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ABSTRACT

Investigated were aspects of language development (association, memory, comprehension, and production) in three groups (50 individuals per group) of deaf adolescents who were variously trained by the pure oral method, the combined oral-manual method, and the Rochester fingerspelling method. One hearing group was matched with the deaf in age, and another in comprehension of written language. All groups were reported to be equal on a verbal recognition memory test, but the deaf trained in the combined method showed poorer recall on the same test. The Noun Pairs Memory test showed all groups equal on the number correct and on most error categories, except that both hearing groups and the oral group imported more incorrect words from outside the test to complete the sentences. The orally trained deaf were reported to be more like both hearing groups in their comprehension of multi-meaning words and in their control over distracting associations when questions on meaning were asked. The orally trained deaf were also found to be similar to the hearing in their ability to select meaning and in choosing fewer associations when the multi-meaning words were presented in sentences. (Author/GW)

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LANGUAGE DEVELOPMENT IN DEAF AND HEARING ADOLESCENTS

Solis L. Kates

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THE CLARKE SCHOOL FOR THE DEAF
Northampton, Massachusetts

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TABLE OF CONTENTS

SIGNIFICANT FINDINGS FOR REHABILITATION WORKERS

I

The findings of this research which are most relevant to the work of rehabilitation and so al service workers are those which compare the language development of deaf adolescents trained by different methods. These findings would be useful in advising deaf students and their families about educational programs. For convenience in discussion, the pure oral students are referred to as the Oral group: the combined oral-manual as the Combined group· and the Rochester fingerspelling group as the Rochester group. All deaf subjects were matched on age, IQ, written language comprehension and socio-economic background.

The results suggest that the Rochester fingerspelling method may provide students with primary word associations for well known words similar to those of well-educated hearing adults (college students).

However, the Oral subjects seemed more advanced in their knowledge of word meanings, in their control of associations when meaning was appropriate, and in their superior use of syntax as an aid to memory and in the interpretation and production of language. The Oral group was also considerably better than the Rochester group and far better than the Combined group in writing longer, more complicated, clearer and much more grammatical sentences. Rochester was in the middle and Combined was the poorest. In general, these results suggest that the Oral method may enable deaf students to achieve more advanced language development.

In spite of the differences mentioned above there are many ways in which deaf adolescents trained by the Oral, Combined and Rochester methods are similar. There are certain areas of language development in which the deaf students in all 3 groups greatly need improvement. Deaf students need more emphasis and effective instruction in the correct use of function words (articles, prepositions, conjunctions, pronouns) as opposed to content, or key, words which carry the general meaning of a phrase or sentence (nouns, verbs, adjectives, adverbs). They also need to learn to use the correct verb forms and word endings, especially the agreement of subject and verb. And deaf students need more knowledge and practice in using the less well known meanings of words and the likely contexts, both in terms of meaning and syntax, for these other meanings.

THE PROBLEM

<> There are approximately one-half million deaf persons in the United States, most of whom have inadequate language development and, as a result, are inferior in overall educational achievement.

<> It has been demonstrated consistently that the educational attainment of deaf children falls far below what might be predicted on the basis of age and intelligence.

<> The area in which the deaf child and deaf adult is weakest, and which underlies his deficiency in other areas, is his language ability.

<> One study of deaf students aged 10 to 16, representing 54% of the deaf school children, found:

1) The average gain in reading from age 10 to 16 was less than one year for the entire period.

2) The average reading achievement of deaf 16 year olds was at the 3.4 grade level.

3) 80 percent of deaf 16 year olds were below the 4.9 grade level in reading, considered the minimum for using connected language.

<> The profoundly deaf person who has been so since before the age of language learning may know quite a number of isolated words, but with rare exceptions will he be able to form or comprehend sentences which approximate the complexity of Grade 4 reading level.

<> Thus, the problem of adequate language learning for the deaf remains a major problem for parents, teachers and for the deaf themselves.

<> The issue of whether the pure oral, combined oral-manual, or fingerspelling method for communication and education is most effective has been often obscured by emotional biases. Additional objective data is needed so that a fair evaluation can be made.

<> Educators of the deaf also need accurate and specific knowledge of the verbal strengths and weaknesses of their students so that they can improve their teaching programs.

<> Because of the differences in educational methods and opinions about them, it is important to evaluate the effects of school and method in order to counsel adequately deaf students and their parents.

<> In addition to being informed about the effects of the different methods, people working with the deaf need more objective information about the specific ways in which the deaf are different from the hearing in verbal skills -- and whether they are only delayed in their language development or whether their sensory handicap causes permanent limited and inferior language development.

IMPLICATIONS FOR ACTION

Subject Groups: Oral (pure oral), Combined (oral-manual), Rochester (finger-spelling), Hearing-Age (matched with the deaf in age), Hearing-Achievement (matched with the deaf in language comprehension, but 2 - 3 years younger than the deaf and Hearing-Age subjects).

Word association results, while not contradictory, suggest 2 somewhat conflicting needs. The Oral and Combined groups especially, need to learn associations to well known words which are more similar to the hearing. This means developing a similar hierarchy of related words, ideas, etc. At the same time the Rochester and Combined groups, particularly, need to become more meaning-oriented rather than association-oriented, and to resist the distracting influence of associations when meaning is appropriate.

The deaf groups were, for the most part, similar to the older hearing group in the various tests of verbal memory, suggesting that deafness does not interfere with basic verbal memory. However, the deaf groups, but particularly the Rochester and Combined groups, need to learn to use syntax more effectively as an aid in recall.

Most deaf students need to become more familiar with the less common meanings of multi-meaning words and the likely contexts for them.

All deaf students, but particularly Rochester and Combined, also need to improve their syntax, especially through more instruction and practice in using function words in phrases and sentences (function words are articles, conjunctions, prepositions, and pronouns.) They also need to improve their use of inflected endings, especially verb forms.

The deaf, especially Rochester and Combined, need much more work on the production of connected language so that they are able to relate ideas and express them in longer, more complicated sentences.

Summary:

The one conspicuous way in which the deaf were dramatically poorer than both hearing groups, even the one matched with them on written language comprehension, was in grammatical errors, especially in the use of function words and inflected word endings. Possibly, this deficiency may be minimized through appropriate teaching measures, recently developed.

Overall, the Oral group seemed more knowledgeable about meaning and more meaning-oriented than Rochester and Combined. The Oral group was also substantially better than Rochester, and far better than the Combined group, in the use of syntax, both as an aid to memory and in sentence production. These are extremely important aspects of language development.

The Rochester group was better than the Oral and Combined groups in the similarity of their primary word associations to the hearing. This is significant because it involves the relationship of ideas or aspects of ideas in thinking.

The Combined group wrote more passive sentences than the other 2 deaf groups. This is thought to be an indication of verbal sophistication.

SUPPORTING FINDINGS

Word Association Test results showed that Rochester gave primary word association responses more similar to those of the college norms than the Oral or Combined deaf groups. The deaf groups were similar in idiosyncratic responses. The Word Comprehension and Contextual Cues Tests, however, showed that the Rochester and Combined subjects were more prone to choose associations when meaning was appropriate and seemed more association-oriented than the Oral deaf group and the 2 hearing groups.

On the tests of recognition memory and recall and of memory for noun pairs the deaf performed quite similarly to both hearing groups. On the Sentence Memory Test, when syntax was involved (the sentences as opposed to the word strings) the Oral group's recall was more like the older hearing group than the Rochester or Combined group.

The Sentence Construction results showed that the Oral group was better than the Rochester and Combined groups in using less overlapping vocabulary, longer, more complicated and clearer sentences, though the Combined groups used slightly more passive sentences (a sign of sophistication) than the Oral and Rochester groups. Although both hearing groups made far fewer grammatical errors than the deaf, the Oral group was much better than the Rochester group and very much better than the Combined group. The Rochester group was also much better than the Combined group. All 3 deaf groups, however, made many minor categorial errors (misuse or omission of determiners) and many morphological errors (inflected endings), especially with verbs. The deaf groups also made a moderate number of strict subcategorial errors, often involving improper preposition addition or omission.

A simplified summary of the performance of the deaf groups is given below.

WORD ASSOCIATION STUDY

Phase I (20 Ss, 248 words) - deaf equal, but hearing better.

Phase II (50 Ss, 33 words) - commonality: Rochester more like hearing, Oral next, Combined least.

idiosyncrasy: Deaf equal.

superordinate: Rochester slightly more, Oral next, Combined least. (But superordinates a sign of immaturity)

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RECALL & RECOGNITION MEMORY STUDY

Recall - Oral and Rochester were quite similar to both hearing groups in short term recall for unconnected words that have been presented sequentially.

Recognition memory - no significant differences among the deaf and hearing groups on the total number of errors or on the types of errors.

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NOUN PAIRS STUDY

Intentional Recall - 5 groups equal on number correct and most scoring categories, except imported words - Rochester and Combined imported fewer words.

Rochester and Combined also had less commonality with college on incorrect responses (thus Oral and Hearing more alike on this part of the test).

Incidental Recall - Generally Hearing-Age best, then Oral and Combined, Rochester and Hearing-Achievement poorest. Hearing-Age recalled more verbs.

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SENTENCE MEMORY STUDY

Generally Hearing-Age better than all, other groups were equal. When syntax involved (sentences) Hearing-Age better than all, Oral more like Hearing-Age.

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WORD COMPREHENSION STUDY

Oral was more like both hearing groups than Rochester and Combined in knowledge of multi-meaning words and in control of association when meaning called for.

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CONTEXTUAL CUES STUDY

Deaf more correct on strong meanings than weak, hearing groups slightly more on weak meanings.

Oral and both hearing groups significantly more correct on all sentences than Rochester and Combined.

Oral also chose fewer associations, Combined next, Rochester poorest.

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SENTENCE CONSTRUCTION STUDY

Overlap	- Hearing-Age and Oral significantly less than Hearing-Achievement, Rochester and Combined.
Number of Words	- Hearing-Age most, Oral more than Hearing-Achievement, Rochester and Combined.
Sentence Complexity	- Oral generally better than Rochester and Combined, fewer stereotyped sentences than Rochester and Combined.
Clarity of Communication	- Hearing better but Oral slightly better, Rochester next, Combined last.
Passive	- Combined used slightly more passive sentences than Oral and Rochester.

SENTENCE CONSTRUCTION STUDY (cont.)

Grammatical Errors	- Overall both hearing groups much better, Oral much better than Rochester, and Rochester much better than Combined.
	Most errors minor categorial and morphological (more), moderate number strict subcategorial.

In an extensive research project of this kind which has continued over 5 years, the list of those people who were really helpful becomes too long for inclusion here. Therefore it is necessary, though regrettable, to thank them as a group rather than as individuals. We were given great cooperation and vital assistance in every school, where we tested, by the administrators, guidance counselors, school psychologists, teachers, staff and students. Since these people were already very busy with their own school responsibilities, we were particularly grateful for their willingness to help.

We are very grateful to every individual who worked with us and for us at the many schools for deaf students and for hearing students. The schools for the deaf include: The Clarke School, The American School, The New York School, The Lexington School, The Rochester School, The Austine School, The Beverly School, and The Rhode Island School for the Deaf. Our sincere gratitude also extends to all those in the public schools where we tested hearing students including: the grammar, junior and senior high schools in Northampton, Easthampton, Williamsburg and Hatfield, Massachusetts.

In addition we are grateful to those people on the Clarke School staff whose opinions and advice were invaluable in the preparation of instructions and test materials, and in the development of our research program: particularly Dr. George T. Pratt, Miss Marjorie E. Magner, David Manning, and Mr. and Mrs. Stanford C. Blish.

Our consultants, Dr. Herbert Rubenstein and Dr. Bernard Kaplan provided valuable criticism and suggestions, and the work of Mrs. Donna Robbins, Mrs. Anne Young and Miss Karen Bruscoe was extremely important in carrying out this research.

This research investigated different aspects of language development: association, memory, comprehension, and production. Subjects were 3 groups of deaf adolescents trained by 1) the pure Oral method, 2) the Combined oral-manual method, and 3) the Rochester fingerspelling method, plus one hearing group matched with the deaf in age, and another hearing group matched in comprehension of written language. One study found that the Rochester subjects gave more written primary word associations similar to the college norms than the Oral or Combined, but Rochester also used more superordinates, often an indication of less sophistication.

All groups were equal on a verbal recognition memory test, but the Combined deaf showed poorer recall on the same test. The Noun Pairs Memory test showed the 5 groups equal on the number correct and in most error categories, except both hearing groups and the Oral group imported more (incorrect) words from outside the test to complete the sentences, and their errors had more commonality with college subjects' free associations to the test sentences. The incidental recall results on this test showed the age-matched hearing group generally best, then Oral and Combined, with Rochester and the language-matched hearing group poorest. The Sentence Memory test involved sequentially presented words in sentences and strings. Here the older hearing group (age-matched) was best, with the other groups equal. However, on the parts involving syntax, though the older hearing group was best, the Oral group was more like them than the other 3 groups.

The Oral deaf were again more like both hearing groups in their comprehension of multi-meaning words and in their control over distracting associations when meaning was called for. The Oral deaf were also similar to the hearing in their ability to select meaning and in choosing fewer associations when the multi-meaning words were presented in sentences.

In writing sentences, the age-matched hearing group was best in the various measures of sentence structure, and the Oral group was usually better than Rochester and Combined. But both hearing groups were greatly superior to the deaf, making for fewer grammatical errors, with the Oral fewer than Rochester and Combined, and Rochester fewer than the Combined deaf group. In most instances the language development might be improved with more instruction in sequential memory, incidental learning, grammatical inflections, determiner use, and the interpreting and writing of longer, more complicated sentences.

LANGUAGE DEVELOPMENT IN DEAF AND HEARING ADOLESCENTS

INTRODUCTION

This research investigated several important aspects of language development including word association, meaning, syntax, verbal memory, language comprehension and language production. The studies compared 3 groups of deaf adolescents trained by 1) the pure Oral method, 2) the Combined oral-manual method, and 3) the Rochester fingerspelling method, plus one hearing group matched with the deaf in age, and another hearing group matched with the deaf in written language comprehension. A detailed description of the various subject groups and the other criteria for subjects will be found in the section on subjects which follows this introductory section (page 4).

The studies discussed in this final report are listed below with a brief descriptive statement about each one. All the tests used written language since it provided a more accurate means of analyzing the language development of the deaf.

ASSOCIATION PROCESSES.

Word Association (see pages 6-14) was investigated because of its importance in verbal organization and verbal thinking, and because of the effects of associative intrusion in verbal activities.

The Word Association Test contained 248 well known multi-meaning words; subjects were asked to write the first word they thought of after reading each word on the list. In addition to the evaluations of the results of the test itself, words and responses from this test were used to provide popular word associations for subsequent tests.

VERBAL MEMORY.

We were interested in the roles of meaning and syntax, and of associative intrusion in recognition memory for words and in recall of words, word strings, and sentences. Various interrelated kinds of memory play important roles in language acquisition: recognition, recall, sequential memory, intentional recall, and incidental recall. All tests investigated short term memory.

Recall and Recognition Memory Test (see pages 15-17). This test had 2 phases. One phase tested recognition memory, which is usually less difficult than recall, and the effects of associative intrusion on it. The other phase tested short term recall for individual words and the relation of associative intrusions.

