in general to communicate. A need still exists to find techniques to help deaf children obtain higher language skills. The purpose of the present research project was to discover a teaching technique to improve the recall and comprehension of students with hearing impairments.

The next section of the literature review focuses on different communication methods used to present information to children who are hearing-impaired. Some methods of

communication have consistently been found to be superior. The present research project was based upon the combination of the two best methods of presenting information to students with hearing impairments.

B. Modes of Communication

To alleviate the linguistic handicap of hearing-impaired individuals', extensive research has been conducted to determine the relative efficacy of various modes of communication with persons having hearing impairments. In the studies, information has been presented through a variety of methods, commonly known as: a) the oral or oral/aural method (use of listening and speechreading to receive information), b) the auditory method (use of audition alone to receive information), c) the Rochester method (use of fingerspelling plus the oral method to present information), d) the manual method (use of signs and fingerspelling to convey information), and e) the total communication or simultaneous mode (use of audition, speechreading, fingerspelling and signs).

In some of the studies reported below, the 'oral' mode, as described by the researchers, referred to the use of speechreading alone without the use of auditory cues. To maintain clarity with the definitions stated in the preceding paragraph, this method will be referred to as 'speechreading alone.' A few studies have also investigated the presentation of information through the printed word (e.g., reading) and interpreted means (e.g.,

via sign language). The majority of the research literature reported the efficacy of the total communication approach over the oral and manual systems.

Pudlas (1988) examined the sentence reception abilities of 106, seven to 18 year old moderately-severe, severe, and profoundly deaf students across five communication modes. The sentences were presented through speechreading alone, the oral/aural mode, the aural mode, the manual mode (e.g., Signed English), and the simultaneous mode. After each presentation of a sentence on a T.V. monitor, the subjects wrote the sentence on an answer form. The highest score (58.16%) was attained with the simultaneous mode followed by the manual mode.

Moores, Weiss, and Goodwin (1973) investigated the receptive communication ability of 74, four to six year old severely and profoundly deaf preschool children through five modes of communication. The information was presented via the aural mode, the oral/aural mode, the Rochester method, by total communication, and by the printed word. A receptive communication multiple choice test was developed to assess number concepts, adjective-noun phrases, noun-conjunction-noun phrases, and noun-verb-prepositional phrase constructions. The results indicated that the most efficient means of receptive communication (e.g., comprehension) was through the simultaneous use of sound, speechreading and signs, commonly known as the total communication approach.

Grove, O'Sullivan, and Rodda (1979) investigated the comprehension abilities of 26, 16 to 21 year old severely and profoundly deaf adolescents on a wide range of syntactical and semantic structures through oral and total communication methods. The subjects were tested in their preferred communication method. The subjects chose the communication method they wanted the information to be transmitted in, oral, manual, fingerspelling, or any combination of the above. A pictorial multiple choice test, the Test of Communication Skills, was developed by the researchers so that comprehension of a variety of semantic and syntactic structures could be examined. The subjects were instructed to chose which of eight pictures matched the target sentence. For most of the language structures investigated, total communication was once again found to be the most effective method of presenting information.

Newell (1978) assessed 28, 14 to 19 1/2 year old severely and profoundly deaf adolescents' comprehension and recall of short, factual stories presented through oral, manual, simultaneous, and interpreted methods of communication. None of the subjects had attended a residential school for the deaf. They had received the majority of their education exclusively through the oral/aural method of instruction. Results indicated that simultaneous and interpreted presentations were superior to oral and manual presentations.

A few studies have tested the efficacy of reading as a receptive communication method. White and Stevenson (1975) investigated 11 to 18 year old bright, average, and low functioning severely and profoundly deaf students' ability to comprehend factual passages presented through either oral communication, total communication, manual communication, or the printed word. The subjects' comprehension and recall was assessed through a three-foil multiple choice question test administered immediately following the presentation of each story. The highest comprehension scores were attained when the passages were presented in print. The next most effective methods of presentation were manual and total communication, and lastly oral communication. Comprehension through manual communication was slightly better than that achieved by total communication, although the difference was not statistically significant.

Grove and Rodda (1984) assessed the receptive communication skills of 118, nine to 20 year old moderately-severe, severe, and profoundly deaf individuals (the majority of the subjects were profoundly deaf) through four methods of communication. The Test of Communication Skills, an experimental, multiple choice test, was used to assess the receptive skills. Once again, reading, or the presentation of information through the printed word, was the most efficient method of communication, followed, in order, by total and manual communication (both having the

same relative value), and finally by oral communication. The superiority of reading followed by total and manual communication, and lastly by the oral method was found to be constant across different syntactical/semantic message classes, ages, signing dialects and cultural backgrounds.

Only one study thus far, has not demonstrated the superiority of reading over the other communication modes. Moores, Weiss, and Goodwin (1973), when studying the effectiveness of the aural, aural/oral, Rochester, total communication and printed modes of communication, did not find reading to be the superior mode with severely and profoundly deaf, preschool children.

Thus, it appears that for moderately-severe, severe, and profoundly deaf school-age students and adolescents, comprehension and recall is the best when information is presented through the printed word, followed in order by total communication, manual communication, and oral communication. Since the highest comprehension and recall scores were obtained when information was presented through the printed word, with the second best method being total communication, the present research project was designed to test the efficacy of both approaches combined.

Why are reading and total communication the most efficient means of receptive communication? Studies investigating the short-term capacity, linguistic processing, and encoding abilities of the deaf shed some light on this question.

C: Short-Term Memory Span

The literature investigating the memory skills of hearing-impaired individuals was reviewed to discover if a) individuals who have a hearing-impairment have poor short-term memories, and b) if their short-term memory skills affect their comprehension and recall of the English language, and c) if their short-term memory is affected by the communication method used to present the information?

Numerous studies have investigated the memory abilities of hearing-impaired students. Topics researched have included the memory span for digits, letters, words, and sentences, the effect of sign language ability, and the method of encoding strategies used (phonetic, visual, etc.). In these studies, information was presented either verbally, by writing, by fingerspelling, through signs, or through total communication.

Many studies have demonstrated that deaf children have poorer short-term memories than those of hearing children. Kusche (1984) cited Pintner and Patterson (1917), who found in their study of memory span for digits, "that the average deaf child, at any age, never equaled the average ability of seven-year old hearing children" (p. 82). Since 1917 numerous other studies involving different memory tasks have also demonstrated superior recall ability for hearing children and adolescents (Conrad & Rush, 1965, Koh, Vernon, & Bailey, 1971).

Kusche (1984) assessed the memory span of school-age

deaf children, whose principle mode of instruction in their educational setting was total communication, by giving the students the Visual Aural Digit Span (VADS) Test. The severity of the students' hearing loss was not specified in this document. The digits were presented three times: a) once in total communication and the child recalled them in the manner she/he chose (total communication, sign, or orally), b) once in printed form on cards and the child recalled them in the manner of his/her choice, and c) once again through total communication, but this time, the children had to write the responses. Superior results were obtained in the task where the digits were printed on cards. This finding coincides with the previous studies that found that when information was presented in the printed form, higher comprehension and recall scores were obtained.

One important finding that Kusche (1984) discovered, was that the children became flustered when four or more digits were presented in total communication. According to Kusche the frustration evidenced "has important implications for memory and total communication comprehension skills as well as for reading. Perhaps we often assume that deaf children (or adults) understand us because we are signing to them. If memory span and encoding skills are as crucial for total communication comprehension as they are for reading, one is left with the speculation that deaf children are missing much of the

communication that hearing children listen to naturally or automatically" (p. 374). Kusche may have overgeneralized her interpretation since the relationship between viewing the signed presentation of digits alone to viewing the signed presentation of sentences is not analogous. When students have to recall only sets of digits presented randomly, then no prior experience will help them decide as to what the following or preceding digits might be. However, when students have to comprehend and recall sentences, they have cues to use from syntax, semantics, and context. With digits, information of this nature is not available. Unfortunately, children who are deaf usually have a poor language base and little knowledge of English grammar, often making the use of these cues of little help. With reading, on the other hand, even if the reader feels unsure about words, or word relationships, he/she can glance back at previous words, and then continue reading. This strategy is not possible when information is signed. The signed sentence appears just once unless it is repeated.

To study memory from a slightly different perspective, O'Connor and Hermelin (1971), in a series of experiments designed to investigate the effects of stimulus ordering in input and recall, compared the performance of several different handicapped groups and normal children. The researchers found that hearing-impaired subjects, who had a hearing loss of moderately-severe or worse, tended to

recall digits in their spatial order whereas hearing subjects tended to do so in their temporal order. Hermelin and O'Connor (1973) also found that moderately-severe, severe, and profoundly deaf subjects showed improved recall for stimuli presented spatially rather than sequentially.

Carey and Blake (1974) found similar results. They tested young, profoundly deaf and hearing adults on their ability to report letters, shapes, and nonsense figures from a tachistoscopic presentation. The investigators found strong evidence for visual processing in both deaf and hearing groups, and that while deaf subjects were worse than hearing subjects in the recall of figural information, their performance for position memory was equal to that of the hearing subjects.

Some studies have shown that individuals who are deaf actually have better visual, short-term memories. Blair (1957) found that severely and profoundly deaf children significantly outperformed hearing individuals on the Knox Cube Test (in which the order of stimuli were to be remembered) and on the Memory-for-Designs Test (for which the subjects had to reproduce geometic figures). On the Object Location Test (for which subjects had to remember where familiar objects were positioned on a card) the deaf subjects obtained higher scores than did the hearing subjects, though the difference was not significant. On four memory span tests (where sequences of stimuli, digits, pictures, dominoes, and reversed digits were recalled)

hearing subjects significantly outperformed the deaf subjects. Hearing children were able to remember spans of significantly greater length than were the hearing-impaired children. According to these results, the visual memory of deaf and hearing children does differ and this difference is dependent upon the type of memory task involved. "An analysis of the mental demands of the Knox Cube test, the Memory-for-Designs test, and the Object Location test reveals that they tend to involve a visual perceptual act rather than mental abstraction or conceptualization as do the memory spans" (Blair, 1957, p. 261) Blair also administered a reading achievement test to 39 of the older deaf subjects. He computed a correlational analysis of the reading and memory test scores, and found that the four memory span tests, the tests on which the deaf subjects preformed poorly, correlated with the reading tests more significantly than did the other memory tests. From these results Blair inferred that a common psychological basis may account for the hearing-impaired children's poorer memory span and their poor reading skills.

Hanson (1982) found that severely and profoundly deaf college students, who were fluent in American Sign Language (ASL), recalled fewer words than did hearing adults, in an ordered-recall task but not in a free-recall task. In the ordered-recall task, items were to be remembered in the order in which they were presented, whereas, in the free-recall task, items could be recalled in any order,

regardless of the order in which they were presented.

The previously reported studies have demonstrated that the recall scores of individuals who are hearing-impaired are affected by the manner in which the stimuli are presented, and in the specific task requirements of recalling. Deaf subjects perform poorly on tasks in which the order of information is very important. Since in the English language sequencing of words and ideas is very important, recall of linquistic information may be difficult for deaf individuals. Rodda and Grove (1986), in their discussion of the short-term memory capabilities of deaf individuals, concluded that "in learning situations, deaf children will experience more problems than hearing children in holding several verbal items in working memory" (p. 162).