Stimulus words were presented one at a time and the subjects were instructed to remember as many words as possible. First, in the recall phase, subjects were asked to write as many of the words as they could remember, in any order. Then, in the recognition phase, they were to circle the words they had seen before on an answer sheet

where those words were presented with highly related associations and control words.

Noun Pairs Test (see pages 18-23). This test investigated intentional and incidental recall. Intentional recall is purposeful—consciously wanting to remember; it is especially common in the classroom situation. Incidental learning is the unintentional, indirect learning that takes place in many life situations. We were also interested in the use of meaning and syntax as aids in intentional and incidental recall.

Unrelated noun pairs were presented in sentences; subjects were told to try to remember the 2 nouns ("the words in BIG letters"). Intentional recall was tested by asking them to write the second noun of each pair, and incidental recall when they were asked to write the whole sentences.

Sentence Memory Test (see pages 24-28). This test included both word strings and sentences presented sequentially, one word at a time. Subjects wrote as much as they could remember of each word string or sentence immediately after it had been shown. This test was designed to provide information about sequential processing, and about the effect of meaning and syntax as an aid to recall.

COMPREHENSION

Comprehension of language not only involves awareness of meaning of the words used but also knowledge about the syntactical relationships of those words. The effect of associations on comprehension was also evaluated.

Word Comprehension Test (see pages 29-33). This test had 3 parts, all of which presented multi-meaning words separately, with little or no syntax or context. One part tested knowledge of the strong (common) and weak (less well known) meanings: subjects were to choose the meaning of multi-meaning words which were presented with control alternatives. Another part asked them to choose the meaning (weak or strong) of multi-meaning words when they were presented with a control word and a popular association.

Contextual Cues Test (see pages 34-38). This test evaluated the ability to use context to determine the appropriate meaning of multi-meaning words, and the influence of associations on this process. It involved the comprehension of the meaning and syntax of words and sentences. Subjects were asked to choose the meaning of the underlined word in a sentence from answer choices including 1) the strong or weak meaning, 2) a popular association, 3) a control word.

LANGUAGE PRODUCTION

Language production is more advanced than the other aspects of language tested. It requires a thorough grasp and control of meaning and syntax.

Sentence Construction Test (see pages 39-47). This study assessed written language production in terms of clarity of communication, sentence length and structure, overlapping vocabulary, function and content words, and kinds of grammatical errors (grouped according to the principles of generative grammar). Subjects were asked to write a good sentence using a given word (a noun); some of the nouns were related and some unrelated.

GENERAL CRITERIA FOR THE SELECTION OF SUBJECTS FOR ALL STUDIES

All of the studies described in this report used the same criteria for selecting and matching subjects and subject groups. Only the size of the groups varied in some of the studies.

A detailed description of the subjects is provided below in order to avoid repetition of this information at the beginning of every study. The description of subjects given with each of the individual studies will only indicate the numb r of subjects in each group.

In every study 5 subject groups participated: Oral, Rochester, Combined, Hearing-Age, and Hearing-Achievement. All subjects were in the normal range of intelligence and had no physical or emotional handicap other than deafness in the deaf groups. All groups were half male, half female.

The level of written language comprehension was the average of the word and paragraph meaning scores on standard achievement tests; IQs were obtained from the performance scale from standard intelligence tests. School test scores for IQ and achievement were used unless the tests did not seem comparable, in which case we administered Wechsler and Stanford Achievement Tests. Socio-economic background was based on the numerical ratings of the Hollingshead Two Factor Index of Social Position (1967).

In order to ensure objectivity in our scoring and related data evaluation, we coded all subjects and groups to conceal their identity and educational background, etc.

DEAF SUBJECTS

There were 3 deaf subject groups, based on the language training method used in their schools.

> Oral - deaf subjects trained by the pure Oral method (speech and lipreading).
>
> Combined - deaf subjects trained by the combined oral-manual method (speech, lipreading, signing and fingerspelling).
>
> Rochester - deaf subjects trained by the Rochester finger-spelling method (speech, lipreading and fingerspelling).

All deaf subjects were deaf before the age of 3, did not have deaf parents, and had a hearing loss greater than 75 decibels in the better ear (pure tone average at 500, 1000, and 2000 cycles per second).

Oral subjects in these studies were drawn from the Clarke School for the Deaf, Northampton, Massachusetts, and from the Lexington School for the Deaf, New York, New York. Combined subjects were from the

American School for the Deaf, Hartford, Connecticut and the New York School for the Deaf, White Plains, New York, and the Austine School for the Deaf, Brattleboro, Vermont. Rochester subjects all came from the Rochester School for the Deaf, Rochester, New York, since there were no other schools typical of this method within a feasible distance. The Beverly School for the Deaf, Beverly, Massachusetts and the Rhode Island School for the Deaf also participated in some of the earlier, preparatory testing.

HEARING SUBJECTS

There were 2 hearing control groups:

Hearing-Age - matched with the deaf on age, sex, IQ, and socio-economic background.

Hearing-Achievement - matched with the deaf on written language comprehension, sex, IQ, and socio-economic background.

It should be noted that the subjects in the Hearing-Age group were the same age as the deaf, but 2-3 years older than the Hearing-Achievement group. The deaf likewise were the same age as the Hearing-Age subjects but 2-3 years older than the Hearing-Achievement group. This is because the deaf are usually 2-3 years behind their hearing contemporaries in written language comprehension. For this reason it would not have been adequate to use only one hearing group matched in age (which would have been more advanced in written language comprehension than the deaf) or only a hearing group matched in written language comprehension (which would have been 2-3 years younger than the deaf chronologically, and in terms of general experience and development).

The use of a younger and an older hearing group also provided information about language development in the hearing, indicating whether differences in deaf performance were proceeding along normal developmental lines, or a lasting consequence of their sensory handicap. In addition, use of the 2 hearing groups often indicated whether performance on a given task was more related to language development (when deaf and hearing-achievement groups were similar), or to general development and experience (when deaf and hearing-age groups were similar).

Hearing subjects were from 9 to 18 years of age and were from the public schools in Northampton, Easthampton, Williamsburg, and Hatfield, Massachusetts.

WORD ASSOCIATIONS IN DEAF AND HEARING ADOLESCENTS
(Word Association Study)

The deaf population can be useful in determining how much normal language development, in the form of word associations, is dependent on the auditory channel, since the deaf learn verbal language without the usual auditory stimulation and feedback. However, some of the studies of word association in the deaf have had differing results. For example, studies by Schein (1961) and Koplin, Odom, Blanton, and Nunnally (1967) have indicated that the deaf subjects had reduced commonality in their responses and fewer opposite responses, than comparable hearing subjects. The Schein study also showed more superordinate responses in the deaf subjects; however Koplin et al found no significant differences in superordinates, although there was a consistent trend. In a more recent study by Restaino (1965), where hearing and deaf adolescent groups were equated by age, the hearing group was not significantly different from the deaf groups either in commonality of responses or in superordinate responses. The hearing group was significantly lower in opposite responses than one deaf group, but similar to another deaf group. Such differences in word association results indicate that further study is necessary to obtain more conclusive evidence about word associations in deaf and hearing adolescents.

Restaino was also concerned because one deaf group showed more commonality and same-form-class responses than the other, despite their similar oral methods of instruction. She concluded that the variable of specific school environment must be given more attention; for example, there may be differing modes of instruction within the oral method used in each school. Consequently, a more valid sample would be obtained if more than one school were included in comparisons about the efficacy of differing instructional methods. Two schools using the oral method and two schools using the combined oral-manual method were included in our studies. But, unfortunately, we could not include more than one school typical of the Rochester method of instruction, which uses fingerspelling and oral methods together; we recognize this limitation of our sample.

Generally, we hope that a study of 3 different deaf subject groups may indicate what differences in word association measures may, in part, be ascribed to the various methods of instruction in the schools for the deaf. Such information may help to evaluate how well the teaching techniques are achieving their purposes, and whether new techniques are called for.

Two hearing control groups will be used, one group matched with the deaf group on age and IQ, and the other matched on written language achievement and IQ. If the deaf groups are significantly different in performance from the age matched hearing group (older) but not from the language matched group (younger), they can be described as delayed but nevertheless proceeding along normal developmental lines. But, if the deaf groups are significantly different from both hearing groups, it may indicate that qualitative effects are associated with the sensory handicap.

Furthermore, these 2 hearing groups of different ages can help us evaluate how age influences changes in word association responses. Such measures as commonality and contrast responses apparently increase with age, whereas superordinate responses decrease after reaching a high point at about the twelfth year. We expect to learn whether these differences are also evident in our results.

METHOD

Test Materials. The Word Association Test consisted of 248 stimulus words, each of which was a multi-meaning word with two well known meanings (Table 1). Most were frequently used words as established by Thorndike-Lorge (1944), (between 50 and 100 occurrences per million words). The language of the instructions was evaluated by 2 experienced teachers of the deaf as known by deaf students comparable to those tested in this study. The test was divided into 2 halves. When the subjects finished the first half, they were given the second. Test protocols were scanned during the session and subjects were asked about any unclear responses.

Procedure. Six to ten subjects were usually tested in a group. After determining that the instructions were well understood, the subjects were asked to write down the first word that came to mind, to guess, and to work quickly. There was no time limit.

Scoring. We used 2 modes of analyzing the word association responses of our subjects. In the first mode, Phase I, we tabulated the responses, to 248 target words, of 20 subjects from each group of 50, whose protocols contained 10 or fewer unscorable responses. In this phase of the study, we focussed on the variables of commonality and idiosyncrasy. Norms were based on the responses of an additional group of 250 college students.

The second mode of analysis, Phase II, included all 50 subjects within each subject group; no subjects were eliminated. However, only those target words eliciting responses from at least 48 of the 50 subjects were selected. A final total of 33 words was chosen; the reasons for those choices are described under the section on Phase II.

Phase I. Twenty Subjects, 248 Target Words.

Subjects. Responses were obtained from the 50 subjects in each of the previously described Oral, Combined, Rochester, Hearing-Achievement and Hearing-Age groups (see page 4 and Table 2 for details). Since the protocols of many subjects contained a high proportion of unscorable responses, 20 subjects in each group were selected who had 10 or fewer unscorable responses. When there was a choice among protocols, the selection was made at random. Table 3 shows the means and SDs for the number of unscorable responses for all groups of 20 subjects.

Scoring. In tabulating responses, obvious misspellings were corrected and included with the proper spelling. Singular and

plural forms of the same noun were combined. Different tenses of the same verb and different forms of the same word were tabulated together as in go(ing), carry(carries), and fast(er). Frequency in the college norms was the basis for the commonality scoring of the responses given by the deaf and hearing control groups. Each response of the subjects in each group was assigned a commonality score which represented how frequently this response was given as an association by the college students to that particular stimulus word. Thus, if a subject in a deaf group or hearing control group gave "play" as the response to the target word ACT, this response was scored as 11.7, which was the frequency with which the college students responded with the word "play" to the target word ACT.

This scoring method not only notes the existence of the association response in the college norms, but also takes into account the relative popularity of the response. In this way we could ascertain how similar the word association responses of each subject group were to those of the verbally sophisticated group, both in kind and in frequency.

An idiosyncrasy score was given for the number of association responses in each subject group that did not appear in the college norms.

The stimulus words were also classified according to the frequency of their use in language according to Thorndike-Lorge (1944); there were 141 AA words, 58 A words, and 49 O words (other lower frequency stimulus words). A commonality and an idiosyncrasy score was obtained for each level of language frequency, the AA, A, or O (other) level. Thus, in addition to the general commonality (C) and idiosyncrasy (I) scores, subjects received a commonality and an idiosyncrasy score for each of these 3 frequency levels: CAA, CA, CO and IAA, IA, IO scores.

RESULTS. Phase I

Commonality. To test for this variable, a one between- and one within analysis of variance was carried out with 5 subject groups and 3 levels of word frequency (see Table 4). The main effect for groups was significant at the .001 level. A Duncan Range test showed no significant differences in commonality between the deaf groups (Table 4). The Hearing-Achievement group, showed significantly more commonality than the Combined deaf group ($p < .01$), and the Hearing-Age group showed significantly more commonality than all other groups.

The main effect for word frequency was significant at the .001 level. It is obvious from the means for AA words (24.32), for A words (24.81) and for Other words (28.42), shown on Table 5, that the significant finding refers to the difference between the 2 highest frequency words and the lowest frequency words. The lowest frequency words result in greater commonality than words in the 2 higher frequency levels.

The interaction Groups x Word Frequency was significant at the .001 level. When we inspect both Table 5 and the Figure 1, we find that the

significant interaction is largely the contribution of the 2 hearing groups. Although the deaf groups were quite similar in their respective scores on the 3 different frequency types of words, the 2 hearing groups, particularly the Hearing-Age group, showed substantial differences in their commonality responses to these word groups, offering more common responses to those words with the lowest frequency.

Idiosyncrasy. For this dependent variable, a one between- and a one within- subjects analysis of variance was performed for the 5 subject groups and for the 3 levels of word frequency (Table 6). This variable is the complement of the commonality variable, but may yield additional information about the tendency of deaf subjects to respond with word associations that typically do not appear in the association responses of our normative group for that particular word.

The results of the analysis of variance showed that there was a significant difference between Groups (Table 6). A Duncan Range test indicated that there were no differences between the deaf groups in the number of idiosyncratic responses (Table 6). Again, the Hearing-Achievement group tended to be more like our normative college group on this variable than the 3 deaf groups, offering significantly fewer idiosyncratic associations. The Hearing-Age subjects showed significantly fewer idiosyncratic responses than any of the deaf groups or the Hearing-Achievement group.

There was a significant difference among the 3 levels of word frequency, an F value of 105.0 being obtained with 2 and 190 degrees of freedom. The means for the AA words, for the A words, and for the O words were 6.15, 6.60, and 8.59 respectively. It appears that the association responses to the lowest frequency words contained more idiosyncratic responses than the responses to the more frequently used words.

In the Groups x Word Frequency interaction, which was significant at the .001 level, the significance was a consequence of a rise in the number of idiosyncratic responses given by the deaf groups to the lowest (O) frequency words. The number of idiosyncratic associations of the deaf groups increased with the decrease in word usage frequency (Table 7 and Figure 2). However, the number of idiosyncratic associations given by the hearing groups was similar for relatively high or low frequency words.

DISCUSSION. Phase I

Commonality. The finding that both hearing control groups showed more commonality than the deaf groups in their association responses to the target words was expected and tended to support the hypothesis. Deese (1968, p. 99) suggests "...the fundamental problem in the study of associations does not consist of individual contiguities but of patterns of organization and structures which can generate those arrangements." He goes on to state that the interrelations between 2 items and their other related verbal elements would suggest a structure. Further, he implies that the retrieval in memory leading

to a particular association response may stem from the intersection of some set of distinctive features. The theoretical suggestions advanced by Flavell and Draguns (1957) may offer some further understanding about the underlying processes in word association. They speculate that there is a diffuse, general framework of thoughts which may have as components, (or features in Deese's sense) such aspects as images related to the stimulus word, vague words having superficial and external similarity to the stimulus word, reactions to the word based on its membership in a familiar phrase, and reconstructions based on common personal predicates, and on denotative and connotative meanings. Following this preparatory phase, which is analogous to the first stage of Neisser's 2 stage account of memory and thinking (1967), there is a differentiation of these presentations (or reconstructions, to use Neisser's description), so that one reconstruction becomes more reality oriented and is the logical response. Flavell and Draguns do not specify the process by which a particular reconstruction comes to the fore as the association response. However, Neisser describes an early stage of reconstructions based on information in memory from which the later stage of thought (an executive process) selects some reconstruction which is elaborated further.

On the basis of these speculative statements, we may try to ascertain whether the deaf subjects, who show less commonality than the 2 hearing groups, fall down in the primary process stage or in the secondary process stage, or both. Except possibly for imagery reconstructions, deaf subjects have in their long term memory fewer traces of previous constructions similar to the college group, than the 2 hearing control groups. Consequently, the deaf subjects are handicapped by (a) the lack of sufficiently similar reconstructions occurring in the primary process stage which can be elaborated by the executive secondary process into a popular association response, or by (b) insufficient vocabulary knowledge for the executive secondary process to transform their primary process stage imagery into popular verbal associations, or both.

Consequently, the deaf subjects produce significantly fewer commonality responses than the 2 hearing groups, although not differing among themselves. This suggests that the deaf, when compared to the hearing, are deficient in the traces of previous constructions of words and connected language materials which are available for elaboration into popular word association responses, even if there is equal richness of imagery.

Similar reasoning can be used to account for the significantly greater number of idiosyncratic responses in the deaf groups when compared to the 2 hearing groups, although again the deaf groups did not differ among themselves. These results--and many other studies show similar findings--indicate that not only do deaf subjects have fewer traces of word information stored in their memory that do not lead to similar popular responses to the hearing; but they may transform images similar to those of the hearing into word association responses which are not found in the normative hearing sample. Possibly the image and its elaborated verbal response are not related as

adequately as in the hearing control groups (Kates et al, 1962). The elaboration process suffers because of this dissociation.

The finding that low frequency words showed significantly more commonality than high frequency words was unexpected. This result was a main effect in the statistical operations involving all groups. However, the Groups x Word Frequency interaction revealed that only the hearing control groups showed more commonality in responding to the low frequency words, whereas the deaf groups showed little difference in their commonality of responses. The previously discussed theoretical formulations could account for this finding. Because the hearing subjects have more heterogeneous traces available with more frequent words for reconstructive purposes (in the primary process stage), they tend to respond to them with a greater variety of associations. When the less frequent words are the stimuli, the reconstructions are more limited and the executive secondary process probably elaborates the response associations from a smaller number of possibilities, leading to more commonality of response.

The hypothesis dealing with greater idiosyncrasy for low frequency words was supported but again, this main effect must be considered with the Groups x Word Frequency interaction. The interaction shows that the hearing groups offered about the same number of idiosyncratic responses to the stimulus words, whether high or low frequency, but the deaf gave more idiosyncratic responses to the low frequency words.

Phase II. Fifty Subjects, 33 Target Words.

Subjects. The 5 groups of 50 subjects included the Oral, Combined and Rochester deaf and the Hearing-Achievement and Hearing-Age groups (Table 8).

Materials and Procedure. Thirty-three target words were selected from our Word Association tabulations for 250 deaf and hearing subjects. Over 100 words were first selected to which 46-50 subjects in each group had responded, with no more than 25 single responses in any group. Non-word or nonsense word responses such as -ose for the target word rose were counted as blanks and led to the exclusion of the target word if there were more than 4 blank responses. Target words were then chosen from the list which would be likely to elicit one or more of the following responses:

subordinate response: The name of a particular member of a category included by the target word (target word: plant, response: rose).

superordinate response: The name of a class or category to which the target word belongs (target word: rose, response: plant).

whole response: The entire and complete entity, or unit, of which the target word is an element or segment (target word: leaf, response: plant).

part response: An element or segment of the target word (target word: plant, response: leaf).

contrast response: Something which is opposite or the other extreme of the target word (target word: dark, response: light).

The final list of 33 target words was compiled by 3 independent judges. It consisted of 29 words which, it was believed, would elicit 5 subordinate, 12 superordinate, 7 whole, 7 part, and 7 contrast responses. Four words were included which were not likely to produce any of the above response types, but had been responded to by each of the 50 subjects in the 5 groups. Table 9 presents the 33 words and their scoring categories; note that 9 words have 2 scorable categories.

Scoring. The subjects were given numbers so that their names and their schools were not known to the scorers. The responses to the 33 target words on each subject's test were scored first for commonality - really popularity - in the college norms (based on 250 subjects). The response of each subject in our deaf and hearing groups was given as its score, the number of college students who also gave that response to the target word. If no college student gave that response, it was counted as an idiosyncratic response; a separate tally of idiosyncratic responses was kept for each subject (blanks were not included). The mean commonality (popularity) and the idiosyncrasy scores were obtained for each subject. If the response fitted one of the scoring categories--subordinate, superordinate, whole, part, contrast, it was tabulated under that heading.

RESULTS. Phase II

Commonality (Table 10). The analysis of variance procedure for this dependent variable indicates a significant finding at better than the .01 level. Duncan Range tests indicate that the Combined deaf had significantly less in commonality when compared with the Rochester deaf, although not significantly different than the Oral deaf (Table 10). An alternative description of the results is that the Rochester deaf subjects were not significantly different from the 2 hearing control groups, though the Combined deaf had significantly less commonality than the Hearing-Age but not the Hearing-Achievement group. The Hearing-Age group had significantly more commonality than the Combined, Oral, and Hearing-Achievement groups, but not the Rochester deaf.

Idiosyncrasy (Table 11). The analysis of variance results for idiosyncrasy show that there was a significant difference among the 5 groups. Further analysis, making use of the Duncan Range procedure demonstrates that the Hearing-Age group gave significantly fewer idiosyncratic responses than any of the other 4 groups. In addition, the Combined deaf gave significantly more idiosyncratic responses than the Hearing-Achievement group. There were no significant differences among the 3 deaf groups on the idiosyncrasy variable.

Superordinate Responses (Table 12). The analysis of variance was significant for this dependent variable which consisted of 12 target words that could elicit a superordinate response. Further evaluation on Duncan Range tests showed that both the Hearing-Age and Hearing-Achievement groups gave significantly fewer superordinate responses than all 3 deaf groups. On this measure, the Rochester group showed significantly more superordinate responses than the Combined deaf group.

Subordinate Responses (Table 13). The analysis of variance procedure showed that there was a significant difference among the groups on this variable, consisting of 5 possible responses. Further analyses (Duncan Range test) showed that the Hearing-Age group gave significantly more subordinate responses than the Oral, the Combined and the Hearing-Achievement groups, although the Hearing-Age group was not significantly different from the Rochester deaf group. The Rochester deaf gave more subordinate responses than the Hearing-Achievement group. There were no significant differences among the 3 deaf groups on this variable.

Whole Responses and Part Responses. Calculations on these are not reported because there is little or no rationale for predicting the behavior of the different groups.

Contrast Responses (Table 14). The analysis of variance result was significant, indicating that the 5 groups were different in the number of contrast responses. The Duncan Range results indicated that the Hearing-Age group responded with significantly more contrast responses than the Oral, Combined and Hearing-Achievement groups. The Rochester group gave significantly more contrast responses than the Combined deaf group.

DISCUSSION. Phase II

In Phase I, 20 subjects with relatively complete protocols on all 248 stimulus words were used from each group of 50. It is quite possible that, because of this selection device, we may have chosen the best subjects in each group, particularly in the deaf groups. Consequently, it was thought advisable in Phase II, to include all 50 subjects in each group by selecting stimulus words to which virtually all subjects had responded. The differing results on the 2 dependent variables common to both phases are of interest, and other dependent variables provide further information about the word association behavior of both deaf and hearing adolescents.

Commonality. The findings on this variable were different from those of Phase I, probably a consequence of fewer stimulus words, and partially because all the subjects in each group were included. The Hearing-Age group was significantly higher than the other groups except for the Rochester group. The Rochester group was the only deaf group that was not significantly different from the 2 hearing control groups, even though the Rochester group and the other 2 deaf groups were not significantly different from each other on this variable.

The fact that the Rochester deaf group was not significantly different from the 2 hearing groups on the commonality measure suggests that this group has word association thought processes, both primary and secondary, that are more like the hearing subjects than the other 2 deaf groups. The Combined deaf group would appear to be least like the 2 hearing control groups in their word association processes. The Oral deaf group was between the Rochester and the Combined deaf groups, since this group was like the younger hearing group (Hearing-Achievement) and unlike the older hearing group (Hearing-Age).

Idiosyncrasy. The results on this dependent variable showed that the Hearing-Age group, as anticipated, responded with fewer idiosyncratic responses than the other 4 groups. And while there were no significant differences among the deaf groups, the Combined deaf subjects were the only deaf group that gave a significantly larger number of idiosyncratic responses than both hearing groups. Again, on this variable, the Combined deaf appeared to be least like the hearing groups.

Superordinate Responses. The 2 hearing control groups responded with significantly fewer superordinates than the deaf groups. Previous research indicates that fewer superordinate responses is a measure of increasing verbal maturity after the sixth grade or the 12th year (Palermo, 1963). In this study, the Rochester group had significantly more superordinate responses than the Combined deaf group; apparently, on this measure there is some evidence that the Rochester group is less verbally mature. This may possibly be due to emphasis on superordinates, or words covering certain categories, in the Rochester method of instruction.

Subordinate Responses. As anticipated, the Hearing-Age group gave more subordinate responses than the other 4 groups. However the Rochester group was not significantly different from the Hearing-Age group and gave significantly more subordinate responses than the Hearing-Achievement group, though the deaf groups were not significantly different from each other. Again, this result distinguishes the Rochester group from the other deaf groups; in this case, it points to a more mature verbal development.

Contrast Responses. It has been found that subjects with more verbal maturity give more contrast responses (Koplin et al, 1967). Our results supported this hypothesis since the Hearing-Age group had significantly more contrast responses than the Oral, Combined, and the Hearing-Achievement groups. The Rochester deaf group was not significantly different from the Hearing-Age group or from the Hearing-Achievement groups, but was superior to the Combined deaf group. These findings again seem to suggest that the word association responses in the repertoire of the Rochester deaf subjects are more mature than those of the other deaf groups.

SHORT TERM RECALL AND RECOGNITION MEMORY OF UNCONNECTED WORDS
(Recall and Recognition Memory Study)

In an important publication, Withrow (1968) suggests that the memory of deaf children may be adversely affected by their reliance on vision in developing a language system. He found that children with normal hearing were superior to deaf children in the recall of visual stimuli presented sequentially in time, which supported an earlier finding by Blair (1957). Withrow attributes this result to the greater experience of hearing children in coding and processing sequential stimuli in spoken language. Since Withrow made use of silhouettes and geometric forms, which the hearing group may have been better able to code verbally, it seemed worthwhile to study immediate memory for sequential stimuli using verbal language.

The major purposes of this study were to determine 1) the ability of the 3 deaf groups to recall unconnected words immediately after a sequential presentation and 2) their ability to recognize these words immediately after the recall task in a multiple choice format with associatively related words. We also wanted to compare these deaf groups with the 2 matched hearing groups on these recall and recognition tasks.

METHOD

Subjects. There were 29 subjects in the Oral, Rochester, and Combined deaf groups and in each of the 2 hearing groups. All details about these subjects are given in the separate section on subjects (page 4) and in Table 15.

Materials. The stimulus materials consisted of a list of 28 words; 14 words and their associations were taken from the word association norms for 248 multi-meaning words previously obtained from deaf and hearing children and adolescents as part of this project (Kates norms, Table 16). The other 14 words were taken from the 5th grade norms (N = 280) published by Entwisle (1966), (see Table 17). The Entwisle norms were also used because only 14 of the 248 Kates stimuli survived the stringent criteria for inclusion in the experiment. Each of the 14 Kates words had the same primary (most frequent) and secondary association responses across all 5 subject groups, who were comparable to the subject groups in this phase (see Table 18). Other criteria included minimal visual similarity between the target words and their associations, and between the target words. Finally, the associative overlap among the associations in the response hierarchies of the target words was reduced to a minimum.

The control words were chosen from the Thorndike-Lorge (1944) word book and a children's dictionary for the middle elementary grades (Courtis & Watters, 1951). They were all well known words (Thorndike-Lorge A or AA), and were not an association to any of the target words on the entire list. To prevent the obvious conclusion that each line contained 3 related words and an odd one, control words were selected so that they were not conspicuously different

in form or content from the critical words in a set (see Table 19).

For both memory tasks, which required just one presentation of the target words, a random order of the 28 target words was used. In the recognition task, another random order of the 28 target words was used on the answer sheets, with each target word embedded in a line of 4 alternative choices. Each line contained the target word, the primary association, the secondary association, and the control word; and within each set of 4 choices on a line, an ordering was used which insured that each type of word occurred an equal number of times in each left to right position. Words appeared in lower case letters.

Procedure. Target words were presented sequentially on a screen by a 16 mm film projector. The film automatically provided an exposure time of 0.6 seconds per word. Each word was instantaneously replaced by the following word, so that there was no interstimulus interval.

The subjects first received an instruction sheet telling them they would see many words on the screen and that they should try to remember them. Three example words were then flashed on the screen, and subjects practiced the multiple choice recognition procedure. To clarify the instructions, the proper word in the first example was already circled. Subjects completed the remaining examples by themselves.

These instruction sheets were then checked and collected, and the answer booklets were handed out face down. Subjects were asked not to turn the booklets over until told to do so. The entire list of target words was then projected on the screen one at a time. This presentation was followed by a 3 minute recall period. In this period, subjects were asked to write all the words they could remember on a blank sheet. After these papers were collected, subjects began work on the recognition answer sheets. Subjects were instructed to circle one word in each line that they thought they had seen on the screen. They were told to do every line, and to guess if they did not know. Booklets were checked for omissions and double answers as they were collected.

RESULTS

For the recall task, analysis of variance results indicated that there was a significant difference between the subject groups in the number of target words correctly recalled. Further analysis of this group effect showed that the Hearing-Age group was significantly superior to the Combined deaf group on the number of target words correctly recalled (see Table 20). The other 2 deaf groups, the Hearing-Achievement, and the Hearing-Age groups were not significantly different in number of target words correctly recalled.

In the recognition task, the first result indicated that there was no significant difference in the number of recognition errors made by the 5 groups (Table 21). The second result concerned the interaction, Groups x Error type, and again, no significant interaction was evident. This finding indicates that the pattern of

errors (whether the primary association, or the secondary association, or the control alternative was incorrectly chosen instead of the target word) was quite similar from group to group (Table 22).