D. Encoding Strategies

How do deaf people encode information into short-term memory? Several different encoding strategies have been investigated in the literature: speech-based, auditory, visual, sign-based, and fingerspelled codes.

Conrad (1970; 1971; 1973) found that profoundly deaf children who had good speech skills used a speech-based code for storing information in memory while those with poor speech skills relied on some other mediating code. Hanson (1982) also found evidence of use of a speech-based code by severely and profoundly deaf college students who were fluent in American Sign Language. In her study of

ordered versus free recall of words, she found that in the ordered-recall task, deaf subjects used a speech-based rehearsal strategy (e.g., simultaneously signing and mouthing the words). The more the deaf subjects used a speech-based code, the greater accuracy they achieved. The signers who presented the signed stimuli maintained a neutral facial expression during the presentation of the signs. In the free-recall task Hanson found no evidence of the use of a speech-based nor a sign-based code. It was postulated that a visual code may have been used.

MacDougall (1979) investigated the development of visual processing and short-term memory in hearing and severely and profoundly deaf children. The students with normal hearing were eight to 10 years-old and 15 to 18 years-old. The students with impaired hearing were 10 to 12 years-old and 15 to 18 years-old. All the students were asked to recall letters of the alphabet presented in IBM script or Orator type. MacDougall (1979) found that the deaf children in the younger group depended almost totally on visual processing whereas the deaf children in the older group used both visual and auditory cues in memorization. This developmental pattern was reversed for hearing students with the younger group relying mainly on auditory processing and the older group supplementing the auditory with visual coding.

Wallace and Corballis (1973) also found evidence of visual and auditory encoding in severely and profoundly

deaf individuals. They discovered that both orally-educated deaf individuals (aged 11 to 14 years) and those educated through the Rochester method (aged 14 to 27 years), generally used visual encoding when four-letter sequences where presented. When five-letter sequences where shown, the orally-educated deaf individuals used both visual and acoustic encoding, whereas the group educated through the Rochester method did not rely on acoustic encoding. It was postulated that they made use of a fingerspelling code.

Fingerspelling as an encoding process has also been studied. Swanson and O'Connor (1981), in their study of verbal and dactylo-kinesthetic encoding (referred to as fingerspelling) in the short-term memory of severely and profoundly deaf children, found that vocalization, signing, and fingerspelling served to integrate visual representations and improve recall performance. In addition, Hirsh-Pasek and Treiman (1979) found that when reading, deaf adults tended to recode the information into fingerspelling.

Another processing system, cherology (also referred to as the use of sign language), appeared to be an effective encoding system for deaf children and adults. Odom, Blanton, and McIntyre (1970) studied the coding medium and word recall ability of severely and profoundly deaf students in the fifth grade with that of normal hearing fifth graders. The average age of the students that were

hearing-impaired was 16 years old. They had an average reading grade equivalency of 5.0 (range: 4.0-6.3). The researchers found that deaf children were more likely to remember words when there was a sign language equivalent for it, than when there was not. In fact, the deaf students recalled all words better than did the hearing students. This was attributed to the deaf children's superior recall of the signable words. Conlin and Paivio (1975) in a paired-associate task also discovered that signability facilitated recall for moderately-severe, severe, and profoundly deaf high school and college students.

Bellugi, Klima and Siple (1975) investigated the coding strategy used by profoundly deaf college students in remembering lists of signed words with the coding strategy used by hearing college students in remembering lists of spoken words. The deaf students had learned American Sign Language as their first language from their parents. In tasks requiring either immediate recall or a short-delayed recall of visually presented letters or words, hearing subjects encoded the information in a phonological form (Conrad, 1962, Hintzman, 1967). Bellugi, Klima, and Siple (1975) found similar results for the hearing subjects in their study. In comparison, the researchers found that the deaf subjects encoded the linguistic information according to the formational parameters of signs. The basic features that comprise the formation of a sign are referred to as

the formational parameters. Stokoe (1960) identified several formational properties of signs, such as hand configuration, place of articulation, and movement.

Shand (1982) found similar results. He tested the ability of profoundly deaf university students to remember words in an ordered recall task using speech-based (e.g., the words were similar phonemically) and sign-based words (e.g., the words were similar according to the formational parameters of the signs). He found that the formationally similar sign word lists were not recalled as well as the lists of words having formationally dissimilar signs (e.g., the speech-based word list). Shand stated that this observation indicated that sign-based encoding was being used and that speech-based encoding was not being used.

Several different types of encoding strategies have been used by moderately-severe, severe and profoundly deaf individuals. All the encoding strategies have proven to be beneficial. The use of a speech-based code has been found to be especially beneficial in the recall of information presented in an ordered manner (Conrad, 1979, Hanson, 1982). Sign-based encoding, visual encoding, and fingerspelling have assisted in the comprehension and recall of information. Hanson (1982) pointed-out that stimulus input (e.g., signs, printed words, and speech), task requirements, and individual subject characteristics (e.g., degree of hearing loss, educational background, etc.) are likely to influence encoding strategy. A

particular encoding strategy might be more useful for one individual than another; however, the integration of encoding strategies seems to be important for overall comprehension and recall, especially for English sentences, in which the order of information is important. Therefore, total communication in combination with print should allow hearing-impaired students to use the encoding strategy most suited to their needs yet allow them to draw upon the other strategies when needed.

E. Techniques to Promote Recall

A variety of methods used to emphasize words or word groups have proven to be beneficial in aiding recall, especially for poor readers. Signalling is one method that has been used to promote recall. Signals are "special words and phrases used by authors attempting to cue readers to the relative importance, function and interrelatedness of ideas expressed in a prose passage" (Baine, 1986, p. 164).

In order to determine if signalling affects recall, Meyer (1975) wrote pairs of passages, which were identical except for the signalling aspect. In each pair of passages, one contained signals and the other had the signals removed. The act of removing signals, was accomplished by deleting words and phrases from the original passages that contained redundant content and relations. The content, structure, and order of presentation of ideas remained constant in the pairs of

passages. Meyer presented these passages to hearing college students. She found that signalling did not significantly increase the students' recall of the passages. As cited from Baine (1986), Meyer stated three reasons that may have accounted for the lack of a significant increase in recall: a) the signals used were not of the types that would produce the largest gains (this was not explained in further detail), b) too many dissimilar items were combined together as signals, and c) the information emphasized was at the top level of the content structure, which is usually remembered best without the aid of prompts. Information located at the top level of the content structure within a passage, are the superordinate ideas or the main parts of the message. Meyer postulated that signalling would have been more effective if it had been used with middle or lower level information, which is usually not recalled as well. Middle and lower level information refers to subordinate ideas, ones that add support to the main part of the message.

Other techniques have had more success in promoting recall. Rennie, Neilsen, and Braun (1981) in their study using students in the seventh grade found that italics were beneficial for cueing superordinate information for poor readers when the content was unfamiliar. No improvement in recall occurred with passages using familiar content.

O'Shea and Sindelar (1983) found that segmenting sentences improved the comprehension of both high and low

performance readers in the first and third grades. The researchers used Klare, Nichols and Shuford's (1957) criteria in segmenting written prose. The guidelines are as follows (as cited in Baine, 1986, p. 169).

a) Subjects and predicates of simple sentences were separated, and the object was also separated from the predicate.

b) Phrases (chiefly prepositional) were set off.

c) Noun modifiers, if short, were linked with the noun, verb modifiers with the verb, but single subjects or objects stood alone.

d) Clauses were set off and, if long, broken into appropriate thought units. (Klare, et al., p. 42)

O'Shea and Sindelar (1980) modified the above criteria in the following manner:

a) Contractions containing subject and verb were not separated.

b) Subject and verb at the end of a sentence of dialogue were not separated, as in the phrase, "said Andy" (Baine, 1986, p. 169-170).

Underlining is another technique used to promote recall. Several studies (Cashen & Leicht, 1970, Crouse & Idstein, 1972, Rickards & August, 1975) found that underlining segments of the text or principles and concepts significantly aided the recall of the underlined segments of the passages by college students. In fact, Cashen and Leicht (1970) found that statements adjacent to the

underlined sentences were also recalled significantly more often.

Most of the studies indicated that special cueing techniques aid recall. Italics were useful for poor readers in the seventh grade in recalling superordinate ideas in passages containing unfamiliar information (Rennie, Neilson & Braun, 1981). Segmenting sentences were useful in improving the comprehension of good and poor readers in the first and third grades (O'Shea & Sindelar, 1983). Underlining principles and concepts in a text was useful for helping college students recall the passages (Cashen & Leicht, 1970, Crouse & Idstein, 1972, Rickards & August, 1975). Since, on the average, deaf individuals are poor readers and have poorer memory skills for sequential and temporal information than do hearing students, a cueing technique might assist deaf students in comprehending and recalling information.

None of the previously cited studies, used cueing techniques with hearing-impaired individuals. However, using the information obtained from the research conducted with hearing students, a cueing technique was constructed for the present study that may prove to be beneficial for hearing-impaired individuals. This technique is described below.

Presentation of information through total communication and print would permit the encoding of information through a variety of means (e.g. visual,

sign-based, fingerspelling, auditory, and speech-based). Since it is difficult for any individual, hearing-impaired or not, to attend to visual information that is presented simultaneously in two places (e.g., in this case, by the hands of the teacher while signing and by print on a page) without forsaking one or the other, the present author decided that the optimal situation would be the presentation of information through total communication followed sequentially by a presentation of selected information in printed form. Thus, print is used as a cueing device to focus student attention on essential information.

The alternative method of using print as the primary vehicle for presenting information and total communication as a cueing technique was decided against since the process of reading may be disrupted. When children read at rates of less than forty words per minute, comprehension begins to decrease (Wood, Wood, Griffiths & Howarth, 1986). The use of total communication as a cueing technique during the reading process would slow down the reading rate. Therefore, the use of print as the cueing technique with total communication as the primary vehicle for presenting information seemed to be the logical choice.

F. Total Communication/Print Method

The total communication plus print (TCP) procedure as explained in section C of the methodology section (to follow) is based on the following rationale derived from the review of the literature.

1. Cueing techniques have helped hearing school-age, college, and university students comprehend and recall information. Italics as a cueing technique, was found to be useful especially for poor readers in the 7th grade in recalling superordinate ideas in passages containing unfamiliar information (Rennie, Neilsen, & Braun, 1981).

2. Deaf individuals, on the average, are considered to be poor readers since by the time they graduate from high school, they often have only achieved a grade four reading equivalent.

3. Studies have shown that deaf individuals comprehend most through reading followed by total communication.

4. The percentage of comprehension by hearing-impaired individuals, when information is presented through total communication or print alone is low, thus in the present study both methods have been combined.

5. Hearing-impaired students have poorer memory skills than hearing students for sequential and temporal information. English sentences require recall of sequential and temporal information.

6. The use of a speech-based code assists in the recall of linguistic information presented in an ordered

manner (Conrad, 1979; Hanson, 1982). Moderately-severe, severe, and profoundly deaf individuals use a variety of methods to encode information. Consequently, information should be presented in a variety of ways.

Based on the above rationale, a total communication plus print approach was developed. In this approach, total communication is the main method of communication with the sequential use of the printed word acting as a cueing technique. The printed stimulus was added as an adjunct to total communication to promote better comprehension and recall. Only selected words and phrases, from a narrative passage presented by total communication, will be sequentially presented in printed form. The following discussion reviews the types of words that should be cued.