IMPLICATIONS

What does stand out in the recall results is that the Oral and Rochester deaf groups were quite similar to the hearing groups in short term recall for unconnected words that have been presented sequentially. Several previous studies have consistently shown the inferiority of deaf subjects to hearing subjects in the recall of sequentially presented material, particularly verbal materials or materials that can be coded in verbal terms. The crucial differences between our study and the other studies showing the inferiority of the deaf, may have been the stimulus materials and the elimination of an interstimulus interval. Possibly, Withrow's sequentially presented stimulus materials, though not verbal, permitted verbal coding, which may have contributed to the superior performance of the hearing subjects compared to the deaf. Simultaneously presented materials do not offer the same opportunity in time for verbal coding as do the sequentially presented materials. Consequently, the superiority in verbal coding of the hearing over the deaf subjects shown in sequential presentation, was partially reduced with simultaneous presentation in the Withrow study. Tentatively, it may be inferred that an interstimulus interval permits rehearsal of the previously coded materials. This rehearsal time may allow the hearing subjects, with their greater sophistication in verbal coding, to organize or assimilate the coded materials in a manner that leads to better recall. Since our procedure did not permit such rehearsal period for assimilating the coded stimuli, this advantage of the hearing subjects over most of the deaf subjects was eliminated. Their recall behavior, then, showed no significant differences. Further evidence is essential to corroborate this inference.

The recognition procedure showed no differences among the deaf and hearing groups on the total number of recognition errors and on the types of recognition errors. A possible inference is that, in short term recognition memory, the influence of associatively related words is not a significant factor. Another possible inference is that the short term recognition memory of deaf subjects operates as well as that of hearing subjects regardless of verbal language sophistication or of associatively related materials that may impair recognition. On the other hand, in storing verbal materials over much longer time intervals, there may be some significant difference between deaf and hearing subjects. These speculations are advanced cautiously because they require further experimentation for corroboration.

MEMORY FOR NOUN PAIRS IN DEAF AND HEARING ADOLESCENTS
(Noun Pairs Study)

The purpose of this study was to investigate the short term recall of unrelated nouns in pairs, presented in a sentence context. It was anticipated that the meaningful content of the sentence context would aid in the recall of the missing nouns, especially for subjects with better language development. We also wanted to determine whether our 5 groups differed in their capacity to learn noun pairs presented in a sentence context (Rowher, 1967).

Since there was only one Study Trial in which to learn the 14 noun pairs, many errors were expected in the subsequent Test Trial. We anticipated that the analysis of these errors would provide information about the internal strategy employed by subjects to store and retrieve briefly exposed verbal materials. Conrad (1970), in a study of the recall of consonants, found this procedure of error analysis useful for inferring how subjects code stimulus materials for later retrieval.

We also planned to compare the 5 groups on their ability to learn sentence materials they were not expressly instructed to remember, to determine whether differences in incidental recall could be found among the groups. Incidental recall probably represents a major means by which we acquire knowledge useful for dealing with the world, ourselves, others and objects.

It was hypothesized that the Hearing-Age group would be significantly superior in their recall of the missing nouns to the other 4 groups, who would not be significantly different among themselves. We assumed that the greater language sophistication of the Hearing-Age group would permit them to reconstruct the meaningful content of the sentences more accurately and hence enable them to recall the missing word. When incidental recall was evaluated, we believed that both the Hearing-Age and Hearing-Achievement groups would be significantly superior to the deaf groups. Given their greater experience with verbal language materials, probably leading to sharper attention to incidental verbal stimuli of a task, both hearing groups would be more likely to recall the verbal materials of sentence stimuli even when not expressly asked to do so.

METHOD

Subjects. There were 30 subjects in each of the 5 groups consisting of the Oral deaf, the Combined deaf, the Rochester deaf, the Hearing-Achievement and the Hearing-Age (see page 4 for a complete description of subject groups). Table 23 gives the mean age, IQ, written achievement level, and socio-economic status of the 5 groups.

Test Materials (see Table 24). The test was presented on film. It consisted of 14 sentences, each containing 2 unrelated, well known nouns (50 to 100 occurrences per million words according to Thorndike & Lorge). All the sentences were constructed in the

following pattern: The adjective noun (subject) transitive verb the noun (direct object). A typical sentence was: The old KING bought the BOAT. Sentences were constructed so that the other words would not provide clues to the second noun, which had to be recalled later in the test.

In the Study Trial complete sentences were presented, containing both nouns of each pair. The Test Trial showed the same 14 sentences, in a different random order, but with a blank instead of the second noun. For example: The old KING bought the _____. An answer sheet with 14 numbered blanks was provided.

Three experienced teachers of the deaf indicated that all words and sentences in the instructions and in the test would be easily understood by deaf students 10 years of age and older, trained by any of the major methods.

Procedure. This test was given to groups of 16 to 32 subjects at a time. They were instructed to read the sentences on the screen and to remember the words in BIG LETTERS (for example, The old KING bought the BOAT). They were told they would see the sentences again but with a blank, and that they were to write the missing word (The old KING bought the _____). All the instructions were in writing and the examiner went over them with the subjects. Then 3 illustrative sentences were presented as examples, following the procedures to be used in both the Study and Test trials. These examples were checked to be sure the subjects knew what to do.

First, the Study Trial was presented, in which all 14 sentences were shown, one at a time, for 5 seconds each. The Test Trial followed it after a 10 second interval. Each of the sentences with the missing noun was shown (in a different random order) for 5 seconds and immediately followed by a 15 second period during which the subjects were to write the missing noun on their answer sheets. All timing was controlled by the film.

Immediately after writing the last answer in the Test Trial, the completed answer sheets were collected and the instructions for the incidental memory part of the test were shown on the screen. A new answer sheet was given out which had 14 numbered lines, each consisting of: The _____ _____ _____ the _____.

The subjects were asked to write as many of the sentences they had seen on the screen as they could remember. They were told to guess if they did not know. There was no time limit.

In order to learn whether the incorrect answers given in the recall of the missing nouns were popular associations to each of the 14 sentences, another phase of this study was carried out with 100 students from the University of Massachusetts. These college students were requested to complete each of the 14 sentences with the very first word that came to mind; in each sentence the missing word was the second noun of the pair. Their responses to each

incomplete sentence were tabulated on the basis of frequency. Consequently, when a subject from one of our 5 groups recalled an incorrect noun, it was also scored according to its frequency in the responses of the college students.

Scoring and Dependent Variables.

Recall Phase. The principal dependent variable was the number of missing nouns that were correctly recalled. In addition, types of errors were analyzed to determine whether they were one of the other 13 missing nouns; one of the first nouns of any pair; a word from anywhere on the test; or a word imported from outside the test; and how frequently it was given as the association to the incomplete sentence by a sample of college students.

Incidental Recall Phase. Here the number of first nouns, the number of second nouns, and their sum were analyzed to determine if there were any differences among the groups. The same statistical treatment was given to the number of adjectives, verbs, adjectives and verbs summed, and the total number of words (first and second nouns, adjectives, and verbs summed) incidentally recalled by the 5 groups.

RESULTS

Recall. The analysis of variance results of the number of correct responses (the missing noun of that pair) showed that there was no significant difference among the 5 groups (Table 25). Consequently, the first hypothesis is rejected. Analysis of variance procedures also showed that there were no significant differences on the measures evaluating the types of incorrect responses made by the 5 groups except for incorrect words imported from outside the test (Table 26). Incorrect responses for the following dependent variables were not significant: incorrect, but one of the 13 other missing nouns (Table 27); incorrect, but one of the first nouns of any of the pairs (Table 28); an incorrect word imported from any of the 14 sentences on the test or from the examples at the beginning of the test (Table 29), and the number of blanks (Table 30).

Duncan Range analyses of the incorrect response imported from the outside (Table 26) revealed that the Combined and the Rochester deaf had significantly fewer of this type than Hearing-Age and Hearing-Achievement. On the other hand, the Oral deaf were not significantly different from the hearing groups, though not significantly different from the other 2 deaf groups.

Another evaluation determined the similarity of the incorrect responses of the 5 groups to the free association responses given by college students when completing the sentences with the second noun missing (see Table 31). An analysis of variance procedure showed that there was a significant difference among the 5 groups in the average association value (frequency of the incorrect responses). Duncan Range calculations (Table 31) showed that the Combined and

the Rochester deaf groups had significantly less commonality with the normative College group than both Hearing-Age and Hearing-Achievement groups. Again, the Oral deaf group was not significantly different from the 2 hearing groups nor from the other 2 deaf groups. The number of incorrect responses given by each group that appeared on the college list barely missed significance at .05 level (Table 32).

Incidental Recall. We evaluated the incidental recall of these 14 sentences by our 5 groups in order to account for learning that occurred without specific instructions. There were significant findings with regard to the following dependent variables: first nouns; second nouns (the missing nouns); first and second nouns together; test adjectives; test verbs; test adjectives and verbs together; and nouns, adjectives, and verbs together (Tables 33, 34, 35, 36, 37, 38, 39).

Duncan Range analyses for incidental recall showed that 1) Hearing-Achievement recalled significantly fewer first nouns than the other groups with the deaf groups not significantly different from each other (Table 33); 2) Hearing-Achievement recalled significantly fewer second nouns than the other groups with the deaf groups not significantly different (Table 34); 3) Hearing-Achievement recalled significantly fewer first and second noun pairs than the Combined deaf, Oral deaf, and Hearing-Age but not the Rochester deaf; and the 3 deaf groups were not significantly different from each other (Table 35); 4) Hearing-Achievement recalled significantly fewer test adjectives than all other groups; the Rochester deaf recalled significantly fewer test adjectives than the Hearing-Age and Oral deaf; the Oral deaf and the Combined deaf were not different (Table 36); 5) Hearing-Age recalled significantly more test verbs than all the other groups, with the 3 deaf groups not significantly different (Table 37); 6) Hearing-Age recalled significantly more test adjectives and test verbs together than Hearing-Achievement, Rochester deaf, Combined deaf; Hearing-Age and Oral deaf were not significantly different; Oral deaf recalled significantly more adjectives and verbs than Hearing-Achievement; the 3 deaf groups were not significantly different (Table 38).

The overall incidental recall for first, and second nouns, test adjectives and test verbs showed that the Hearing-Achievement group gave significantly fewer incidental recall responses than the Combined, Rochester, Oral deaf and the Hearing-Age groups; the latter groups were not significantly different (Table 39). The second hypothesis consequently, is rejected.

DISCUSSION

Recall Phase. Since there were no significant differences in the number of correct nouns recalled, the testing procedure of this phase of the experiment may not have been sufficiently difficult to discriminate among the 5 groups. Yet from a more positive viewpoint, the finding of no significant differences among the hearing and deaf groups may point to similar ability of these groups to make use of

sentence contexts to help generate missing nouns. This generalization must be limited to easy verbal materials consisting of 14 or fewer six-word, simple sentences, for which missing nouns are to be supplied. It would be interesting to increase sentence length or the number of sentences to discover at what point, if any, the hearing groups show superior recall, based on their greater exposure to verbal materials.

The central problem, however, concerns what mode or strategy deaf subjects use to store and retrieve the missing nouns of each succeeding sentence to aid them in maintaining equivalent recall. This was investigated by an analysis of the types of errors but only 2 findings seem clear. The Rochester and the Combined deaf imported fewer words from outside the test words and also gave fewer common sentence-associated responses when unable to recall the correct nouns than the Hearing-Age and Hearing-Achievement.

When the Rochester and Combined deaf groups make mistakes, they tend to use the test materials to which they have been exposed for more of their responses. Their thought tendencies seem more restricted to the stimuli which have been recently presented and less open to popular associations. On the other hand, the 2 hearing groups offered fewer incorrect responses originating from the test and gave more associatively related responses, which were often meaningful completions of the sentence. It may be inferred that hearing subjects, when responding to incomplete sentence stimuli, are more open to completing the sentence with an associatively related verbal response that may not be generated by the immediately presented stimuli. The Oral deaf were not significantly different from the 2 hearing groups on these variables, indicating that their internal language tendencies may be similar to those manifested by hearing subjects.

Incidental Recall. The hypothesis that both hearing groups would be significantly better than the deaf in incidental recall was not confirmed, because the Hearing-Achievement group was less capable in incidental recall on all measures. Consequently, it may be inferred that incidental memory is more related to chronological maturity and general experience than it is to language development. (The Hearing-Achievement group subjects are about 2 years younger than the other 4 groups and equivalent in language to the deaf groups.) Further, in the Incidental Recall Phase, the Hearing-Achievement group was significantly inferior to the other 4 groups on the second noun (the missing noun of the Recall Phase) when they had not been inferior in the Recall Phase. It would seem that the specific instruction of the Recall Phase leads the Hearing-Achievement group to recover missing nouns which, on the other hand, they cannot retrieve as well only a short time later after they have discharged this instruction. Perhaps the interpolated activity of recalling the missing nouns in the Recall Phase interfered more with the Hearing-Achievement group, so that they were less able to retrieve in the Incidental Phase even those materials they had previously been asked to learn. Possibly, subjects at this age are highly vulnerable to interpolated activities in their short term memory ability.

The fact that the Hearing-Age group remembered significantly more verbs in the Incidental Recall Phase requires some comment. It is possible that the more advanced language development of the Hearing-Age group provided a better background for storing and retrieving verbs more accurately, that is, advanced language development and incidental recall of verbs is related. Possibly, their greater experience with the basic syntactical structure of noun-verb-noun (subject-verb-object), in which the sentence stimuli of this study were cast, assisted them in relating these language forms for better incidental recall.

SHORT TERM MEMORY FOR SENTENCES AND WORD STRINGS
(Sentence Memory Study)

Many studies indicate that deaf subjects are not as proficient in recalling sequentially presented items as matched hearing subjects; however, deaf subjects seem to have done as well as their hearing counterparts in recalling simultaneously presented materials after short exposure. Most often, the reason for the inferior recall on the part of deaf subjects on sequential materials has been ascribed to their relative lack of experience in dealing with temporal sequences, as used in the processing of speech. It is in the processing of speech that the hearing subjects have had a great deal of practice and deaf subjects have had relatively little experience.

This study was primarily concerned with evaluating whether deaf subjects, educated by different methods, were, in fact, deficient in their short term memory for stimulus materials presented briefly and sequentially, when compared with hearing groups, one matched on age and another on written language achievement. The stimulus materials were divided into meaningless word strings and into meaningful sentences to determine whether syntax and meaning had any significant effect.

METHOD

Subjects. There were 5 groups of 30 subjects each, with 3 groups composed of deaf students from an Oral, a Combined, and a Rochester educational background. The other 2 groups consisted of hearing students matched with the deaf groups (the Hearing-Age and Hearing-Achievement groups). See the section on subjects (page 4) and Table 40 for details.

Test Materials and Procedure. Seven examples, plus 8 sentences and 8 word strings (scrambles) were shown, one word at a time, on a screen by a movie projector. Each word was instantly replaced by the next word in both sentences and word strings. The sentences were composed of 7 words and the scrambles of 5 words, all of which were highest frequency words (at least 50 occurrences per million according to Thorndike-Lorge). In the opinion of 6 experienced teachers of the deaf, the sentences would be easily understood by deaf students 10 years of age and older, trained by the 3 educational methods whose effects we were evaluating. A typical sentence was: the children had fun at the circus.

The words used in the scrambles were taken randomly from the 8 sentences, one from each sentence. All articles were omitted and most prepositions. A typical scramble was: they teach fun chair went.

Sentences and scrambles were presented in a random order as follows: one random order was made for the 8 sentences and another for the 8 scrambles. Then 2 sentences and 2 scrambles were pulled from each order and that group of 4 was randomized. Limiting conditions for the order were: no more than 2 consecutive scrambles or

sentences, and no runs of 5 or more where the sentences and scrambles alternated. The list of examples, and test sentences and word strings are shown in Table 41, together with the exposure times for each sentence and word string.

Scrambles and sentences were presented without an initial capital or final period. They were preceded by a number on the screen, so that the subjects would put their answers in the proper place on the answer sheet. Each word in each sentence or scramble was exposed one word at a time for either two-tenths of a second or for one-tenth of a second and instantaneously replaced. After the words of each sentence or scramble had been shown, there was a 60 second interval during which the subject was to write as many of the words as he could remember, in the order that he had seen them. Then the words of the next sentence or scramble were exposed. Both the word exposure and the writing interval were timed by the film. The subjects were instructed to write only when the lights were on, which was during the 60 second interval. When the sentences and scrambles were exposed, the room lights were not on.

After reading and going over written and filmed instructions and 5 illustrations, the subjects did 2 timed examples, one sentence and one scramble, and these were checked to be sure that the subjects knew what to do. Certain sentences from the instructions were also written on the blackboard for emphasis. Throughout the examples and test, the subjects were told to guess if they did not know. The test was given to groups of 5 to 35 subjects.

Scoring Procedure and Dependent Variables. The first and probably most significant dependent variable was the number of correct words in the correct position, that is, when both sentences and strings were written exactly as they appeared on the screen (C). When the words were recalled with a grammatical shift and were nevertheless correct and in the correct position, they were scored as correct but with a grammatical shift (CG). Examples are: child substituted for children or done for did.

Those words which belonged in the sentence or string but were recalled in the wrong position were counted as another dependent variable (S). If these words were recalled with a grammatical shift, they were counted as (SG).

In addition, the sentences recalled by the subjects were scored to determine whether the minimal meaning of the sentence was conveyed, and also for the essential minimum sense of the noun phrase and of the verb phrase. Consequently, 3 additional dependent variables relating to the meaning and the structure of the recalled sentence were made part of the analysis. Table 42 shows the minimal meaning scoring key, the minimal noun phrase, and the minimal verb phrase.

RESULTS

For the recall of all the words in both the appropriate word

strings and sentences (including minor grammatical alterations) and regardless of correct position, the analysis of variance procedure showed a significant finding (Table 43). On this variable further computations (Table 43) showed that the Hearing-Age group was significantly superior to the other 4 groups, and the Oral group was significantly superior to the Hearing-Achievement and the Rochester groups but not significantly different from the Combined deaf (Table 43). There were no significant differences between the Hearing-Achievement, Rochester, and the Combined groups.

When the sentences were considered alone without the word strings, the number of words recalled, including minor grammatical alterations and regardless of correct position, there was found to be a significant variation among groups (Table 44). Making use of the Duncan Range technique (Table 44), we noted that the Hearing-Age group recalled more words of the stimulus sentences than the Hearing-Achievement, Rochester, and Combined groups, but there was no significant difference between the Hearing-Age and Oral groups. The Oral group was significantly superior to the Hearing-Achievement, Rochester, and Combined groups.

Now, when the word strings were evaluated alone without the sentences for the number of words recalled, including minor grammatical variations and regardless of correct position, the results of the analysis of variance indicated that the 5 groups were significantly different (Table 45). Duncan Range results revealed that the Hearing-Age group was superior in such recall to the other 4 groups while the Hearing-Achievement was inferior to the Combined, Oral, and Hearing-Age but not significantly different than the Rochester group (Table 45).

It seemed desirable to compare the groups on the more stringent criterion of correct word in correct position (including grammatical shift) on both sentences and word strings. The results are shown in Table 46, and indicate that the Hearing-Age group recalled significantly more words than the other 4 groups, who were not significantly different among themselves.

When the number of correct words (including minor grammatical variations) in the correct position in the sentences alone were evaluated (Table 47), we found that the 5 groups were significantly different. Again, the Hearing-Age group demonstrated its superiority over the other 4 groups, recalling more correct words in their correct position. The Oral group was significantly superior to the Hearing-Achievement and Rochester groups, but not when compared to the Combined group.

Finally, the number of correct words recalled in their correct position was examined for the word strings for the 5 subject groups (Table 48). This analysis showed that the Hearing-Age group was significantly superior to the other 4 groups in recall. The other 4 groups showed no significant variation on this variable.

To evaluate the ability of our subject groups to recall completely

correct sentences and word strings, and each of these separately, additional analyses of variance were completed. The Duncan Range (Table 49) dealing with the number of completely correct sentences and word strings added together showed that the Hearing-Age group was significantly superior to the other 4 groups. The Oral group was significantly superior to the Rochester group, but not to the Combined and Hearing-Achievement groups. The Rochester, Combined, and Hearing-Achievement groups were not significantly different.

When the recall of completely correct sentences was assessed (Table 50), we found that the Hearing-Age group was significantly superior to the other 4 groups. The Oral group was significantly better than the other 2 deaf groups, but not the Hearing-Achievement. The Combined and Rochester deaf and the Hearing-Achievement were not significantly different.

With regard to the completely correct recall of word strings, the Hearing-Age group was significantly superior to the other 4 groups who were not significantly different from each other (Table 51).

There was a significant finding for the total number of minimal meanings of verb phrases given for the 8 sentences based on the analysis of variance procedure (Table 52). The Duncan Range procedure showed that the Hearing-Age group recalled a greater number of verb phrases than the Combined, Rochester, and Hearing-Achievement; there was no difference between the Hearing-Age and the Oral. In addition, the Hearing-Achievement group recalled significantly fewer verb phrases than the Oral, Rochester and Hearing-Age groups (Table 52).

A significant finding for the number of correct meanings of noun phrases for the 8 sentences was found (Table 53). Further calculations showed that this significance was due to the Hearing-Achievement giving significantly fewer correct noun phrase meanings than the other 4 subject groups (Table 53).

The Hearing-Age group recalled significantly more minimal meanings of the sentences than the Combined, Rochester, and Hearing-Achievement but was not different from the Oral. The Hearing-Achievement recalled significantly fewer minimal meanings than the other 4 subject groups (Table 54).

DISCUSSION

Recall of word strings. When word strings were considered separately, the Hearing-Age group was superior to all other groups on the correct word in the correct position regardless of grammatical change, and also on correct word regardless of position and/or grammatical change. Their greater language sophistication probably accounts for this superiority. An interesting finding was that the Hearing-Achievement group (which is approximately 2 years younger than their language-matched deaf peers) was equivalent to the deaf groups on the correct word in the correct position, but on correct words regardless of position, they were inferior to both the Oral and

Combined deaf groups. This may indicate that the Hearing-Achievement, more than the deaf, focussed more on the correct word order in recalling the words themselves and/or that they were literal in following the instructions to write the words in the same order. Another important factor may have been that there was little, if any, rehearsal time which might have benefited this younger hearing group who -- in spite of being matched with the deaf on the comprehension of written language -- still have greater overall experience in processing verbal materials. In any case, these results with nonsyntactical word strings differ from Withrow's (1968) and cast doubt about the alleged inferiority of deaf subjects in their memory for sequentially presented verbal stimuli.

Recall of sentences. On recall for sentences, we note that the Hearing-Age group was typically superior to all other groups. Further, the Oral group generally was superior to the Hearing-Achievement, Rochester and Combined groups in recall of sentences. Possibly the semantic and grammatical components of the sentences were more skillfully utilized by the Oral deaf in their recall than by the Hearing-Achievement or the other 2 deaf groups; this inference is related to the finding that the Oral group had been similar to those groups on the word strings (where there was no syntax, and only the meaning of individual words). It is also important to note that the Hearing-Achievement group was no better than the Rochester and Combined groups when meaning and syntax could be used to aid in the recall of verbal stimuli.

KNOWLEDGE OF MULTIPLE MEANINGS OF WORDS IN DEAF AND HEARING ADOLESCENTS (Word Comprehension Study)

Most words have several meanings and, typically, the more frequently a word is used the more meanings it has. Such multiplicity of meanings for a word, according to Slobin (1971), arises because people prefer to acquire and store a smaller number of words, each with many meanings, than to learn and store a different word for each meaning. Whether deaf individuals also prefer to learn multi-meaning words in this way is a question worth exploration. This characteristic of frequently used words has significance for the language development of deaf individuals. The ability of deaf subjects to recognize the different meanings of multi-meaning words may indicate the adequacy of their vocabulary and provide information about how their vocabulary is organized. If only the most popular meaning is known and the less popular one is not recognized, then we know that deaf subjects would have many problems when a word is used in a context where the less frequent meaning is intended. Further, words whose many meanings are known, will be more quickly recognized as compared to words with only a single meaning (Rubenstein, Garfield, & Millikan, 1970). Consequently, knowledge of the various meanings of multi-meaning words is an aid to their recognition and possibly in reading comprehension.

In a pertinent study, MacGinitie (1969) shows that deaf adolescents are more able than hearing adolescents to resist the effects of misleading contexts in selecting the appropriate meanings of multi-meaning words. In interpreting this unexpected finding, MacGinitie seems inclined to think that word association plays a much smaller role in the thinking and verbal processes of the deaf. Two other possibilities, which he does not favor, involve more flexibility in dealing with multiple meanings, and unclear distinctions between semantic and associational relationships. Because this finding is so unexpected, further study seems indicated.

Our investigation, reported below, is very similar to that of MacGinitie's, but puts forward the hypothesis that the Hearing-Age and Hearing-Achievement subjects will have more correct strong and weak meanings when meanings are called for, and fewer association responses than the deaf groups, who will not differ among themselves.

METHOD

Subjects. Five groups of 29 subjects each participated in this study. Three of the groups were deaf subjects trained by different methods: Oral, Rochester, and Combined. The other 2 groups were hearing subjects: the Hearing-Age group, and the Hearing-Achievement group. See the section on subjects on page 4, and Table 55.

Materials. Two tests were constructed for this study. One test (Test I-A) attempted to ascertain whether popular word association responses influenced deaf and hearing subjects in their interpretation

of multi-meaning words, presented out of context, when meaning was asked for. A second test, Test I-C, investigated whether the deaf were as knowledgeable as the hearing about both stronger and weaker meanings of the multi-meaning words.

Twenty-six target words were chosen from a list of multi-meaning words previously used in the word association study with 5 groups of hearing and deaf subjects similar to those of the present study. All target words had a general language usage of 50 or more times per million (Thorndike-Lorge A and AA).

Thirteen of the target words had their primary (most popular) association common to all the subject groups. The remaining 13 had a secondary association response common to all groups. Secondary responses were less popular than primary responses, but had greater than idiosyncratic frequency. Although it might have been desirable to have both primary and secondary responses to the same words, which we tried to achieve, very few words had both a primary and a secondary response across all groups. The primary and secondary associations were cross checked to insure that they occurred minimally, if at all, as associations to other target words in any of the subject groups.

The strong and weak meanings of the target words were obtained 1½ to 2 years previously from evaluations by 150 deaf and hearing adolescents comparable to our deaf and hearing subjects. All meanings were given in single words or short phrases. For 17 of the 26 target words, all 5 groups agreed about the strong and weak meanings, and for the remaining 9 words, there was almost complete unanimity. Control alternatives, which were single words and short phrases, were chosen to accompany the other response choices. They were also checked against the association hierarchies of the target words to insure that they were not associatively related to them.

Thus, there were 2 sets of 13 target words, one with primary associations, the other with secondary associations. For each target word, there was also a strong meaning, a weak meaning, and 2 available control response choices (see Table 56). These 2 sets of 13 target words with their accompanying response alternatives were used in making up the 2 tests, each in a multiple choice format, described below.

Test I-A, Meaning Test. Each target word was accompanied once by the multiple choice alternatives of the strong meaning, an association, and a control response, and once by the weak meaning, the same association, and the same control response. Since there were 26 words, the number of items in this test totalled 52. Instructions asked for the meaning of the target word.

Test I-C, Control Test. The 52 items in this test had the same meaning and control alternative in Test I-A but no association alternative was present, its place being taken by an additional control response. Instructions asked for meaning.

Instructions were worded so that they would be clear to the deaf

and were checked by a teacher of the deaf experienced in both the oral and manual methods. Target words were randomized for each section of the test with the restriction that all target words were presented before any word was repeated. The target words appeared in the same order but the first and second sections of the tests were switched, so that half the subjects saw the strong meaning of a particular word first, and half saw the weak meaning first. Given 3 kinds of multiple choice alternatives (meaning, association, random), there were 6 possible positions of these choices. All of these were used for the response alternatives and were distributed randomly (but with equal numbers) throughout each test half.

Procedure. Test I-A (Meaning) and I-C (Control). The experimenter and subjects went over the directions together and then did the examples together. Instructions were to choose the multiple choice alternative that told what the underlined word meant. They were told to guess, if they did not know the answer.

RESULTS

We will present the results dealing with Test I-C, the control test separately, and will then discuss the results of Test I-A.

For Test I-C (no association response alternatives present), the Combined deaf group chose a significantly smaller number of correct meanings than the Rochester deaf group, who in turn, chose a significantly smaller number of meanings than the Oral deaf and Hearing-Achievement groups, who chose a significantly smaller number of meanings than the Hearing-Age group (see Table 57). The results also indicated that the strong meanings of the target words were significantly better known than the weak meanings of the corresponding words (Table 57). Another result showed that the superiority of the better known strong meaning over the weak meaning was less for the Hearing-Age group than for the other 4 groups (Table 58).

When the performances of the 5 groups is compared on Test I-A where correct meaning is asked for (in the presence of a strong meaning, an associatively related word, and a control word) the following results emerge. The Hearing-Age group chose significantly more strong meanings than the other 4 groups. The Hearing-Achievement group chose significantly more strong meanings than the Combined and Rochester deaf groups; there was no significant difference between the Hearing-Achievement and the Oral deaf groups (Table 59). The Oral deaf group chose significantly more strong meanings than the Combined deaf group but was not significantly different than the Rochester group. There was no significant difference between the Rochester and Combined deaf groups (Table 59).

When the weak meaning was the correct response, the Hearing-Age group selected significantly more weak meanings than the other 4 groups. Again, the Hearing-Achievement group was not significantly different than the Oral deaf group but was superior to the Rochester and Combined deaf groups (Table 60). The Oral group was significantly

superior to the Combined and Rochester deaf groups on this variable. The Combined and Rochester deaf were not significantly different (Table 60).

We were also interested in ascertaining whether there were any differences among the groups in the number of associations chosen when strong and when weak meanings were the correct answers respectively. In the presence of strong meanings as the correct response, the Hearing-Age groups chose significantly fewer associations as the correct response than the other 4 groups (Table 61). Again, the Hearing-Achievement group was not significantly different from the Oral deaf group but chose fewer associations than the Combined and Rochester deaf groups (Table 61). The Oral group chose significantly fewer associations as the correct response, when the strong meaning was called for, than the Combined group, and the Combined and Rochester group were not significantly different (Table 61).