G. Words to be Cued

What words and phrases should be emphasized? Unfortunately, there is not a simple answer to this question. In the previous studies that dealt with cueing techniques, Meyer (1975) postulated that signalling would be more effective if subordinate ideas had been cued. Rennie, Neilsen, and Braun (1981) found that italics were beneficial for cueing superordinate information in passages containing unfamiliar content for poor readers in the seventh grade. O'Shea and Sindelar (1983) found that segmenting sentences within a passage improved the comprehension of good and poor readers in the first and third grades. Several studies found that underlining

segments of a passage or principles and concepts aided college students in recalling information (Cashen & Leicht, 1970; Crouse & Idstein, 1972; Rickards & August, 1975). Based on the research that dealt with cueing techniques and research that focused on the linguistic skills of hearing-impaired individuals, the present author decided to cue the following categories of words in the TCP approach:

1. Unfamiliar Content. Cueing was found to help poor achievers recall more when unfamilar content was used. No effect was found when familiar content was used (Rennie, Neilsen & Braun, 1981). For the present study, unfamiliar content was defined as words not on the Clarence R. Stone's Revision of the Dale List of 769 Easy Words.

2. Abstract Words. Abstract words are more difficult to comprehend and recall than words with concrete referents (Paivio, Yuille, & Madigan, 1968). In addition, abstract concepts are also more difficult for hearing-impaired individuals to understand. Hearing-impaired children do better on problems dealing with concrete events and objects than when they have to deal with abstract materials (Wood, Wood, Griffiths, & Howarth, 1986). For the present study, abstract words were defined as those having a value of less than six according to Paivio, Yuille, and Madigan's list (1968) of 925 nouns.

3. Difficult Linguistic Concepts for the Deaf. Based on the research that shows that cueing helps poor readers comprehend more, it was assumed that by drawing attention

to certain linguistic concepts that are difficult for the deaf, comprehension and recall may be enhanced. Negatives (Quigley & Kretschmer, 1982) were chosen to be cued in the TCP approach.

4. Superordinate Ideas. Since hearing-impaired students, in general, are poor readers, and since cueing makes important information more salient for poor readers (Rennie, Neilson & Braun, 1981), it is postulated that emphasizing main ideas would be benefical for aiding hearing-impaired students comprehension and recall.

Since a sentence in the stories could contain any of the above concepts or none, it was decided that:

a) first any unfamiliar or abstract words were cued,

b) secondly, negatives would be cued,

c) third, if the sentence did not contain any words pretaining to a) or b) above then superordinate ideas were chosen, and

d) only if the sentence did not contain any concepts pretaining to a), b), or c), then subordinate ideas were chosen.

Based on the preceding information on which words should be emphasized and on the literature review dealing with different techniques to promote recall, the following guidelines were developed for the selection of the printed stimulus in the TCP approach.

1. The cued printed stimuli consisted of thought-units or phrases. Usually words were not presented in isolation,

rather, when possible they were presented in a cluster of words that naturally fit together (e.g., The big, blue ball). Only in situations were a word did not fit in a thought unit, or the sentence consisted of only two words was one word presented in isolation.

2. One strip of printed words (3" x 9") was used for each sentence in the paragraphs (e.g., for the sentence 'Once there was a poor farmer', the accompanying printed stimulus was "a poor farmer").

3. The complete sentence was not printed on the paper strips.

4. Generally cued words were hand-printed in lower case letters, except for the first letter of proper nouns and the first letter in a sentence.

H. Story Selection

What types of passages should be used in testing children's comprehension and recall? Narrative prose is often used in research with younger children because it is more concrete, has events and characters with which young children can relate to (Baker & Stein, 1981), and is interesting, and subsequently holds the childrens' interest and attention (Baine, 1986). In addition, when fictional narrative passages are also unfamiliar (e.g., the students have not previously read the passages), then it allows an experimenter to control for knowledge that was acquired previously (Baine, 1986).

III HYPOTHESES

Given: a. that hearing-impaired students comprehend the most when information is presented through print (P), with total communication (TC) being the second best method, and

b. that hearing-impaired students have poorer memory skills, than hearing students, for sequential and temporal information which in turn affects their comprehension and recall of the English language, and

c. that print can be reviewed whereas total communication cannot, therefore, the use of print will aid a student's memory ability, and

d. that hearing-impaired students' comprehension and recall of information are still poor through total communication or print alone, it follows that the combination of both methods, TC and P, should help to aid students in comprehending and recalling information over and above that achieved by either TC or P alone.

Therefore, it is hypothesized:

a. that hearing-impaired students would comprehend and recall the most information when stories are presented in the TCP mode,

b. with Print being the second best method of presentation, and

c. TC the last.

IV METHODOLOGY

The following discussion describes the experimental subjects, the test instruments, the presentation methods, and methods of data collection and data analysis.

A. Subjects

Six subjects were selected from a public school in Edmonton that used total communication to teach hearing-impaired students. The subjects were selected on the basis of the following criteria. The subjects had to:

1. have an independent reading level between grade 2.2 and 2.8,
2. have a moderately-severe, severe or profound hearing impairment,
3. be in an educational program that uses total communication,
4. be between the ages of 7 and 12 years of age, and
5. have no apparent visual problem affecting their reading ability or comprehension of total communication as reported by their teachers.

To determine whether the students matched the criteria, information was obtained from student files and from their teachers. Once the students had been selected, they were given the Diagnostic Reading Scales (DRS) to ascertain their reading levels. If a student's independent reading level was between a grade equivalent of 2.2 and 2.8, parental permission was requested for the student's participation in the research project. The parents were

asked to sign a Consent to Participate form. The parents were advised that they could withdraw from participation in the study at any time. The students' names were not used in the study, rather a letter was assigned to identify each student and this was used in data analysis.

The subjects were between the ages of seven years, 11 months and 11 years and 11 months. The subjects' had sensorineural hearing losses bilaterally that ranged from moderately-severe to profound. Their hearing-impairments were discovered in their preschool years, one as young as eight months of age, and one as old as four years of age. The use of total communication as the method to communicate with them was started in the preschool years, one as young as two years, four months and one as old as seven years of age.

All six subjects had hearing parents. Two of the six subjects' parents had good signing ability, one had fair signing ability, and three had poor signing ability.

Four of the six subjects performed average to above average on non-verbal psychological tests. Two of the six subjects placed at the low average range of I.Q. Three of the six subjects were noted as having a learning disability.

B. Test Instruments

1. Diagnostic Reading Scales (DRS)

The Diagnostic Reading Scales (DRS) (Spache,1981) was chosen as the test to assess the six subjects' reading

abilities since the DRS: a) provided a grade equivalence rating of students' reading abilities, b) used the same methods for estimating the difficulty of the passages used in the present research project for obtaining grade equivalents for the experimental stories (e.g., the Spache Readability Formula was also used in estimating difficulty of the passages in the DRS), and b) the DRS would not influence performance on reading tests that were planned to be administered in the classroom.

The administration of the DRS was modified slightly when the test was given to the six hearing-impaired subjects. Due to the subjects' articulation difficulties, their mispronunciations of words were not scored as incorrect if they knew the appropriate sign equivalent. In addition, all the instructions and questions were conveyed in total communication. An instructional reading grade equivalent and an independent reading grade equivalent were obtained for each student. "The instructional level is a measure of oral reading and comprehension. It indicates 1) the level of oral reading and comprehension ability that the average teacher would find acceptable for classroom or group instruction, and 2) the grade level of basal or other reading material at which a student would be placed in a typical classroom. The independent level is a measure of silent reading comprehension. It designates the highest level of supplemental instructional or recreation materials that should be offered to the student for silent,

independent reading" (Spache, 1981, p. 9). The students' independent reading grade equivalents were chosen as one of the criteria for the subject's inclusion in the present research project since this level of reading ability should provide enough skill for the students to read the stories in the print presentation method.

2. Rhode Island Test of Language Structure (RITLS)

The Rhode Island Test of Language Structure (Engen & Engen, 1983), was used in the present research project to determine the subjects' comprehension of total communication. The RITLS focuses on different syntactic structures used in the English language. The examiner presents a stimulus sentence (e.g., "The boy was kicked by the horse.") and the student points to one of three pictures which he/she feels represents the target sentence. The test is normed for hearing subjects aged 3 1/2 to six years, and hearing-impaired subjects aged five to 17+ years. Two hundred eighty-three hearing children and 364 hearing-impaired children served in the standardization group.

Reliability coefficients were calculated using scores from 91 kindergarten children and 69 hearing-impaired children ranging in age from five to 16 years. "The reliability was evaluated with the Kuder Richardson formula 20 (KR20). The result was 0.72 for the 91 hearing subjects and 0.88 for the 69 hearing-impaired subjects..." (Engen & Engen, 1983, p. 26). As reported in the test manual, the

split-half reliability coefficient obtained with the first version of the test, with the hearing-impaired subjects in the pilot study, was .91.

The sentences on the normative study and the pilot study were rank ordered for difficulty and found to be very similar. "The Spearman rank order correlation coefficient for the hearing-impaired group was 0.94 and for the hearing 0.85. The correlation between the hearing and the hearing-impaired groups on the two different occasions was 0.89 and 0.85 in the pilot and normative studies, respectively, with $p < 0.001$ in all cases" (Engen & Engen, 1983, p. 28).

3. Preschool Language Assessment Instrument (PLAI)

The Preschool Language Assessment Instrument (Blank, Rose, & Berlin, 1978) was used in this research project to formally assess the six subjects receptive and expressive language skills. The PLAI is an experimental test, "designed to assess young children's skills in coping with the language demands of the teaching situation" (Blank, Rose, & Berlin, 1978, p. 1). It is intended to be used with hearing children aged 3 to 6 years; however, if a student's "language skills are questionable, the test may be usefully administered to children up to 10 years of age" (Blank, Rose, & Berlin, 1978, p.1).

The PLAI tests the student's ability on four levels of abstraction.

I. Matching Perception

(e.g., What is this? What is the lady doing?)

II. Selective Analysis of Perception

(e.g., What do you do with it? I like to eat some _____.)

III. Reordering Perception

(e.g., How are these different? What could she have seen?)

IV. Reasoning about Perception

(e.g., Which one of these things could we use ...? Why did you pick that one?)

The child's responses to the questions or statements are scored as 0 (inadequate), 1 (ambiguous), 2 (acceptable), or 3 (fully acceptable). After completion of the test, a mean score is obtained of the child's ability at each of the four discourse levels. A mean score a) below 1 indicates weakness, b) between 1.0 and 1.4 indicates moderate weakness, c) between 1.5 and 2.0 indicates moderate strength, and d) above 2.0 indicates strength.

Blank, Rose, and Berlin assessed three aspects of reliability: a) rater-reliability, b) split-half reliability, and c) test-retest reliability. An agreement of 81 percent to 93 percent was obtained when four different raters independently scored the 60 test items for each of ten children. An agreement of 92 percent to 98 percent was obtained when agreement was calculated between 3 out of the 4 raters. "These results indicate there is a

high level of agreement among raters in scoring the individual items" (Blank, Rose, & Berlin, 1978, p.6). When mean scores for each of the 10 children, were calculated by the four raters, identical mean scores were obtained 83 percent of the time. In none of the cases did the mean score vary by more than 0.3 between the raters, with the mean differences averaging at 0.1. This again indicated high inter-reliability.