When the weak meaning was the correct response, we found that the Hearing-Age group selected significantly fewer associations than the other 4 groups (Table 62). The Hearing-Achievement group was not significantly different from the Oral group but selected significantly fewer associations than the Combined and Rochester groups (Table 62). The Oral deaf group also selected significantly smaller number of associations, when weak meaning was called for, than the Rochester and the Combined deaf groups; the latter 2 groups were not significantly different (Table 62).

In order to evaluate whether comprehension of the multi-meaning words affected their choices when highly associated words were included among the alternatives, difference scores were used and analyzed. Here, the number of correct choices of each subject on Test I-A was subtracted from the number of correct choices on Test I-C (control with correct meaning and 2 random words) to get a difference score. These difference scores were analyzed first for the strong meaning alternative and then for the weak meaning alternative. Results with the strong meaning difference score indicate that the Hearing-Age group was significantly different from the other 4 groups, showing that the performance of the latter groups was significantly decreased by the presence of highly associated words as compared to that of the Hearing-Age group (Table 63). The Hearing-Achievement group was significantly different from the Combined and Rochester groups, showing that the Hearing-Achievement group was relatively more able to select correct strong meaning responses in the presence of highly associated words (Table 63). There was no difference between the Hearing-Achievement and the Oral groups and no difference between the Rochester and Combined groups (Table 63).

With regard to the weak meaning alternative difference score, the Hearing-Age group was significantly different than the other 4 groups, who did not differ significantly among themselves (Table 64). Consequently, the Hearing-Age group, the most sophisticated language group, was able to show least effect of the presence of associatively related choice alternatives when selecting the correct weak meaning responses.

DISCUSSION

From the results of the control test (Test I-C), it would appear that the Oral deaf group, as compared with the Combined and Rochester deaf groups, more closely approximates the knowledge of the meanings of the multi-meaning words possessed by the 2 hearing groups. An inference from this finding is that Oral deaf education contributes more to an adequate vocabulary of words having more than one meaning. Since this was a limited sample of words, this implication should be treated cautiously, requiring further support. The 2 hearing groups were more knowledgeable about multi-meaning words, which suggests that deaf subjects do not learn multi-meaning words to the same degree as hearing subjects.

To find out the degree of stability of knowledge of multi-meaning words, whether strong or weak, we evaluated the responses of the 5 groups on strong and weak meanings given the presence of highly associatively related words as an alternative. From the results, it is apparent that the Hearing-Age group showed greatest ability to resist the effects of the associatively related word when both strong and weak meanings were called for. The Hearing-Age group chose fewer associatively related words than the other 4 groups as the correct response while the Hearing-Achievement group selected fewer associatively related responses than the Combined and Rochester deaf groups. In each case, when strong and weak meanings were required, the Oral deaf group was not significantly different from the Hearing-Achievement group. But when strong meaning was called for, the Oral deaf selected fewer associatively related words than the Combined deaf and selected fewer associatively related words than the Combined and Rochester deaf when weak meaning was required.

Finally, our results do not confirm those of MacGinitie and appear to be more in line with the language experience of deaf and hearing people. Hearing individuals who are matched with the deaf on age and intelligence, know more meanings of multi-meaning words than the 3 deaf groups which we examined. However, the orally trained deaf group was similar in its knowledge of multi-meaning words to the hearing group matched on written language achievement and IQ, whereas the deaf group exposed to the total communication method was inferior to the latter hearing group. Finally, deaf subjects trained by the total communication method, seemed more influenced by highly associatively related words than hearing subjects. However, the orally trained deaf subjects were not different from hearing subjects matched on written language achievement but were generally less influenced by the presence of highly associated words than the deaf subjects trained by total communication methods, particularly when weak meanings were required.

INTERPRETATION OF MULTI-MEANING WORDS IN DIFFERENT SENTENCE CONTEXTS
(Contextual Cues Study)

One prevailing view is that many frequently used words have more than one meaning because one phonetic form with many meanings is easier to acquire than many specific phonetic forms each with a specific meaning. This means that a great number of words with more than one meaning will manifest some ambiguity when used in a sentence unless the sentence features clarify the intended meaning. In order to understand a sentence containing multi-meaning words, there must be some method of discovering the relevant meanings of these words in that sentence. Probably, the proper understanding of these words is based on their syntactical use (i.e. noun or verb, etc.) and on the meanings of the other words in the sentence (Slobin, 1971).

The fact that many familiar words have more than one meaning is often a source of great difficulty for children as they acquire their English lexicon. When they eventually master the second, different meanings of many familiar words, children have not only enormously increased their vocabulary knowledge but also the flexibility with which they use and understand language. In addition, alternative meanings of words are often vital in the comprehension and use of humor and slang.

Many studies have established the retardation of the vocabulary development of deaf children. The further question arises of their capacity to use and understand particular words in different contexts. In order to assess these abilities, this study attempts to establish whether the deaf subjects know the different meanings of these multi-meaning words, and whether they can readily and appropriately shift from one meaning to the other when the context calls for such change.

The part that association processes play in the understanding and use of multi-meaning words is also an important question. When words have more than one meaning, it would seem likely that close associations to these words may be selected instead of a meaning alternative, particularly one that has been shown to be weak.

The purpose of this study, then, is to determine the extent to which different deaf groups and hearing groups use context and syntax to aid them in the interpretation of multi-meaning words. We hope to be able to determine if deaf groups are as capable of shifting flexibly from one meaning of a specific word to another when called for by the context and the syntactical form. We will also evaluate the degree to which associations influence the selection of the appropriate meaning of particular multi-meaning words when used in a sentence with ambiguous cues or with definite cues.

METHOD

Subjects. The subjects consist of 3 deaf groups, Oral, Combined, and Rochester, plus 2 hearing groups, one matched with the deaf

groups on written language achievement, IQ, sex, socio-economic background and the other matched with the deaf on age, IQ, sex, and socio-economic background. There were 30 subjects in each group. A detailed description is given in the separate section on subjects (page 4) and relevant statistics on Table 65.

Materials. Eight multi-meaning words were chosen which had one primary association common to all 5 adolescent deaf and hearing groups in the Word Association tabulations. This criterion greatly restricted the selection of possible target words. Another criterion that reduced the number of target words was that each target word had one strong meaning and one weak meaning known to all 5 subject groups. All target words and both their meanings were A or AA words in the Thorndike-Lorge count (at least 50 occurrences per million words).

Four sentences were composed for each target word, making a total of 32 sentences. Two of these sentences provided only ambiguous cues, that is, only minimal contextual cues about the meaning of the target word. The 2 definite cues sentences were basically the same as the ambiguous sentences but had one additional cue which made the meaning much clearer, but not certain. Thus, for each of the 8 multi-meaning target words there were 4 sentences: one strong meaning-ambiguous cue sentence, one strong meaning-definite cue sentence, one weak meaning-ambiguous cue sentence, and one weak meaning-definite cue sentence. For example, for the target word Fire:

Strong Meaning	
ambiguous cue	He will make a fire.
definite cue	He will make a fire with wood.
Weak Meaning	
ambiguous cue	He will fire you.
definite cue	He will fire you if you are lazy.

Each of the 4 types of sentences (1. strong meaning-ambiguous cue, 2. strong meaning-definite cues, 3. weak meaning-ambiguous cue, 4. weak meaning-definite cues) was presented with 4 response alternatives: the strong meaning, the weak meaning, the primary association, and a control alternative. The same 4 answer choices appeared, in different orders with the 4 test items using the same target word. These response alternatives were either single words or very short phrases, using well known words. The control alternatives were randomly chosen, well known words which were not conspiciously different from the other answer choices, so the Ss would not automatically reject them because they were the only unrelated answer choice (see Table 66 for the list of target words, sentences, and answer choices).

A typical test item was: He had a top.

1.	ring	(control word)
2.	highest place	(strong meaning)
3.	toy	(weak meaning)
4.	bottom	(primary association)

Each of the 4 sentences for each target word was presented separately and mixed with the sentences for other target words. The test was divided into 2 parts with one of the strong meaning sentences for a particular target word (either strong-ambiguous or strong-definite) and one weak meaning sentence (either weak-ambiguous or weak-definite) in each part. The tests were counterbalanced so that half of the Ss took Part 1 first and the others took Part 2 first. Within each part the sentences were randomized, so that the sentences were in different positions in Part 1 and Part 2. The response alternatives were also in different randomized orders.

Procedure. The Ss were tested in groups of 14 to 35 and were instructed to read the sentence carefully and to choose the answer that told what the underlined word meant IN THAT SENTENCE. The instructions were written and were gone over by the examiner, with excerpts written on the blackboard for emphasis. The first example was already answered correctly in the instructions and was discussed by the examiner. The Ss did the next 2 examples, which were checked to be sure they knew how to proceed. They were told to do every one and to guess if they didn't know. The test was self-paced and they did one part one day and the other part the next day.

RESULTS

The analysis of variance and Duncan Range test for the selection of the appropriate meaning alternatives for the target words in the sentences showed that there was a significant difference among groups, with the Hearing-Age, Hearing-Achievement, and the Oral deaf groups not significantly different; they selected significantly more appropriate meaning alternatives than the Rochester and Combined deaf groups (Table 67). Further, significantly more appropriate meaning alternatives were selected when the strong meaning was correct than when the weak meaning was correct (Table 68). In addition, where the sentence contained ambiguous cues, there were significantly more appropriate meaning alternatives selected than when there were definite cues. A significant Groups x Meaning Strength was found with the 3 deaf groups consistently dropping off in the number of appropriate meanings when weak meaning was correct as compared to the hearing groups rising slightly when weak meaning was correct (Table 68). Probably, significance in this interaction was principally due to the Rochester deaf group falling down considerably when weak meaning was called for (Table 68).

The measure involving inappropriate meaning alternatives showed that there was a significant groups effect with the Rochester deaf group making significantly more of these errors than the Hearing-Age, Hearing-Achievement, and the Oral deaf groups (Tables 69 and 70). The Rochester deaf group was not significantly different than the Combined deaf group; the Hearing-Age, Hearing-Achievement, and Oral deaf group were not significantly different (Tables 69 and 70). Further, significantly more inappropriate meaning alternatives were chosen when the weak meaning was correct than when the strong meaning was correct (Table 70). Again, the significant Groups x Meaning Strength

interaction apparently was due to the slight difference in the inappropriate meanings chosen by the Hearing-Age group whether strong or weak meaning was correct, whereas the Hearing-Achievement, Oral deaf, Combined deaf, and Rochester deaf groups showed considerably more inappropriate meaning alternatives when weak meaning was correct (Table 70).

The analysis of variance procedure evaluating the selection of association alternatives (a wrong response since an appropriate meaning alternative is correct) showed a significant finding for groups (Table 71). The Hearing-Age, Hearing-Achievement, and Oral deaf groups were not significantly different among themselves although these groups made fewer wrong selections of association alternatives than the Combined and Rochester deaf groups (Tables 71 and 72). The Rochester and Combined deaf groups were not significantly different on this measure (Tables 71 and 72). It seems that more association alternatives were selected when the strong meaning alternative was correct than when the weak meaning was correct (Table 72). The significant Groups x Meaning Strength interaction indicates that the Hearing-Achievement group differed considerably from the Rochester deaf group whereas the other 3 groups seemed to have a similar pattern of performance for incorrectly selecting the association alternative given either strong or weak meaning. While the Hearing-Age, Combined deaf, and the Oral deaf showed similar declines in associations selected in the weak meaning condition, the Hearing-Achievement group declined greatly in the weak meaning condition and the Rochester deaf group showed only a minimal decline in the weak condition (Table 72).

DISCUSSION

The results showed that the Oral deaf subjects were significantly superior to the Combined and Rochester deaf subjects in selecting the appropriate meaning for a target word embedded in sentences, first where a strong meaning was appropriate and second, where a weak meaning was appropriate. Since the test included only words whose weak and strong meanings were known by each subject in our 5 groups, this result suggests that the Oral deaf have greater ability than Combined and Rochester deaf subjects to use sentence contexts in interpreting the different meanings of well known words. Presumably, knowledge of the meanings of the other words and of the grammatical components leads to better ability to select the intended sense of the multi-meaning word. Based on this better comprehension of multi-meaning words in context of written language by the Oral deaf subjects, we may infer that the Oral educational method affords its students greater skills in the interpretation of written language.

Another finding concerned with the selection of inappropriate meaning (weak where strong was intended; and strong where weak intended), would confirm the above analysis except for one slight difference. On this variable, the Combined deaf subjects were not significantly different from the Oral deaf, and the 2 hearing groups. Consequently, those deaf subjects exposed to the Combined method apparently acquired sufficient written language skills to enable them to avoid choosing

inappropriate meanings with the same degree of accuracy as the two hearing groups and the Oral deaf. It should be recalled that the Rochester deaf fell significantly below the 2 hearing groups and the Oral deaf on this measure; therefore, we may infer that the Rochester method was not as adequate as the Oral method in helping its students eliminate inappropriate meanings.

The third finding again indicates superiority of the Oral deaf group which, like the 2 hearing groups, selected fewer association responses than the Combined and Rochester deaf groups, when the appropriate meaning was requested. Apparently, the Oral deaf subjects have better control and awareness of the significance of association response alternatives and how they differ from meanings of the target words. The conclusion, thus, seems justified that the Oral program of instruction, more than the Combined and the Rochester, contributes significantly to identifying and controlling intruding associatively related responses where meaningful responses are demanded. Overall, the 3 findings, described above, would point to the Oral method as a more adequate type of preparation for interpreting written language than either the Combined or the Rochester method.

WRITTEN SENTENCE CONSTRUCTION IN DEAF AND HEARING ADOLESCENTS
(Sentence Construction Study)

This research investigated the ability of deaf adolescents to write sentences containing a preselected word. These sentences were then compared with those of hearing adolescents on a number of different measures. One measure evaluated whether the sentences written by deaf adolescents about related noun pairs (such as woman-lady) and about unrelated noun pairs (as kitchen-balloon), had as many overlapping words as those of matched hearing controls. In addition, we hoped to determine whether highly related nouns have more overlapping words in their sentence contexts than unrelated noun pairs (Rubenstein & Goodenough, 1965).

Another measure evaluated how well the subject is able to communicate meaning in the sentence he has written. In this assessment, correct grammatical construction is secondary to meaningful communication of some idea that is in line with accepted fact or standard.

The number of words per sentence were also counted, as were the number of simple, compound and compound-complex sentences composed by the different subject groups. According to Templin (1950), the limited vocabulary of deaf adolescents forces them to use a larger number of words to express a given concept than matched hearing counterparts. But our general experience indicates that deaf usually write short sentences. And on the other hand, the greater language ability and experience of the hearing adolescents may result in their having many more ideas or concepts to incorporate in the sentences. On this basis the sentences of the hearing subjects should include more words and thus offset the greater number of words required by the deaf to express their concepts.

Closely related to the number of words and ideas in a sentence is whether the sentences, written using each target word, refer to some characteristic of this word, whether distinctive, relevant, or general -- or none at all. In our opinion the more specific and distinctive the attribute of the target word included in the sentence, the more sophisticated the language and the greater the productive language ability.

We also were extremely interested in the grammatical skills manifested by our deaf subjects and hearing adolescents. Taylor (1969) studied the grammatical structures of deaf children and adolescents, using an error scoring system based upon the rules suggested by Chomsky (1965). Chomsky has described 3 types of rules -- categorial rules, strict subcategorial rules, and selectional rules -- which occur in the base component of grammar. In addition, there are transformational rules in the transformation component, and morphological rules in the phonological component; these rules were incorporated by Taylor in her system for evaluating the types of errors made by the subjects. For greater coverage and explicitness, Taylor added three other errors: minor categorial errors, order

errors, and other errors. We followed the Taylor scoring system in evaluating errors in sentence construction. It was hoped that the use of this system might provide information about the types of errors consistently made by the deaf child, whether he was likely to violate the more basic rules of sentence generation or more advanced ones.

METHOD

Subjects. There were 3 groups of 30 deaf subjects from 3 different educational backgrounds, the Oral group, the Combined manual-oral (Combined), and the Rochester fingerspelling method. In addition, there were 2 hearing control groups, one matched on age and the other matched on written language achievement. The subjects are described in the section beginning on page 4. Table 73 shows the 5 different groups and how they compare on the relevant matching variables of age, IQ, written language achievement, and socio-economic status.

Test Materials. The stimulus materials consisted of 8 related and 8 unrelated noun pairs, 16 pairs (32 words) in all (Table 74). An example of a related noun pair was horse-pony and an unrelated noun pair was car-button. The nouns were presented one on a page, were underlined and in lower case letters. Below the noun were 2 lines on which a sentence was to be written.

Each test was divided into 2 separate parts: Part 1 contained one member of every pair and Part 2 the other member of each pair, that is, 8 words from the related pairs plus 8 words from the unrelated pairs. The 16 words of Part 1 were then put in 2 different random orders, called 1a and 1b, containing the same 16 words but in different orders. Part 2 also contained 16 words, the other members of the related and unrelated pairs of Part 1, and used the same 2 random orders as Part 1. For example, if dad were in position 4 in Part 1a, father (the other member of that related pair) would be in position 4 on Part 2a -- and if dad were in position 8 on Part 1b, father would be in position 8 on Part 2b. For all Ss, the same word from each pair was always in Part 1 and the other word from each pair was in Part 2, though the orders were different.

The related and unrelated noun pairs were selected as follows. Forty noun pairs, 20 of them related and 20 unrelated were chosen from the Connecticut Free Association Norms (1961). These were then presented, in 2 random orders, to 150 adolescent (junior high school) and 150 college students to be rated in terms of their relatedness or unrelatedness on a 5 point scale. Instructions were to read the underlined pairs of words and, using the 5-point scale, mark "how similar" (college), or "how much alike" or "how much the same" (adolescent) the judges thought the words were in meaning.

Eight related pairs rated 3.33 and above in a weighted tabulation were selected; eight unrelated pairs below 1.18 were also selected. The adolescent range was 3.33 to 4.89 for the related pairs and 1.05 to 1.18 for the unrelated pairs. Table 74 shows the related and unrelated pairs, the evaluations made by both the adolescent and the

college judges, and the Thorndike-Lorge word frequency count.

Procedure. The subjects were tested in groups of 5 to 35 and were instructed to read the underlined word at the top of the page and to write a good sentence using that word. When they finished that sentence, they were to go on to the next page until all pages were completed, they were told to do every page. The test was self-paced. Two completed examples were shown and then the subjects completed a third example, which was checked before they began work on the test itself.

Dependent Variables and Scoring. To assure anonymity, the sentences were coded so that the scorers could not know which subject had written the sentence or which group he belonged to. Sentences from different subjects and different groups were mixed together to further insure anonymity and eliminate order effects in scoring.

Overlap Score. For each subject, the 2 sentences written for each noun pair were compared to determine the number of words they had in common. Overlap scores were tabulated for the total number of words in common, the number of content words in common (nouns, verbs, adjectives, and adverbs) and the number of function words in common (articles, conjunctions, prepositions, pronouns).

Number of Words. The number of function words, content words, and the total number of words in all 32 sentences were counted for this variable.

Sentence Complexity Scoring. Each sentence was evaluated to determine if it was a simple, compound, or complex sentence -- or an incomplete sentence. In addition, the number of sentences using the passive voice were counted for each subject and also the number of stereotyped sentences (5 words or less).

Clarity of Communication. This variable evaluated how well the person has communicated his meaning in the sentence. There were 3 levels of communication including: clear communication of meaning in all parts of the sentence (a score of 3), clear communication in most of the sentence (scored 2 points), very ambiguous meaning in the sense that the sentence as written could mean any number of things (scored 1 point), and the sentence which does not express any meaning (scored 0). The reliability of this communication variable scoring was .975, for 2 scorers working independently on a random sample of 624 sentences.

Target Word Attribute. Since each subject was asked to write a sentence about a particular word, it was thought that the more knowledgeable or sophisticated sentence would include or refer to some attribute or characteristic of this target word. The more distinctive the attribute was, presumably the more sophisticated the language level. Sentences were scored for: a distinctive characteristic for the target word (most knowledgeable), a relevant characteristic (next to distinctive

in value), a general attribute, and no attribute included. Two scorers working independently on a random selection of sentences showed a correlation of .95.

Grammatical Scoring. Taylor (1969) devised a system of scoring for grammatical errors, based in part upon Chomsky's system (1965) which she applied to paragraphs written by both deaf and hearing children and adolescents. The 5 error categories explicitly mentioned by Chomsky were expanded into 8 categories, which were used in this phase of the study and are described as follows:

(1) Major categorial errors involved unacceptable functional shift, that is, the writer used one part of speech to perform the function of another, e.g. "The ant said a happy." (Maj) Here the writer used an adjective, happy, in a context where the rules of English require a nominal.

(2) Minor categorial errors were errors involving misuse or omission of determiners and auxiliary verbs, e.g. "They fell into river." (Min) A determiner has been omitted before the noun river; and "A man going to shoot the dove." (Min) The auxiliary is has been omitted before going.

(3) Strict subcategorial errors involved either the generating of a category within a categorial framework where it could not grammatically occur, e.g. "The man looks the dove." (Scat) The writer mistakenly combined an intransitive verb and a direct object, or the omission of a category in a context that requires it, e.g. "He carried back home." (Scat) The direct object required by carried has been omitted.

(4) Transformational errors referred in this study to errors in embedding one sentence into another, that is, failure to produce a grammatical surface form as the result of an embedding, e.g. "The hunter points the gun at the dove which the dove is asleep." (Trans) Here the writer failed to delete the dove from the surface of the relative clause.

(5) Selectional errors were defined as the co-occurrence within a construction of two items whose syntactic feature specifications are not compatible even though the categories of the two items could occur grammatically in that environment, e.g. "The ant surprised the pond." (Sel) Here the verb surprise requires an object with the feature (+Animate).

(6) Morphological errors were errors in the morphographemic shape of inflected forms, e.g. "A dove ranned away." (Mor) Here the writer produced the incorrect surface form of the past tense of to run.

(7) Order errors were errors in the ordering of elements which could not be analyzed in any of the preceding categories, e.g. "Ran the ant home." (Ord) Here the normal subject verb order has been reversed.

(8) Other errors was a catchall class encompassing all deviances not accounted for elsewhere. However, over 95% of these other errors involved the choice of a wrong word which could not be classified as a selectional error, e.g. "The man shot to the dove." (Other) Here, the writer used the preposition to instead of at, the preposition normally ocurring in this construction in English.

Since these 8 major classes of errors were not completely mutually exclusive, the following guidelines were established to preclude overlapping of categories:

(1) All errors involving verb inflections were analyzed as morphological except where the inflection was in error as the result of an embedding transformation's requiring a certain verbal ending. For example, in a sentence such as The dove heard the ant screamed for help, (Trans) the error in verb inflection was analyzed as transformational because the complement construction requires that the verb in the embedded sentence have either the infinitive or -ing ending. However, in a sentence such as The dove heard the ant who scream for help, (Mor) the error in verb inflection was analyzed as morphological since the relative transformation has no effect on verb endings in its domain.

(2) Whenever possible the verb inflection was made to agree in aspect with the auxiliary used by the student. That is, if the student wrote The ant was work hard (Mor) or The ant was worked hard, (Mor) the error was judged to be morphological, with the verb inflection omitted in the first instance and the wrong inflection used in the second. However, in some environments the aspect indicated by the auxiliary was so inappropriate to the context or to the events in the film that the deviance was analyzed as a minor categorial error in the choice of auxiliary, e.g. The apple was hit the man on the head. (Min)

(3) Whenever two verb phrases were immediately juxtaposed and the subject of the first could logically be the subject of the second, the construction was regarded as an example of a conjunction transformational error in which the conjunction had been omitted.

(4) In cases where a necessary genitive was omitted entirely, e.g. The dove carried a leaf in the bill, (Scat) the deviance was analyzed as a strict subcategorial error on the grounds that some necessary category, either an embedded S or a genitive NP, was not generated in the base. However, in instances where the necessary genitive was included, but included without obligatory pronominalization, e.g. The dove carried a leaf in the doves bill, (Trans) the deviance was analyzed as a transformational error, on the grounds that the proper categories had been generated in the base but that transformations necessary to produce a correct surface form had not been performed.

In scoring we used proportions, that is, the number of errors made in each category divided by the number of words used by each subject in his 32 sentences. Otherwise, the subject who wrote more words in each sentence and risked the possibility of making more errors, would have been penalized. Consequently, proportion scores were calculated for each category for each subject in the 5 groups.

RESULTS

Overlap. The analyses of variance for the total overlap (Table 75), and for overlapping content (Table 76) and function words (Table 77) all showed greater overlap in the sentences written for the related pairs than for the unrelated pairs. Among the 5 subject groups, there were significant differences in respect to total overlapping words with the Hearing-Achievement group having a significantly greater total overlap than the other 4 groups (Table 75). The fact that the Hearing-Age group showed almost the smallest total overlap and the Hearing-Achievement the greatest, suggests that total overlap indicates less mature written verbal behavior. When the words in each sentence were examined for overlap in function and content words, it was found that there were significant variations in each case. Duncan Range analyses (Table 76) showed that for the function overlap, the Hearing-Achievement was significantly greater than the Oral and Hearing-Age groups, and the Oral group was significantly smaller than the Rochester, Combined and Hearing-Achievement groups. The Rochester, Combined and Hearing-Achievement groups were not significantly different on function overlap from each other (Table 76). The Hearing-Achievement group also showed significantly greater content overlap than the other 4 groups (Table 77). The other 4 groups were not significantly different from each other (Table 77).

Clarity of Communication. There were 2 methods of evaluating how clearly the subject groups communicated in the sentences they constructed using the nouns of each pair. The first involved the number of sentences which were totally clear. Statistical calculations showed that there was a significant finding on this dependent variable with the Combined deaf writing a significantly smaller number of completely clear sentences than the other 4 groups (Table 78). The Oral and Rochester groups were not different, but the Hearing-Achievement and Hearing-Age groups had significantly more clearly communicated sentences than the Rochester group; the Oral group was not significantly different than the Hearing-Achievement although, like the other 4 groups, wrote significantly fewer clear sentences than the Hearing-Age group. The second evaluation for the degree of clarity of communication showed a significant finding in the analysis of variance (Table 79). Further analyses by the Duncan Range procedure (Table 79) indicated that the Combined deaf group was significantly less clear than the Oral deaf and the Hearing-Age, but more clear than the Hearing-Achievement. The Rochester and Oral deaf were not significantly different although significantly inferior to the Hearing-Age. The Hearing-Achievement had significantly lower communication scores than the other 4 groups.

Number of Words. The results of these analyses show that the Hearing-Age group wrote significantly more words than the other 4 groups while the Oral deaf group wrote significantly more words than the Combined and Rochester deaf and the Hearing-Achievement groups (Table 80). The Hearing-Achievement group wrote significantly fewer total words than the other 4 groups. The Combined and the Rochester deaf were not significantly different. In addition, the average number of content words per sentence written by the Hearing-Age was significantly greater than the other 4 groups; and the Oral deaf was significantly greater than the Combined and Rochester deaf and the Hearing-Achievement (Table 81). The Rochester and Combined deaf were not significantly different; the Hearing-Achievement wrote significantly fewer content words than the other 4 groups. On the average number of function words per sentence, the Hearing-Age had significantly more than the other 4 groups and the Hearing-Achievement wrote significantly fewer function words than the other 4 groups (Table 82). The Oral had significantly more function words than the Combined deaf but was not significantly different than Rochester deaf on this variable (Table 82).

Sentence Complexity. The Hearing-Age group wrote significantly fewer simple sentences than the other 4 groups and the Oral deaf wrote significantly fewer simple sentences than the Hearing-Achievement; the Rochester, Combined and the Hearing-Achievement were not significantly different (Table 83). When the complex, compound, and complex-compound sentences were totaled, the Hearing-Age group wrote significantly more of them than the other 4 groups, and the Hearing-Achievement wrote significantly fewer than the other 4 groups (Table 84). In addition, the Oral deaf wrote more of these complex, compound and compound-complex sentences than the Combined and Rochester (Table 84).

In view of the suggestion made by Lawton (1968) that passive sentences were a sign of linguistic maturity, we counted the number of passive sentences written by our 5 subject groups. The analysis of variance procedure indicated that the Hearing-Age group wrote significantly more passive sentences than the other 4 groups, and that the Combined deaf wrote significantly more passive sentences than the Hearing-Achievement (Table 85). The 3 deaf groups did not write significantly different numbers of passive sentences (Table 85). When the number of sentences containing 5 words or less were counted for each subject (stereotyped sentences), it was ascertained that the Hearing-Achievement wrote significantly more of them than the other 4 groups (Table 86). In addition, the Hearing-Age wrote significantly fewer stereotyped sentences than the Combined, Rochester, and Hearing-Achievement but not the Oral. The Oral wrote fewer stereotyped sentences than the Combined and Rochester deaf.

Grammatical Scoring

Major Categorial Errors. Inasmuch as there were very few Major Categorial errors made by any group, this category was not evaluated by statistical procedures. Apparently, few subjects in any group made unacceptable functional shifts, that used one part of speech to perform the function of another.

Minor Categorial Errors. When Minor Categorial errors (misuse or omission of determiners and auxiliary verbs) were evaluated, there was a significant finding (Table 87). Further analyses showed that the Hearing-Age and Hearing-Achievement groups made significantly fewer Minor Categorial errors than the 3 deaf groups. However, the Oral deaf group demonstrated a significantly smaller proportion of Minor Categorial errors than the Combined and the Rochester deaf, who were not different from each other.

Strict Subcategorial Errors. There was a significant finding when the proportion of errors made in the Strict Subcategorial category were evaluated (Table 88). This error category refers to generating an ungrammatical category (e.g. where an intransitive verb has a direct object) or the omission of a required grammatical category (e.g. where an omission of a direct object has occurred). The Hearing-Age and Hearing-Achievement groups made significantly fewer errors than the 3 deaf groups; the Oral deaf group made significantly fewer errors than the Combined and Rochester deaf groups who were not significantly different (Table 88).

Transformational Errors. (Failure to produce a surface grammatical form as a result of an embedding). The Hearing-Age and Hearing-Achievement groups made significantly fewer Transformational errors than the 3 deaf groups (Table 89). In this error type, the Rochester group made significantly fewer errors than the Combined but the Rochester subjects were not significantly different than the Oral deaf group (Table 89).