"Split-half reliability (corrected for attenuation by the Spearman-Brown Formula) had been assessed for the total sample. The correlations were: Group I= 0.64; II= 0.80; III= 0.83; and IV= 0.86. These correlations indicate a high level of internal consistency within each of the four groups of test items" (Blank, Rose, & Berlin, 1978, p.7).

As reported in the test manual, a measure of test-retest reliability was assessed by administering the test to 34 students seven to 14 days after the initial administration. The test-retest correlations for the different levels were: level I= 0.73;, level II= 0.83; level III= 0.86; and level IV= 0.88. These correlations indicated stability from one administration to the next.

Blank, Rose, and Berlin (1978) also assessed the content validity and discriminative validity of the PLAI. Content validity was assessed by having five psychologists and special education teachers read chapters 2 and 3 in The Language of Learning where the language model, upon which the PLAI is based, is discussed. The specialists then

rated the 60 test items into the four discourse levels. Seventy-five percent agreement was obtained between the 5 specialists, 95 percent agreement was obtained between four of the five raters. "These figures suggest that independent raters with no previous knowledge of the test, generally concur in the placement of the individual items within the four groups of discourse skills" (Blank, Rose, & Berlin, 1978, p. 7).

Discriminative validity referred to the degree to which a test can identify a group of children who possess language difficulities. Fourteen pre-school aged children, diagnosed as having language disabilities by other test instruments, were tested on the PLAI. "All of the children obtained scores below the 25th percentile on two or more of the four discourse skills, and 8 of the 14 obtained scores below that level on all four groups of subskills. These results suggest that PLAI distinguishes among children according to their level of language ability" (Blank, Rose, & Berlin, 1978, p. 8).

4. Stories

Eighteen equivalent stories, each having 12 associated recall questions, were used to assess the students' recall and comprehension under the three modes, print alone, total communication alone, and a combination of both total communication and print (TCP). The stories were chosen (and modified when necessary) to fit the following criteria. The stories had to:

1) be narrative prose;

2) be 115 +/- 10 words in length;

3) have a readability level between grade 2.0 and 2.2 based on the Spache Readability Formula (Spache, 1972);

4) have a syntactic complexity count between 1.0 and 2.5, based on Streng, Kretschmer and Kretschmer's (1978) revision of Granowski and Botel's (1974) Syntactic Complexity Formula (SCF); and

5) be unfamiliar to the students.

Stories were taken from the Standard Reading Inventory and the SRA Reading Laboratory Kits and subsequently modified to fit the above stated criteria. No two paragraphs are totally equivalent in difficulty because one cannot control for the information that the reader brings with him. However, using the above criteria which take into consideration sentence length, syntax, difficulty of words, difficult structures for hearing-impaired individuals, story length, and story type, the present author felt that comparable stories, in terms of difficulty had been approximated as closely as possible.

Several factors, in addition to the criteria stated above were used in developing and modifying the stories. Pictures were not used with the passages to eliminate any confounding effects that may arise from comprehension obtained through pictorial representation. Although pictures are normally used in the students' basal readers,

they are eliminated in most reading inventories and tests.

To eliminate any memory effect that may confound recall of similar stories, different topics and character names were represented in the 18 stories. Since the number of facts per story may affect recall, an attempt was made to control for this by limiting story length and sentence complexity.

To control for the actual differences that existed between the stories, a counterbalanced experimental design was implemented. The number obtained from adding the readability level and the syntactical complexity count and then dividing the total by two was used to rate the stories from easiest to most difficult. The stories were then ranked from easiest to the most difficult. Next the stories were randomly assigned, starting with the easiest, to one of six groups. After all 18 stories had been assigned, the six groups were divided randomly into three sets, I, II, and III. Each set contained six stories. Each set of stories was alternated between the treatment modes (e.g., for subject A, set I was presented in total communication, for subject B, set I was presented in print, and for subject C, set I was presented in total communication and print combined).

5. Questions

The difficulty level of the questions asked for each story had to be comparable across stories. Shulman and Decker (1980) developed guidelines for linguistically

controlling reading materials for hearing-impaired students. In their guidelines, level I questions are used with hearing-impaired students in grades one and two, and level 2 questions are used with hearing-impaired students in grade 3. Using these guidelines and the research on the acquisition of "wh" questions by hearing and hearing-impaired students (Cairns & Hsu, 1978; Ervin-Tripp, 1970; Lee & Ashmore, 1983; Parnell, Amerman, & Hartig, 1986), two levels of question difficulty were developed for this project. The easier level included:

1. any "who," "what," and "where" questions; and
2. "how much" or "how many" only if a noun followed the question word (e.g., How many eggs...?, What color...?).

The difficult level included:

1. any "why, which, when, whose," and "how" questions; and
2. questions involving negative words.

The following criteria were used in designing questions for each story:

1. 12 questions per story comprised of 6 easier questions and 6 more difficult questions; and
2. 75% of the answers to the questions were cued by use of the printed stimulus during the TCP approach.

For criteria 2 above, cueing by use of the printed stimulus meant that the exact answer or the elements

comprising the answer were displayed. For example, for the question "Why couldn't the farmer fix his roof?", the parts that make up the answer were cued (e.g., no money, no wood), however the relationship was not explicitly displayed on the printed strips (e.g., He had no money and no wood).

Twenty-five percent of the answers were not cued. Since 75% of the answers were cued, the answer (or the elements comprising the answer) to 9 out of the 12 questions were printed on the paper strips. An equal number of answers to the questions in the easy and difficult groups were of the "not cued" type, therefore, in half the stories, answers to two easy questions were not cued, and the answer to one difficult question was not cued. For the remainder half of the stories, the answer to one easy question and the answers to two difficult questions were not cued.

The questions were asked immediately after the completion of each story. The complete questioning method was videotaped. The question format was as follows.

a) First the teacher asked the question through total communication (TC).

b) Second, the teacher showed the printed question and assisted with any unfamiliar words if requested by the student.

c) Third, the student responded through sign and/or speech.

d) Fourth, if the student ambiguously answered the question, the teacher probed to obtain a more exact answer by asking "What do you mean?" If the student partially answered the question, the teacher asked "Can you tell me more?".

During the probe, no further information was given that may have elicited additional recall of information. The intention of the probe was for clarification. The procedure for probing remained constant from student to student.

The same procedure for asking the questions, as outlined above, was maintained for all the questions.

C. Presentation Methods

1. TC Method

Speech, fingerspelling, signs, facial expressions, and gestures were used to present the stories. The stories were signed in Signed English. Signs from American Sign Language were used as much as possible with the addition of fingerspelling, the use of English markers (e.g., ing, s, ed etc.), and the maintenance of English word order. Signed English was the method of signing used in the school in which the students were taught, therefore, the students were familiar with the signs used in this study. Occasionally, there are a few different signs for the same concept or item. To make sure that familiar signs were used with the students, prior to starting the research project, the researcher confirmed the signs used by the

classroom teachers of the students involved in the study.

2. TCP Method

Step 1. The teacher used the TC method to present the first sentence of the passage (e.g. "Little Frog lived by a lake.").

Step 2. With the right hand the teacher signed "look" (V handshape) moving from the right eye to paper strip #1 lying on the table in front of the student. With her left hand, the teacher flipped the paper over and exposed the words (for e.g. "by a lake") for a silent count of "one thousand and one, one thousand and two", or until the child indicated that he had read the printed stimuli.

Step 3. The teacher flipped paper strip #1 back again to the blank side and signed "watch" (V hand-shape moving from the paper to the teacher's eyes).

Step 4. Steps 1 to 3 were repeated for each sentence in the story, until the child followed the sequence. For later sentences, the "watch" and "look" signs were faded from use.

The paper strips were numbered #1, #2, #3 etc. according to the number of the sentence in the story from which the words had been taken.

3. Print Method

The students were instructed to read the stories carefully. The stories were printed in short paragraphs, following formats found in basal readers (e.g., short paragraphs and well-spaced). The print size of the stories

was identical to the print size in the basal readers used by the youngest students participating in the study.

D. Experimental Design

The multielement single-subject treatment design, also known as the alternating treatment design, was used in this research project. This design involves presenting alternating treatments with an individual learner or group of learners. "The interventions are alternated and counterbalanced session by session (or within sessions) rather than over time" (Tawney & Gast, 1984, p. 321).

In this research project 18 stories were presented individually to each of the six subjects through three communication modes: TC, TCP, and P. The 18 stories were rated from easiest to most difficult and then starting with the easiest, randomly assigned to one of six groups. These groups were then randomly assigned to story sets I, II, and III (these procedures are more fully described in section IV.B.).

Each set of stories was alternated between the treatment modes for different subjects (e.g., for subject A, set I was presented in total communication (TC), for subject B, set I was presented in print (P), and for subject C, set I was presented in a combination of total commuication and print (TCP) mode.

The subjects from the youngest class were randomly assigned the letters A, B, and C. The older subjects were randomly assigned the letters D, E, and F. The

experimental design was as follows.

Table 1

Experimental design for the presentation of the story sets to the six subjects.

Subjects	Communication Mode	Story Set
A & D	TC	I
	P	II
	TCP	III
B & E	TC	III
	P	I
	TCP	II
C & F	TC	II
	P	III
	TCP	I

The stories were presented randomly to each subject, with two stories being presented per session, per day. Eighteen slips of paper, bearing a code referring to the story number and mode (e.g., #1 TC) were placed into an envelope. Prior to the first session, the examiner pulled out the slips of paper and recorded the order of presentation for the subject. This was done three times, once for subjects A and D, once for subjects B and E, and once for subjects D and F. Consequently, the stories were

presented in a different order for each set of subjects. Dates on which the stories were presented were recorded.

An example of the randomly determined schedule of implementation of each experimental condition is illustrated in Table 2.

There are many advantages to using a multielement design. Some of the advantages listed by Twaney and Gast (1984) are described below.

a) No baseline condition is required before interventions are introduced. Comparisons between the interventions can be made whether or not a stable baseline is established.

b) Maturational and historical threats are controlled since interventions are presented in rapid alternation rather than for extended periods of time.

c) Sequencing problems are reduced due to implementation of rapidly alternating treatments.

d) "Behaviors do not need to be reversed in order to demonstrate experimental control which is especially useful when studying irreversible behaviors" (Tawney & Gast, 1984, p.316).

e) "The design permits a rapid comparison of several interventions and allows the investigator to conduct a component analysis of a complex procedure..." (Tawney & Gast, 1984, p. 316).

The alternating treatments design has several

Table 2

Example of the random presentation of the stories to subject A.

	Presentation Modes		
Days	TCP	TC	P
1	9		5
2	7	11	
3		2	4
4	6	18	
5	1		3
6			8,13
7		10	17
8	14,12		
9		15	16

Note

The numbers of the stories are listed under the presentation modes.

disadvantages (Tawney & Gast, 1984). They are as follows.

a) The individuals(s) need to be very consistent in administering the conditions and evaluating the data.

b) Numerous extra-experimental variables need to be counterbalanced across interventions (e.g., instructional location, sequencing of the treatments, etc.) which can become difficult to do.

c) "...multiple treatment interference (e.g., the influence one intervention has on the apparent effectiveness, of a second intervention) cannot be determined easily" (Tawney & Gast, 1984, p. 318).

In this research study, the researcher has attempted to control for some of the effects of the limitations of the alternating treatments design by: a) having only one individual administer the treatment conditions in a consistent format across the subjects and stories; b) following a set of guidelines in evaluating the data; c) administering the treatments in one location; and d) counterbalancing and then presenting the stories in a randomized fashion.

E. Data Collection

Permission to perform this study was obtained from the school district, the principal of the school, and parents of the six students who served as subjects.

1. Demographic Information

Information on the student's hearing loss (etiology,

age acquired, type, severity), educational setting, educational backgound (type, number of years in a total communication setting, number of years in school), parental status (e.g., deaf or hearing parents), use of sign language at home, age, grade level, and psychological information (e.g., I.Q., etc.) was obtained from school records and teachers.

2. Reading Level

The students reading level was assessed using the Diagnostic Reading Scales (DRS). The test was administered on an individual basis prior to the start of the research project.

3. Language Level

The students' receptive and expressive language skills in total communication were assessed by administering the Rhode Island Test of Language Structure (RITLS), and the Preschool Language Assessment Instrument (PLAI).

4. Story Comprehension and Recall

Immediately following the presentation of each story, the students were asked 12 questions pertaining to the story. The question and answer period was recorded on videotape. Prior to asking the questions, the story number and presentation mode were also recorded on the videotape.

The answers were scored as either wrong (0 points) or right (1 point). If there was more than one part to an answer, then the student obtained credit for the number of correct parts he/she provided. For example, if an answer

consisted of two parts, then the student was given .5 points for each part he provided. The maximum score per question was 1.

Following the guidelines in the DRS, a separate score was not computed for correct answers obtained after the questioning probes were used.

V. RESULTS

This study investigated the effects of hearing-impaired students' comprehension and recall through three methods of presenting information TCP, P, and TC. The study was designed to answer the following research questions. Were the highest comprehension scores obtained in the TCP mode, followed by the print mode, and finally by the TC approach? Did the printed stimulus in the TCP mode help to promote better comprehension and recall of the stories?

The number of correct answers obtained from each subject in response to the questions was plotted on a graph. The Tawney and Gast (1984) within condition analysis format was used to visually analyze the data. In this method of data analysis, the following information is determined for each condition or subject (see Table 3).

1. Condition Length. The condition remained constant for all subjects since six stories were presented in each communication mode, therefore only six data points were obtained.

2. Estimate of Trend Direction. The split-middle method was used to determine the trend line (see Figure 1).

3. Trend Stability. A 20% stability criterion and the highest data point possible (e.g., 12) were used to calculate the acceptable stability range (e.g., 12 x .20 = 2.4). This number remained constant for each condition per subject. A trend stability criterion envelope was drawn

Table 3

Within condition analysis of subject A's responses under three treatment condtions.

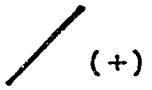
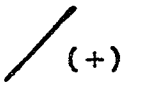
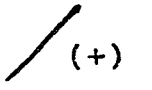
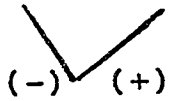
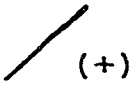
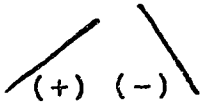
	Conditions		
	TCP	TC	P
1. Condition Length	6	6	6
2. Estimate of Trend Direction	 (+)	 (+)	 (+)
3. Trend Stability	variable (66.67%)	stable (83.33%)	stable (100%)
4. Data Paths Within Trend	 (-) (+)	 (+)	 (+) (-)
5. Level Stability and Range	variable (8-12)	variable (5-12)	variable (6-9)
6. Level Change	9.5-9 (-0.5)	5-12 (+7.0)	7.8-7 (+0.8)

Figure 1. Trend stability of Subject A's responses under TCP presentation mode.

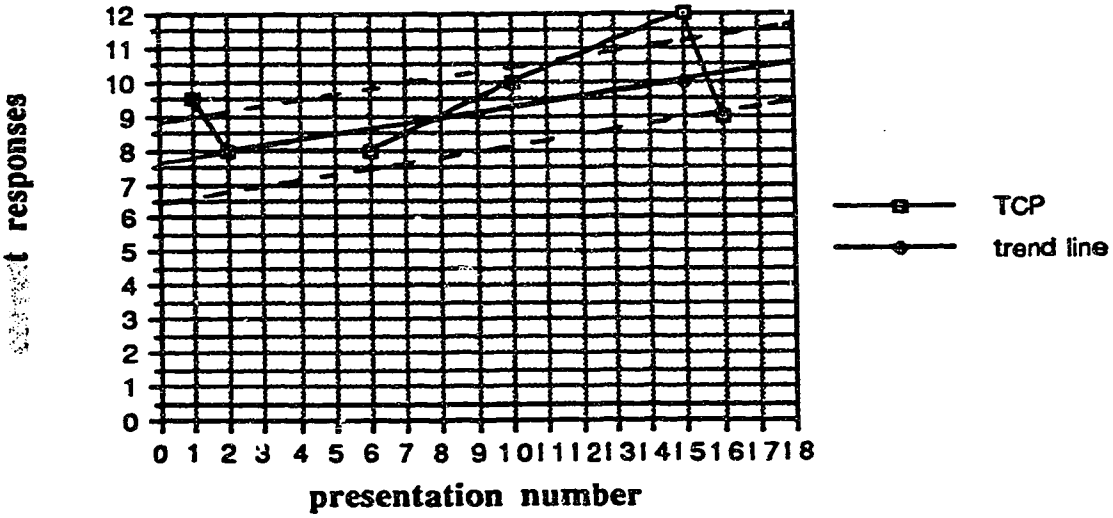
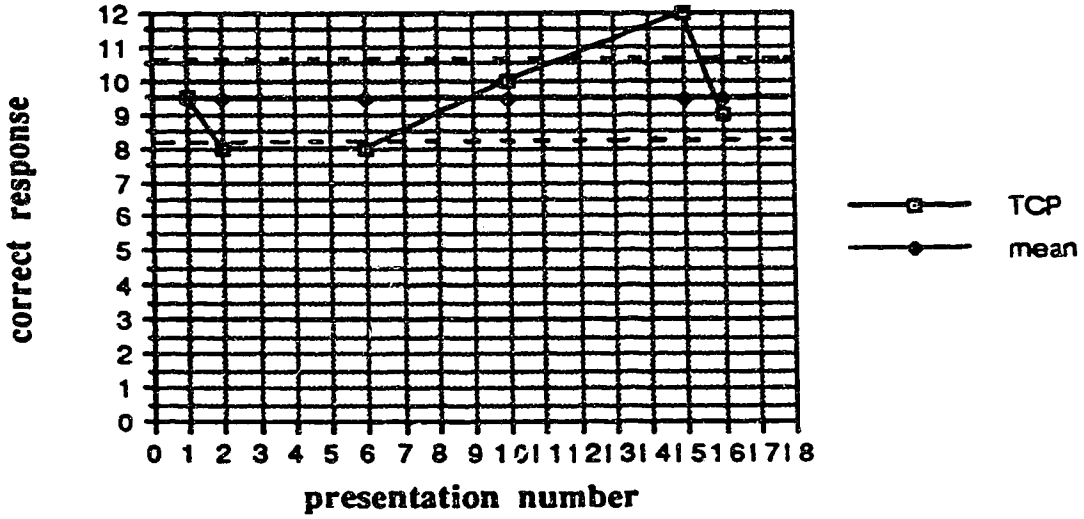


Figure 2. Level stability of Subject A's responses under TCP presentation mode.



around the trend line (see Figure 1). If 80% or more of the data points (e.g., 5/6) fell between the stability criterion range, then the trend was considered to be "stable." If less than 80% of the data points fell within the range, then the trend was considered to be "variable" (e.g., 4 divided by 6 x 100 = 66.67%, variable).

4. Data Paths Within Trend. If there were two distinct data paths within the trend, then these were depicted as showing: a) improving (+); b) decaying (-); or c) zero celeration (=).

5. Level Stability and Range. The mean level was obtained by adding the value of all the six data points, and dividing the sum by six. The "mean level line" was drawn on the graph (see Figure 2). Then the "level stability criterion envelope" was drawn around the "mean level line" using the 2.4 stability criterion (as calculated in step 3 above). The level stability range was calculated by dividing the number of data points within the range by the total number of data points (e.g., 5 divided by 6 = 83.33%). The same criterion as stated in number 3 above was used to determine if the mean level line was stable or variable. The range of values was identified by noting the lowest and highest number of correct responses (e.g., 8 and 12).

6. Level Change. The value of the number of correct responses from the first story and the last story were identified. The smallest value was subtracted from the

largest. The change in direction was identified as an improvement (+), a deterioration (-), or no change (=) (e.g., -.5).

In the Tawney and Gast method of visually analyzing the data, the hypotheses would be considered valid if there was a consistent pattern of responding that varied for each intervention, with little or no overlapping or intersecting data points. If the data points overlap, experimental effect is not evidenced.

The results of the study are presented in five sections. The first section presents the overall findings from the students' comprehension and recall of the stories. Then the results from each subjects' performance on the PLAI, DRS, and RITLS are reported. The third section focuses on the difficulty level of the stories and any differences found between story sets. The fourth section looks at the individual subject's performance on the stories, followed by a discussion involving data obtained from the reading and language tests. The last section focuses on the cued versus non-cued responses.

A. Overall Findings

For all six students, the data paths for TC, TCP and P overlapped (see Figures 3, 4, 5, 6, 7, and 8) varying from 16.66 percent to 100 percent overlap. Therefore, experimental effect was not evidenced. The hypotheses, that hearing-impaired students would comprehend and recall the most information when stories were presented in TCP,

Figure 3. Comparison of the number of correct responses for Subject A for the three presentation modes.

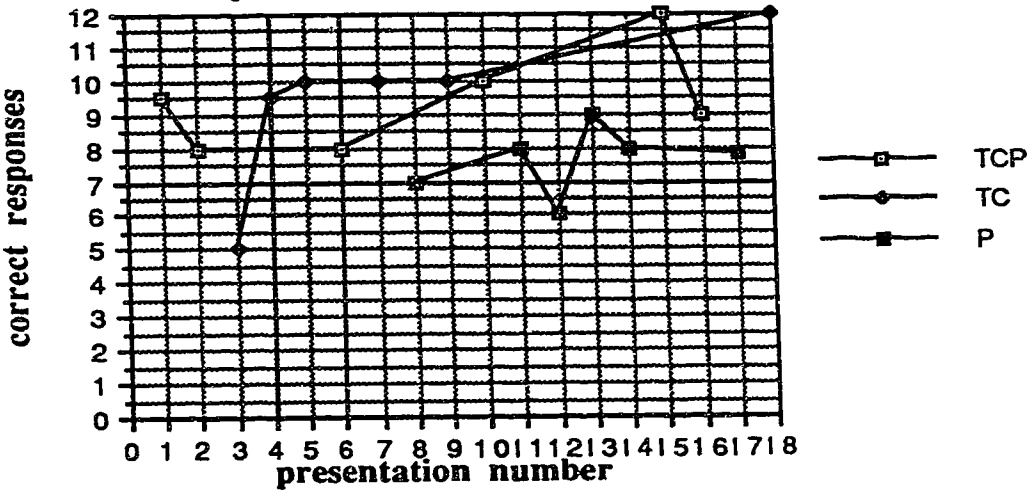


Figure 4. Comparison of the number of correct responses for Subject B for the three presentation modes.

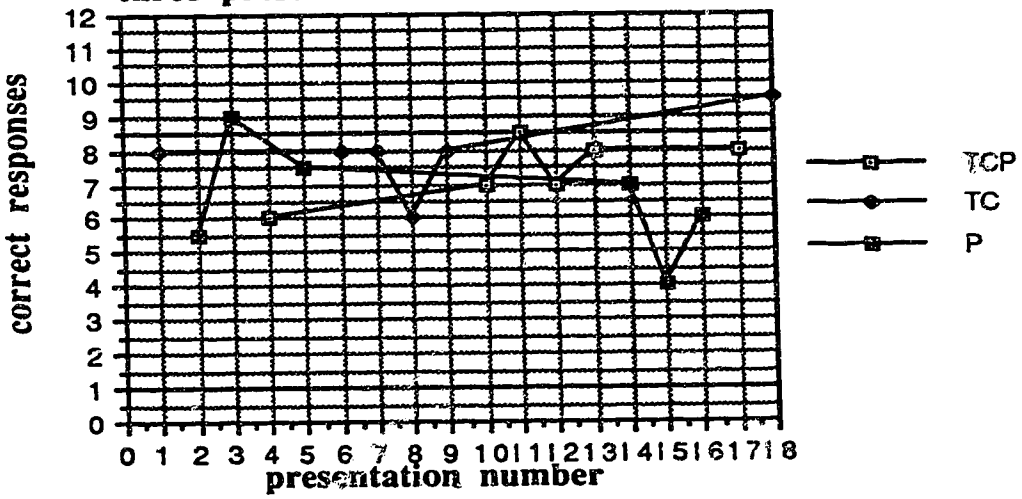


Figure 5. Comparison of the number of correct responses for Subject C for the three presentation modes.

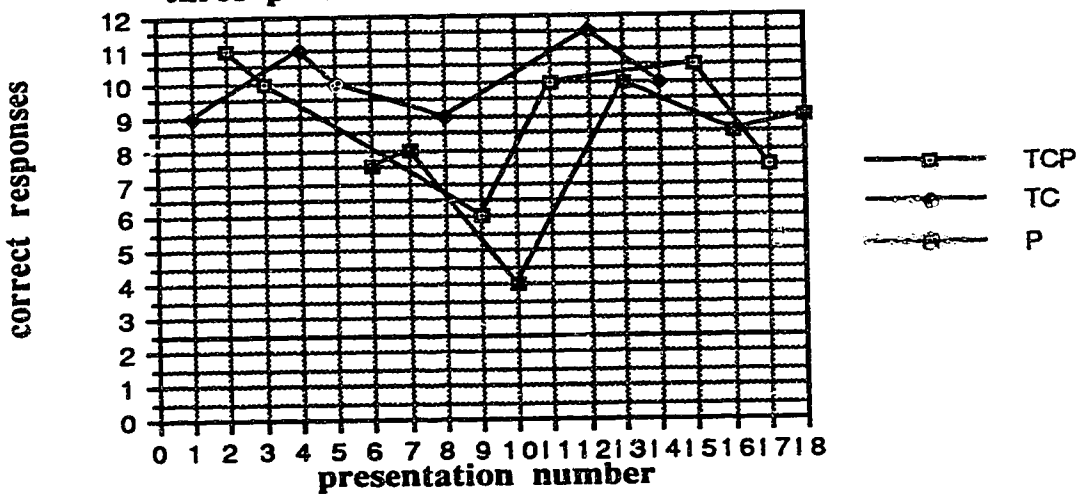


Figure 6. Comparison of the number of correct responses for Subject D for the three presentation modes.

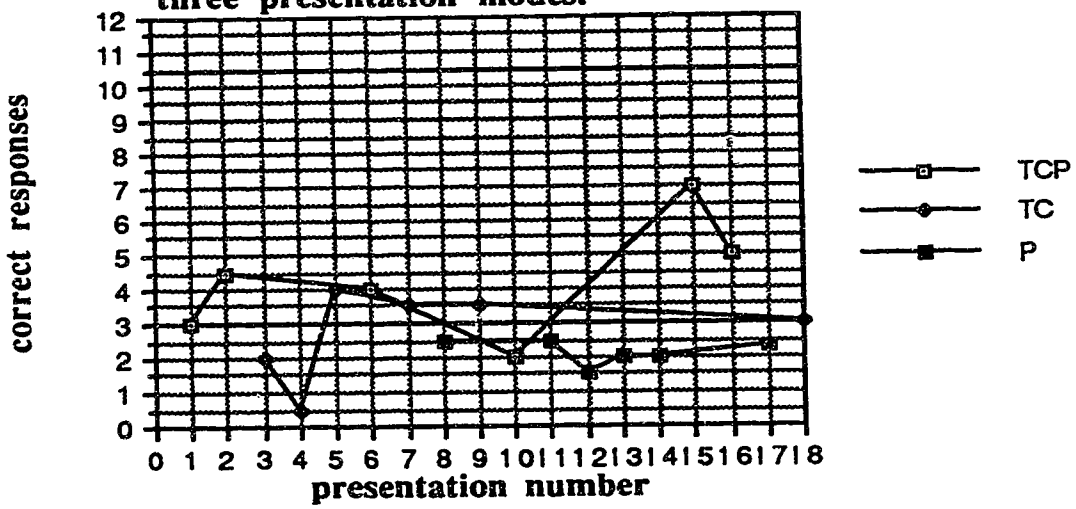


Figure 7. Comparison of the number of correct responses for Subject E for the three presentation modes.

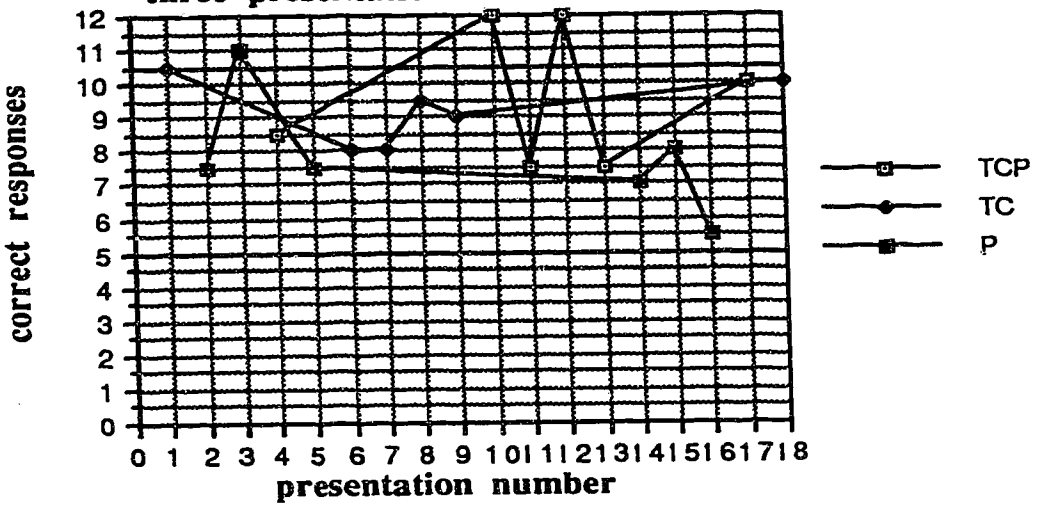
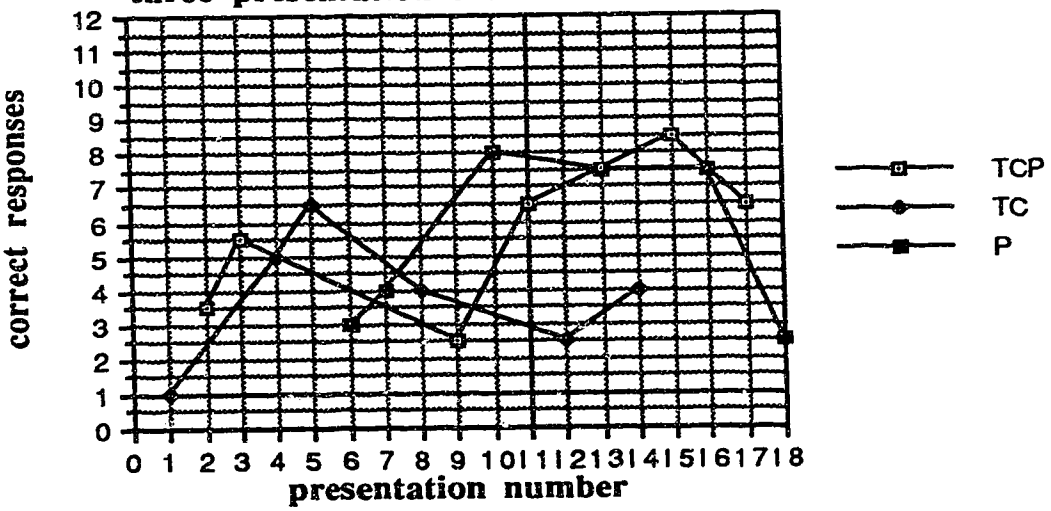


Figure 8. Comparison of the number of correct responses for Subject F for the three presentation modes.



with P being the second best method of presentation, and TC the least was not proven to be valid.

Although, not of significance, there appears to be a trend that the majority of the six students comprehended and recalled the most information when the stories were presented in TCP, with TC being the second most effective method, and P the least effective method. For three of the six students, the highest mean scores were obtained in the TCP mode of presentation. For one of the six students, TC and TCP were equally the most effective method of story presentation. For five of the six students, the lowest mean scores were obtained in the print presentation mode. See Table 4 for the mean average scores obtained by each of the subjects under the three presentation modes.

B. Reading and Language Scores

The students' independent reading levels ranged from a reading equivalent of 2.2 to 2.8 on the DRS (see Table 5). Therefore all of the students' independent reading skills were above the reading levels of the stories.

Five of the six students scored above the 80th percentile on the RITLS. The sixth student was at the 65th percentile. These results indicate that the students were above average in their comprehension of syntactic structures presented through total communication when compared to other hearing-impaired students of similar ages.

All of the students were strong (above a mean score of

Table 4

Subjects' mean comprehension and recall scores of the stories under the three presentation modes.

	Subjects					
Modes	A	B	C	D	E	F
TCP	9.416	7.416	9.160	4.250	9.583	5.500
TC	9.416	8.000	10.000	2.750	9.160	3.830
P	7.630	6.500	7.830	2.133	7.750	5.250

Note

TCP = total communication and print

TC = total communication

P = print

Table 5

Subjects' Reading and Language Scores

	DRS		PLAI				RITLS
Student	Ins.	Ind.	I	II	III	IV	Percentile
A	2.8	2.8	2.8	2.5	1.9	1.5	83.1
B	1.8	2.2	2.6	2.7	2.3	1.3	99.3
C	1.8	2.4	2.9	2.7	2.4	2.1	89.4
D	1.8	2.2	2.6	2.1	1.2	1.2	88.2
E	2.2	2.2	2.8	2.7	2.4	2.4	92.2
F	2.2	2.2	2.8	1.8	1.5	0.6	65.1

Note

PLAI = Preschool Language Assessment Instrument

The mean scores are given.

2.0-3.0 = strong ability

1.5-2.0 = moderately strong

1.0-1.4 = moderately weak

below 1.0 = weak

DRS = Diagnostic Reading Scales

The reading grade equivalents are stated.

Ins. = instructional level

Ind. = independent level

RITLS = Rhode Island Test of Language Structure

2.0) in their ability to respond to level I statements/questions assessed on the PLAI. Five of the six students were rated as strong on level II questions on the PLAI, with the sixth student rated as moderately strong (1.5 to 2.0). Three of the six students were rated as strong on level III questions, two rated as moderately strong, and one rated as moderately weak (1.0 to 1.4). On level IV questions, two students were rated as strong, one as moderately strong, two as moderately weak, and one as weak (below 1.0). These results indicate that some of the students would have difficulty understanding and answering more difficult question forms as found on levels III and IV on the PLAI, which require the student "to use language to restructure or to reflect on those perceptions" (Blank, Rose, & Berlin, 1978, p. 1). Some examples of level IV question forms (as taken from the test manual) are "Which one of these things could we use to fix the cup?, Why did you pick that one?, What will happen if...?, and How do you know this boy is finished eating?" (Blank, Rose, & Berlin, 1978). Some of the question forms asked after the stories were presented to the students in this research project would be of the same difficulty as level IV questions found on the PLAI.

C. Difficulty Level of the Stories

The stories ranged in reading grade equivalents, as assessed by the Spache Readability Formula, from 2.00 to 2.209, with a mean reading grade of 2.113. The stories

ranged in syntactical complexity as assessed by Streng, Kretschmer, and Kretschmer's (1978) revision of Granowski and Botel's (1974) Syntactic Complexity Formula from 1.421 to 2.313 with an average syntactic complexity count of 1.784.

The graphs depicting the students' number of correct answers to the story questions (see Figures 3, 4, 5, 6, 7, and 8) were compared across all subjects to determine how consistently the subjects performed with each story set (e.g., set I was presented in Print to subjects B and E, in TC to subjects A and D, and in TCP to subjects C and F). The results were erratic. In none of the cases were the best recall and comprehension scores associated with a particular story set, indicating that the subjects' comprehension and recall scores were not affected by the relative difficulty of the story sets.

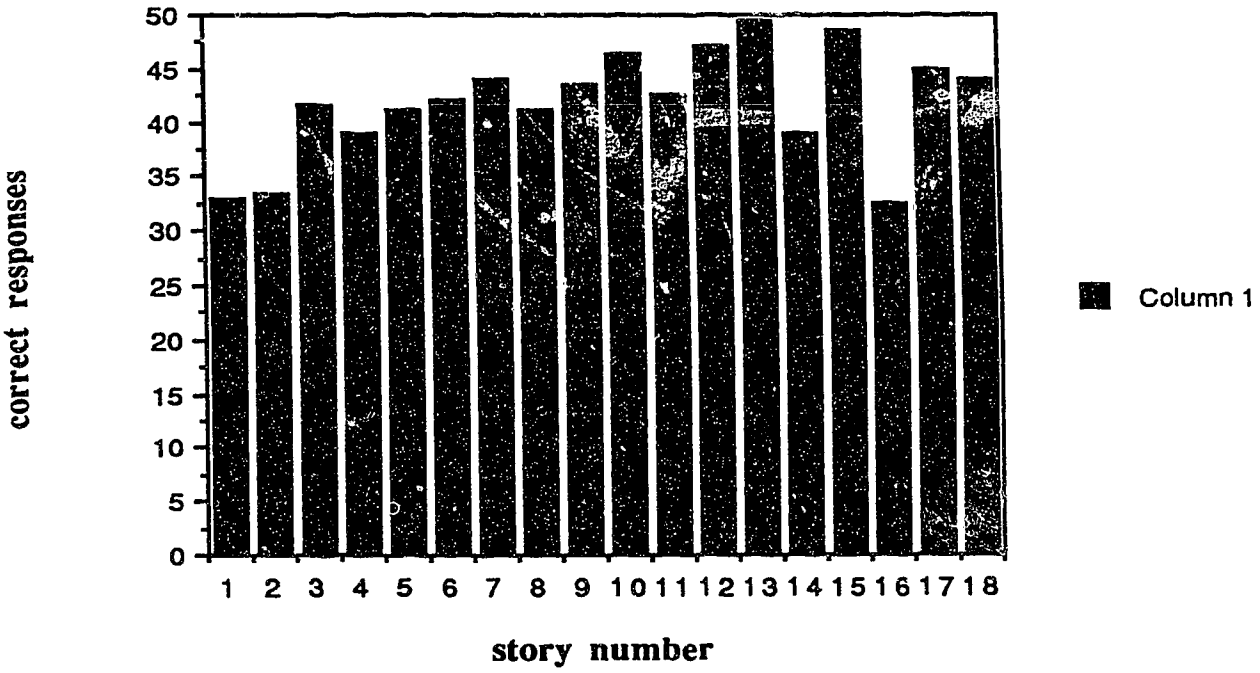
The number of correct responses obtained for each story across all subjects was calculated and graphed (see Figure 9). The three stories that appeared to be the most difficult for the hearing-impaired students to comprehend and answer questions about were story 16, 1 and 2. The four stories that appeared to be the easiest were story 13, 15, 12, and 10.

D. Individual Subject's Performance

1. Subject A

Student A had the highest reading grade equivalent when compared to the other five subjects, as determined on

Figure 9. Number of correct responses obtained for each story across all subjects.



the DRS, yet her comprehension and recall scores of the stories in this study, were the lowest in the print mode, with TCP and TC being equally the most effective method of presenting information to her. It does not appear that the addition of the printed stimulus helped Subject A comprehend or recall more. If the results from story 16 (the third story presented to her, see Figure 3), which appeared to be the most difficult story for all the students, were excluded, then it appears that Subject A understood the best through TC alone.

Subject A answered most of the easy questions on the stories with little difficulty. Of the more difficult question forms, she had the most problems with "when questions" (42.86% accuracy achieved). Whether this is a reflection of Subject A's difficulty in answering "when questions", or whether the answers to "when questions" are minor details, therefore less easily remembered, is hard to distinguish. Subject A answered correctly 33 out of 55 "why questions" (60%), 14 out of 23 "how questions" (60.87%), 4 out of 5 "which questions" (80%), and all three "whose questions." Therefore, it appears that Subject A also had some difficulty answering "why" and "how" question forms.

2. Subject B

TC appeared to be the best method of presenting information to Subject B (see Figure and Table 4) with TCP following closely behind and P being the least effective method. Subject B answered the easier questions of the

stories only slightly better than the more difficult question forms (e.g., 63.89% accuracy versus 56.94% accuracy, respectively). He appeared to have the most difficulty with "who questions" (38.1% accuracy achieved), "where questions" (53.23% accuracy achieved) and "why questions" (54.55% accuracy achieved) questions.

Subject B was moderately weak (see Table 5) in responding to level IV questions and statements on the PLAI. This could account for his difficulty with "why question" forms. His understanding of TC and his ability to answer questions, as tested by the RITLS and PLAI, were among the best when compared to the other five students. Subject B's reading ability, as tested by the DRS, was one of the lowest when compared to the other five students.

For six of the nine sessions, Subject B obtained lower recall and comprehension scores for the story presented second during each session. Fatigue or other extraneous factors could have affected his ability to attend to the second story and answer the questions.

3. Subject C

TC also appeared to be the best method of presenting information for Subject C (see Table 4), with TCP being the second most effective method, and P the least effective. Even when the two low scores (stories presented as number nine and 10) (see Figure 5) were excluded from data analysis, since during this session the student was in a rush and not concentrating as good, TC still appeared to be

the best method of presenting information (mean of 10.0). TCP followed closely behind with a mean of 9.8. Print was still the least effective method (mean of 8.6).

When compared to the other five students, Subject C answered the most questions correctly. He also obtained one of the highest scores on the DRS, RITLS, and PLAI (see Table 4).

Of the story questions, Subject C answered 84.26% of the easy question types and 66.2% of the more difficult forms. He had the most difficulty with "when questions" (33.33% accuracy achieved), followed by "how questions" (63.04% accuracy achieved) and lastly by "why questions" (74.55% accuracy achieved).

4. Subject D

TCP appeared to be the best method of presenting information to subject D (see Table 4). TC was the second best method, and P the least effective method.

Subject D had extreme difficulty answering all the question forms. He correctly answered 32.33% of the easier question forms. Of the more difficult question forms, he answered 18.52% correctly. "What + noun" and "how many/much + noun" were the easiest questions for him to answer.

In comparison, Subject D was moderately weak in answering level III and IV question forms on the PLAI, which could account for his difficulty in answering the more difficult question forms. His reading score on the

DRS was one of the lowest, though, his understanding of grammatical structures, as tested by the RITLS, was average compared to the other students.

Subject D was reported to have learning difficulties. In addition, a memory deficit was noted in his preschool years.

5. Subject E

TCP also appeared to be the best method of presenting the stories to Subject E (see Table 4) followed closely by TC, and lastly by P. Subject E answered most of the easier question forms correctly (83.15% accuracy achieved). He had the most difficulty with "when questions" (38.10% accuracy achieved), and "why questions" (63.64% accuracy achieved).

Student E achieved the highest mean score on level IV on the PLAI (see Table 5) compared to the other five students. He also achieved the second highest number of correct answers in responding to the questions about the stories. Subject C achieved a slightly higher score. Subject E's reading grade equivalent, as tested by the DRS, was of average ability compared to the other five students. He received the second highest score on the RITLS.

6. Subject F

TCP also appeared to be the best method of presenting information to Subject F (mean of 5.5) (see Table 4). Print was the second best method (mean of 5.25) and TC was the least effective method (mean of 3.83). Subject F is

the only student whose least effective method of receiving information was not through Print.

Subject F had difficulty answering most question forms. He correctly answered 43.52% of the easy questions and 38.43% of the more difficult questions. He had the most difficulty with "when questions" (14.29% accuracy achieved), "how questions" (26.09% accuracy achieved) and "whose questions" (33.33% accuracy achieved).

Subject F's reading scores on the DRS were average when compared to the other five students. He had the lowest overall scores on the PLAI and the RITLS. In addition, Subject F has learning difficulties and psychological tests placed him in the low average range of I.Q.

For six of the nine sessions, Subject F correctly answered less questions for the story presented second. Occasionally, he answered some of the questions for the second story with information from the first story. Thus it appears that presenting two stories per session affected Subject F's recall and comprehension of the second story.

E. Cued versus Non-cued Responses

For the stories presented in the TCP approach, the percentage of correct answers that were cued versus those that were not cued, was calculated (see Table 6). Cueing by use of the printed stimulus appeared to be very beneficial for students B and C, slightly beneficial for students A, D, and F, and not beneficial for student E.

Table 6

Percentage of correct answers for cued versus non-cued questions in the TCP approach.

	Subjects					
Answers	A	B	C	D	E	F
Cued	78.70%	64.81%	79.63%	36.11%	78.70%	46.30%
Non-cued	77.78%	52.78%	66.67%	33.33%	83.33%	41.67%

VI. DISCUSSION

Even though the hypotheses that TCP would be the most effective method of presenting information, with P being the second best method, and TC the least effective method, was not validated, the addition of print, as a cueing technique, appeared to be beneficial for three of the six students (students D, E, and F). Their highest mean comprehension and recall scores were obtained on the TCP presentation mode (see Table 4). These three students were the oldest participants in the study. The teacher of these three students reported that they all had learning difficulties. In addition, students D and F were found to test in the low average range of I.Q. on psychological tests.

The combination of TC and P may be beneficial for students who have learning difficulties in addition to their hearing impairment. These observations may seem contrary to the usual, since learning disabled students often have difficulty with reading. However, through the TCP method, the students are first exposed to the message through TC. When the printed stimulus was shown, the student did not have to focus his attention on decoding the printed word and lose comprehension, instead, he/she received the message twice, thereby emphasizing the importance of the word and enhancing comprehension.

For students who have average to above average intelligence, with no additional learning difficulty, the

use of print with total communication, as described in the TCP approach, may not be beneficial and may even distract from their understanding of the stories (e.g., students A, B, and C). Students A and C, at times, seemed bored with the TCP procedure, probably because they understood most of the message presented to them in TC. Student C even guessed at what should be printed on the word strips. Therefore, for students who have average to above average intelligence, with no learning disability, the use of the TCP approach with narrative stories that are slightly below their independent reading level, may be of little help. However, the use of the printed stimulus may potentially be beneficial in learning new and difficult concepts presented in a teaching situation.

In future studies modifications could be made to the type of information that is cued by print. It appears that the primary emphasis should be on presenting the major (superordinate) information in the story and any difficult words. Therefore, it would not be necessary to cue parts from every sentence. This change may help students who have learning difficulties understand the stories better. By more selectively picking information to be cued, and by not cueing parts of every sentence, the amount of time that it takes to present the story would be shortened. As the ideas would be presented in closer unity, this change may have a positive effect on the students' comprehension and recall.

Two research studies have found print to be the most effective method of presenting information to hearing-impaired students (Grove & Rodda, 1984; White & Stevenson, 1975). The results of the present research study did not support this finding, in fact, for five of the six students, print was the least effective method of presenting information. In both the White and Stevenson study and the Grove and Rodda study, a multiple-choice format was used to test the students' comprehension and recall. In the present study, an open-ended question format was used. The questions were asked in TC and then shown in the printed form. The students had to formulate the answers themselves.

There are advantages and disadvantages of both methods of testing students' comprehension and recall. In the open-ended question format, a student's inability to express him/herself might hinder from answering completely. In addition, there is a greater chance of misinterpreting the question. The multiple-choice form is an easier question format since the student simply chooses which of the responses are correct. In addition, since a limited number of choices are stated, there is a greater chance of guessing at the right answer.

An additional difference between the White and Stevenson (1975) study and the present study was the method of communication used in testing comprehension and recall. Print was the only mode used in the White and Stevenson

study to test comprehension and recall. The subjects read the question and chose which of three answers best answered the question. This procedure would give the printed mode an advantage since the subjects could answer questions on the basis of word recognition rather than on comprehension. In the present study, TC was initially used to ask the question, followed sequentially by the printed question.

Additional differences between the White and Stevenson (1975) study and the present study were as follows.

a) White and Stevenson used factual passages, whereas narrative passages were used in the present study.

b) Students were 11.0 to 18.7 years of age in the White and Stevenson study, whereas the subjects were seven to 12 years of age in the present study.

c) Reading grade levels ranged from an average of 2.36 for Group 1 to 4.3 for Group 9 in the White and Stevenson study. The students in the present study had reading grade equivalents between 2.2 and 2.8.

d) The passages used in the White and Stevenson study were at the second and fourth grade levels. Passages having a grade equivalent of 2.0 to 2.2 were used in the present study.

e) The maximum number of subjects tested at one time were 15 in the White and Stevenson study, whereas, in the present study subjects were tested individually.

The Grove and Rodda (1984) study differed from the

present study in the following ways.

a) Isolated sentences were presented through one of four methods of communication and the subjects pointed to one of eight pictures. In the present study narrative passages were used.

b) In the Grove and Rodda study, each subject was tested in only one communication mode. In the present study, each subject was tested in all three communication modes.

If information is presented to subjects in a variety of modes, but tested in only one mode, it may be that the best recall and comprehension scores would occur in the method where the presentation of information and the testing of information are performed in the same mode (e.g. print and print as in the White and Stevenson study). Recognition rather than comprehension of words may help students choose the correct answers.

In comparing all three studies, White and Stvenson, Rodda and Grove, and the present study, there is not sufficient evidence to show that either reading or total communiction are the superior method of presenting information to hearing-impaired students. Many differences exist between the studies, and it is possible that different modes are superior under different conditions (e.g., age of students, type of information, length of information).

Therefore, further research is needed tc test a) if

there is one method of presenting information that is superior in all situations, for all hearing-impaired students, or b) if different methods are more efficient under certain conditions. In addition, further research is needed to test the efficacy of the TCP approach. Areas of concern are: a) is the TCP approach beneficial for hearing-impaired students with learning difficulties; b) would modifications in the type of information to be cued be more helpful, and c) are there beneficial long term effects in using the TCP approach?

To test the efficacy of the TCP approach, modifications may be necessary in the research design. Some of the possibilites are as follows.

a) Display the cued words prior to presenting the full message in TC. This technique may draw more emphasis to the printed word, thereby making it's purpose more explicit for students. However, this technique may not be beneficial for learning disabled students who might not be able to read the

b) Select subjects to participate in the study based on their question answering ability. In the present study, it was difficult to distinguish if the students' ability to answer the questions was affected by his/her comprehension and recall, or his/her inability to answer certain wh-questions.

c) Select more difficult paragraphs for students with

average to above average intelligence. In this study, the three students with average to above intelligence understood the most information through TC when the paragraphs were slightly below their reading level. Would it be beneficial to use the printed word when more difficult information is to be transmitted?

d) Use of a multiple-choice format in testing recall comprehension. A confounding factor would be the recognition of the printed word or signs rather than recall and comprehension.

e) Have the students retell the stories. Unfortunately, hearing-impaired students also have difficulties in retelling stories, so this may not be a valid measure of their recall and comprehension.

Lastly, it would be of interest to know if the students understood the purpose of the printed word. If they did not understand the role, then maybe by making the purpose more explicit, it might be helpful.

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APPENDIX I. DEFINITIONS OF TERMS

alternation - The use of "or" to join sentences.

backward pronominalization - "Pronominalization is the substitution of an appropriate pronoun for a fully specified noun phrase in order to reduce redundancy in the language by eliminating features of the noun phrase which the speaker... will convey to the listener" (Quigley, Steinkamp, Desmond, & Jones, 1978, p. 43).

complementation - "Complements are sentences which are embedded into main sentences" (Shulman & Decker, 1980, p. 14) and they function as a noun phrase. The complement "can be the subject or object of the main sentence, or the object of a prepositional phrase" (Shulman & Decker, 1980, p. 14) (e.g., <u>To be a musician</u> was his ambition).

disjunction - The use of "but" to join sentences.

determiners - Words such as "a", "an", and "the" which precede nouns.

moderately-severe hearing loss - A hearing loss between 56 and 70 dB (Martin, 1981).

severe hearing loss - A hearing loss between 71 and 90 dB (Martin, 1981).

Profound hearing loss - A hearing loss above 90 dB (Martin, 1981).

tag questions - They are questions attached to the end of sentences (e.g., Mark is a carpenter, <u>isn't he</u>?).

APPENDIX II. SYNTACTIC COMPLEXITY FORMULA

0-Count Structures

Sentence patterns- 2 or 3 lexical items

1. NP + V + (adverbial): "Jim fell down. He cried."
2. NP + V + NP: "I ate the apple."
3. NP + be + Complement (noun, adjective, adverb): "It is a kite. That is funny."
4. NP + V + Infinitive Complement: "Jill wants to play."

Simple transformations

5. Interrogative, including tag-end questions: "Where [illegible]"
6. Exclamation: "What a game!"
7. Imperative: "Go to the store."

Coordinate clauses

8. Clauses joined by "and": "She came and she stayed."
9. Non-sentence expressions: "Oh well!, Yes, And then."

1-Count Structures

Sentence patterns- 4 lexical items

10. NP + V + NP + NP(indirect object): "I gave him the book."
11. NP + V + NP + Complement: "We call him Rover."

Noun modifiers

12. Adjectives (big, happy): "I saw a funny show."
13. Possessives (baby's, Mary's): "Mary's dress is new."

14. Predeterminers (some of, none of, six of): "Two of the boys came."
15. Participles used in natural position as prenominal adjective: "boiling water"
16. Prepositional phrases: "The book on the floor is mine."

Other modifiers

17. Adverbials including prepositional phrases, when they do not immediately follow the verb: "Bill threw the fall over the fence."
18. Modals: "could, would, must, ought, dare to, need to, have to": and auxiliaries: "have, had, do, did, be + ing"
19. Contractions for modals and auxiliaries: "I'd" for "had" or "would", "He's" for "is" or "has", "I've" for "have": "I'd go if I could. He's been here."
20. Negatives: "no, not, never, neither, nor, n't"
21. Set expressions: "once upon a time, many years ago, for instance"
22. Gerunds used as subjects: "Jogging is popular now."
23. Infinitives when they do not immediately follow the the verb: "I wanted to come."

Coordinates

24. Coordinate clauses joined by "but, for, so," or "yet": "I was sick so I stayed home."
25. Deletion in coordinate clauses - a 1 count is given for each lexical addition: "Julie and Jerry will

finish or stay after school."

26. Paired coordinates - "both...and": "Both Jane saw it and I saw it."

2-Count Structures

27. Passives: "I was hit by the ball."
28. Paired conjunctions - "either...or, neither...nor": "Either she will go or I will go."
29. Dependent clauses (adverb, noun, adjective): "They left before I did."
30. Comparatives - "as, same as, __er than, more than, __est": "He is older than I am."
31. Participles ("ed" or "ing" forms not used in usual adjectival position): "Running, John tripped. The dog, tied up, barked loudly."
32. Infinitives as subjects: "To graduate is important."
33. Appositives when set off by commas: "Mrs. Jones, my neighbor, is sick."
34. Conjunctive adverbs - "however, thus, nevertheless," etc.: "However, he returned the book."

3-Count Structures

35. Clauses used as subjects: "What you do is your business."
36. Absolutes: "The dance over, the group dispersed."

(Adapted from Streng, Kretschmer, & Kretschmer,1978, p. 156)

APPENDIX III. EXAMPLE OF A STORY AND QUESTIONS

Story 5

One summer day while Tommy was eating breakfast, a chipmunk came to the window.

Tommy sat still. The chipmunk was not afraid. The chipmunk looked in the window. He was curious.

Then he jumped to the ground. He ran to his hole in the tree.

Quickly Tommy got some water and a few peanuts. He put them outside on the grass. Tommy went back into the house. He watched out the window.

The chipmunk looked out of his hole. He came nearer. He drank a little bit of water. He put one peanut in his mouth and ran back to the hole. He came for another peanut, then another one, until they were all gone. He was saving the peanuts for winter.

(adpated from the Standard Reading Inventory, Form A)

QUESTIONS - STORY #5

1. Who looked in the window?
2. When did the chipmunk look in the window?
3. What was Tommy doing when the chipmunk came to the window?
4. Why did the chipmunk look in the window?
5. Why did Tommy sit still?
6. Where did the chipmunk live?
7. What did Tommy give the chipmunk?
8. How many peanuts did Tommy put on the grass?
9. How did the chipmunk carry the peanuts?
10. How much did the chipmunk drink?
11. Where did the chipmunk put the peanuts?
12. Why did the chipmunk put the peanuts in the tree?