Morphological Errors. (Errors in the inflected form for verbs). The Hearing-Age and the Hearing-Achievement groups made significantly fewer Morphological errors than the 3 deaf groups (Table 90). But once again, the Oral deaf group made significantly fewer errors than the Rochester and the Combined deaf groups (Table 90).

Total of all Grammatical Errors. When all the error proportions were totaled over all categories to obtain the grand error sum, it was found that the Hearing-Age and the Hearing-Achievement groups made significantly fewer errors than the 3 deaf groups (Table 91). The Oral deaf group had a significantly smaller total proportion of errors than the other 2 deaf groups (Table 91).

DISCUSSION

Our results, which showed greater overlap in sentences written about related nouns than about unrelated nouns, confirmed the finding of Rubenstein and Goodenough (1965) of a positive relationship between the degree of synonymy of noun pairs and the similarity of their contexts. Obviously, 2 related nouns draw from more similar verbal structures than 2 unrelated nouns. There is a correlated finding that less overlap appears to be associated with greater verbal sophistication. The Hearing-Age group was consistently the lowest in overlap in all 3 measured variables including function, content and total words. Since the Oral group had significantly less function word overlap

than the other 2 deaf groups, the Oral group seems more verbally mature than the other deaf groups, to the extent that lower overlap is related to verbal maturity.

The Hearing-Age group also had a significantly greater total number of words, suggesting that total number of words is related to verbal maturity. And the Oral deaf wrote significantly more words than the other deaf groups, suggesting once again that the oral method of instruction leads to greater verbal sophistication than the other 2 methods. It is likely that the number of stereotyped sentences, of which the Oral deaf wrote significantly fewer than the other deaf, is highly related to the total number of words since stereotyped sentences were those with 5 or fewer words.

The analysis of the grammatical errors (overall) showed that the 2 hearing groups were far superior in being more nearly error free. The deaf groups made significantly and substantially more errors than the hearing groups. However, the Oral deaf group was significantly superior to the other deaf groups in writing sentences that were more grammatically correct. Again, the oral method must be considered as contributing to better knowledge of grammatical language than the other methods of instruction used with the deaf.

DISCUSSION OF DIFFERENCES IN THE PERFORMANCE OF DEAF GROUPS

The results of the tests given in this research revealed certain general differences in the performance of the 3 deaf groups trained by different methods--the Oral group (pure oral-- speech + lipreading), the Rochester group (speech + lipreading + fingerspelling) and the Combined group (speech + lipreading + signing + fingerspelling). Although we will discuss certain tentative conclusions and overall trends based on these results, it must be remembered throughout that further investigation and supportive evidence are absolutely essential to confirm these implications. As might be expected, no one deaf group was better at everything, but rather, each group showed certain strengths and weaknesses.

The Rochester deaf group gave written primary word associations more like the 2 hearing groups than the Oral or Combined group. This is important in thought processes because associations provide links to other chains of thought, and if these links are different, then deaf people might move in different, more idiosyncratic directions in their thinking. The 3 deaf groups, however, were similar in the number of their idiosyncratic word associations. In terms of communication, of course, shared vocabulary and shared associations mean a mutual understanding of the meaning of a word and of closely related (associated) attributes, functions, ideas, etc. Since this test considered only primary associations, it would be interesting to know how much commonality exists in additional associations beyond the initial one.

On several of the different tests, especially Word Comprehension and Contextual Cues, the Rochester and Combined groups seemed more prone to select association answers than the hearing or Oral subjects, even when meaning was appropriate. However, the Combined subjects chose fewer association answers than Rochester on the Contextual Cues test. Even though they had indicated on the meaning part of the Word Comprehension test that they knew the weak meaning, all the hearing and deaf groups chose the strong association more often when the weak meaning was appropriate, than when the strong meaning was appropriate. This suggests that a highly popular association to the strong meaning seems more relevant than a weak meaning and its context.

The Oral and both hearing groups seemed more concerned with meanings and more knowledgeable about them, and favored associations less. On the Word Comprehension and Contextual Cues tests they knew more meanings of these multi-meaning words than the Rochester and Combined groups, and on the Noun Pairs test, the Oral subjects were more like the hearing in often completing sentences with a meaningful word when they could not recall the correct word. In the Sentence Memory test the Oral group was not significantly different from the verbally advanced group, the Hearing-Age group, in recalling the meaning of the verb phrases which were a major component of the sentences. The Hearing-Achievement, Rochester and Combined groups recalled significantly fewer verb phrases than the Hearing-Age.

One must always consider the possibility that some deaf subjects may not have a precise idea of the meaning of meaning, so that they include in the meaning of a word other highly related aspects, attributes, ideas, etc. (in the form of associations). However, as indicated, the Oral deaf and especially the hearing, seemed more meaning-oriented than Rochester and Combined on several tests. Knowledge of the meanings of a word and control of associations involve precision of verbal thought that seems necessary in adequate language development.

Syntax plays a critical part in adequate language development and the indications are that the Oral group may use syntax more than Rochester and Combined to correctly interpret meanings of multi-meaning words (Contextual Cues). Since English contains so many multi-meaning words, this is extremely important. Furthermore, the Oral subjects seem to use syntax more successfully as an aid in recall than the Rochester and Combined groups (Sentence Memory); syntax provides an effective way to organize words for recall as well as for communication.

Again, in language production the Oral group used better syntax in producing longer, more complicated, clearer sentences than the Rochester and Combined groups. In addition, though all 3 deaf groups made considerably more grammatical errors than both hearing groups, the Oral group was considerably better than Rochester and very much better than the Combined group. Rochester was considerably better than the Combined group. The Combined group, however, wrote more passive sentences than the Oral or Rochester groups, and passive sentences are thought to be an indication of language sophistication.

The production of language is an advanced skill; comprehension must precede it. Correct productive language requires a thorough grasp and control of language meaning and language structure. The fact that on several tests the Oral subjects not only demonstrated greater knowledge of meaning and syntax in recall and in language comprehension, but also in written language production, seems to indicate and corroborate, that the Oral group is generally more advanced in language development than the Rochester and Combined groups.

IMPLICATIONS

These results suggest that the fingerspelling method, or some teaching emphasis (since it was possible to use only the Rochester school in the testing) provides the Rochester students with significantly more primary word associations to multi-meaning words shared with a sophisticated hearing group than the Oral or Combined groups. It may be that the fingerspelling method affects verbal responses because it calls attention to each individual word in spelling each one out. It is also probably due, in part, to a preference for association rather than meaning (also indicated by Combined subjects, but not manifested by the Oral group) which could reflect a teaching attitude or emphasis more prevalent at the participating Rochester and Combined schools.

Test results indicated that subjects trained by the pure Oral method seemed more advanced in their knowledge of word meaning, in their control of associations, and also in their superior use of syntax as an aid to memory and in the interpretation and production of language. This generally higher level of language development may be aided by the undistracted attention to the whole English word and to connected English language involved in the Oral approach. There is no fingerspelling breaking down words into letters, no signing in a different language (American Sign Language is different from English) to distract from the concentration on English. Complete attention can be given to lipreading, which depends on context and on the relationships of words. The fact that the Oral group was considerably better than the Rochester and Combined groups in grammatical errors could reflect a generally greater awareness and control of English, and possibly a greater teaching emphasis on determiner use and inflected endings.

The fact that the Rochester group, though considerably less good than the Oral group, made considerably fewer grammatical errors than the Combined group may be due, in part, to the fact that fingerspelling spells out all words, including all determiners and all inflected endings, whereas the American Sign Language does not.

The Combined subjects' use of more passive sentences is a sign of greater language sophistication. This skill with passive sentences may reflect a teaching emphasis, but that is only conjecture.

In spite of these particular differences there are many ways in which deaf adolescents trained by the Oral, Rochester, and Combined methods are similar. There are certain aspects of the language development of the deaf students in all 3 groups which are greatly in need of improvement.

Deaf students need more emphasis and effective instruction in the correct use of function words (articles, prepositions, conjunctions, pronouns) as opposed to content, or key words which carry the general meaning of a phrase or sentence (nouns, verbs, adjectives, adverbs). For the most part function words define the relationships between words, especially between content words. Many of the grammatical errors of the deaf subjects consisted of the omission or misuse of function words.

Deaf students also need to learn to use the correct verb forms and word endings as indicated by many grammatical errors in inflected endings. Errors of agreement in subject and verb were especially common. Although errors of this kind and function word errors do not always interfere with the fundamental meaning of a sentence, their incorrect use can be awkward, confusing, and even misleading, especially where details and subtleties of meaning are involved.

Furthermore, deaf students need more knowledge and practice in using the weak meaning of words and the likely contexts (both in terms of meaning and syntax) for these other meanings. And they would benefit from practice in sequential memory, which is essential

in remembering letters in words, and words in phrases and sentences. They would also benefit from practice in incidental memory for words, phrases and sentences, since this is the kind of memory that assists the hearing person in learning language outside the classroom, where a great part of language learning takes place.

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TABLES

TABLE 1

248 Stimulus Words Used in Phase I - Word Association Test

ACT	ADDRESS	ADMIT	AGE	ANGLE
ARM	AROUND	BACK	BALL	BAND
BANK	BARK	BARREL	BASE	BAT
BATTER	BEAM	BEAR	BEAT	BED
BILL	BIT	BLOCK	BLOW	BOARD
BOIL	BOLT	BOND	BOOM	BORE
BOW	BOWL	BOX	BRIDGE	BRIGHT
CABLE	CALF	CAN	CAP	CARE
CASE	CELL	CHANGE	CHARGE	CHARM
CHECK	CLOSE	CLUB	COAST	COLD
COMPANY	CONTRACT	CORN	COUNT	COUNTRY
COURSE	COURT	COVER	CRACK	CROSS
CRY	CURB	CURE	CURRENT	DATE
DEAL	DECK	DEED	DEGREE	DIAMONDS
DIE	DIGIT	DOWN	DRAW	DRESS
DRIVE	DROP	DUCK	EXPRESS	FAINT
FAIR	FALL	FAN	FAST	FAT
FELT	FIGURE	FILE	FINE	FIRE
FIRM	FIT	FLY	FOOT	FORM
FRESH	FUNCTION	GAME	GAS	GRAIN
GRAVE	GROOM	GROUND	HAIL	HAND
HANDLE	HEAD	HEDGE	HIDE	HORN
HOUSE	INTEREST	IRON	JAR	JERK
JUST	KID	KIND	LAND	LAP
LAST	LEAD	LEAF	LEAN	LEFT
LET	LIE	LIGHT	LIKE	LINE
LIVE	LOCK	LOG	LONG	LOT
MAIL	MAJOR	MATCH	MEAN	MIGHT
MIND	MINE	MISS	MOLE	NAIL
NAP	NOTE	NOVEL	ORGAN	PACK
PAGE	PALM	PARK	PART	PARTY
PASS	PATIENT	PEN	PICK	PIPE
PIT	PLANT	PLATE	PLAY	POINT
POLE	POUND	PRESENT	PUMP	QUACK
QUARTER	RACE	RACKET	RANGE	RARE
RASH	RESERVATION	REST	RIGHT	RING
ROCK	ROLL	ROSE	ROW	RULER
RUN	SAFE	SAW	SCORE	SEAL
SEASON	SECOND	SET	SHADE	SHED
SHIP	SHOP	SHOW	SIGN	SINK
SKIRT	SLIP	SMART	SOIL	SPOKE
SPOT	SPREAD	SPRING	STAGE	STAIN
STAKE	STALL	STAMP	STAR	START
STATE	STICK	STOCK	STORE	STRIP
STUMP	SUIT	SWING	TABLE	TABLET
TAN	TAX	TIE	TIP	TIRE
TISSUE	TOAST	TOP	TRACK	TRAIN
TREAT	TRIP	TRUNK	TRY	TYPE
WAKE	WATCH	WAVE	WELL	WILL
WIRE	WRENCH	YARD		

TABLE 2

WORD ASSOCIATION SUBJECTS - PHASE I

Means and SDs of Control Measures for the 20 Ss With 10 or Fewer Omissions or Unscorable Responses

		Deaf Groups			Hearing Groups	
		Oral	Combined	Rochester	Achievement	Age
Age	Mean	172.5[a]	177.55	170.05	119.6	173.35
	SD	22.44	25.29	24.11	13.75	23.10
Language Achievement	Mean	4.58[b]	4.50	4.63	4.60	--
	SD	.89	1.06	1.26	.82	--
Socio-Economic	Mean	4.10[c]	3.75	3.90	4.05	4.05
	SD	1.84	1.95	1.34	1.66	1.66

a In Months

b Grade Level

c Hollingshead Index

TABLE 3

WORD ASSOCIATION - PHASE I

Means and SDs for Number of Unscorable Responses. N = 20

	Deaf Groups			Hearing Groups	
	Oral	Combined	Rochester	Achievement	Age
Mean	2.05	2.60	1.65	1.70	0.45
SD	2.66	2.90	1.90	1.95	0.81

TABLE 4

WORD ASSOCIATION - PHASE I

Analysis of Variance - Commonality
(N = 20)

SV	df	ss	ms	F
Total	299	29944.11		
Between Ss	99	22005.63		
Group	4	12812.65	3203.16	33.10*
S/G	95	9192.98	96.77	
Within Ss	200	7939.48		
WF	2	1003.58	501.79	21.88*
G x WF	8	2578.30	322.29	14.05*
SWF/G	190	4357.60	22.93	

* Significant at .001 level.

Duncan Range Test - Total Commonality Score

		Comb	Roch	Oral	H.Ach	H.Age	Shortest Significant Ranges
	Means	20.36	21.67	21.81	27.42	34.96	
Comb	20.36		1.31	1.45	<u>7.06</u>	<u>14.60</u>	R2 = 6.20
Roch	21.67			.14	5.75	<u>13.29</u>	R3 = 6.53
Oral	21.81				5.61	<u>13.15</u>	R4 = 6.72
H.Ach	27.42					<u>7.54</u>	R5 = 6.88

Underlined figures indicate significant differences between the respective groups.

TABLE 5

WORD ASSOCIATION - PHASE I

Means and SDs of Commonality Scores for AA, A, and Lower Frequency Words and for Overall Totals. N = 20

		Commonality According to Thorndike-Lorge Frequency			Total Commonality Score
		AA	A	Lower	
Oral	Mean	22.15[a]	21.51[b]	21.17[c]	21.81[d]
	SD	4.81	7.07	10.32	5.28
Combined	Mean	20.36	19.47	21.41	20.36
	SD	4.75	3.90	7.42	4.40
Rochester	Mean	22.48	21.70	19.34	21.67
	SD	3.69	4.94	7.20	3.74
Hearing Achievement	Mean	25.86	25.91	33.67	27.42
	SD	4.70	5.50	8.76	5.09
Hearing Age	Mean	30.75	35.45	46.50	34.96
	SD	6.24	6.89	9.96	6.14
All 5 groups	Mean	24.32	24.81	28.42	25.24

a Mean for 141 stimuli.
b Mean for 58 stimuli.
c Mean for 49 stimuli.
d Mean for 248 stimuli.

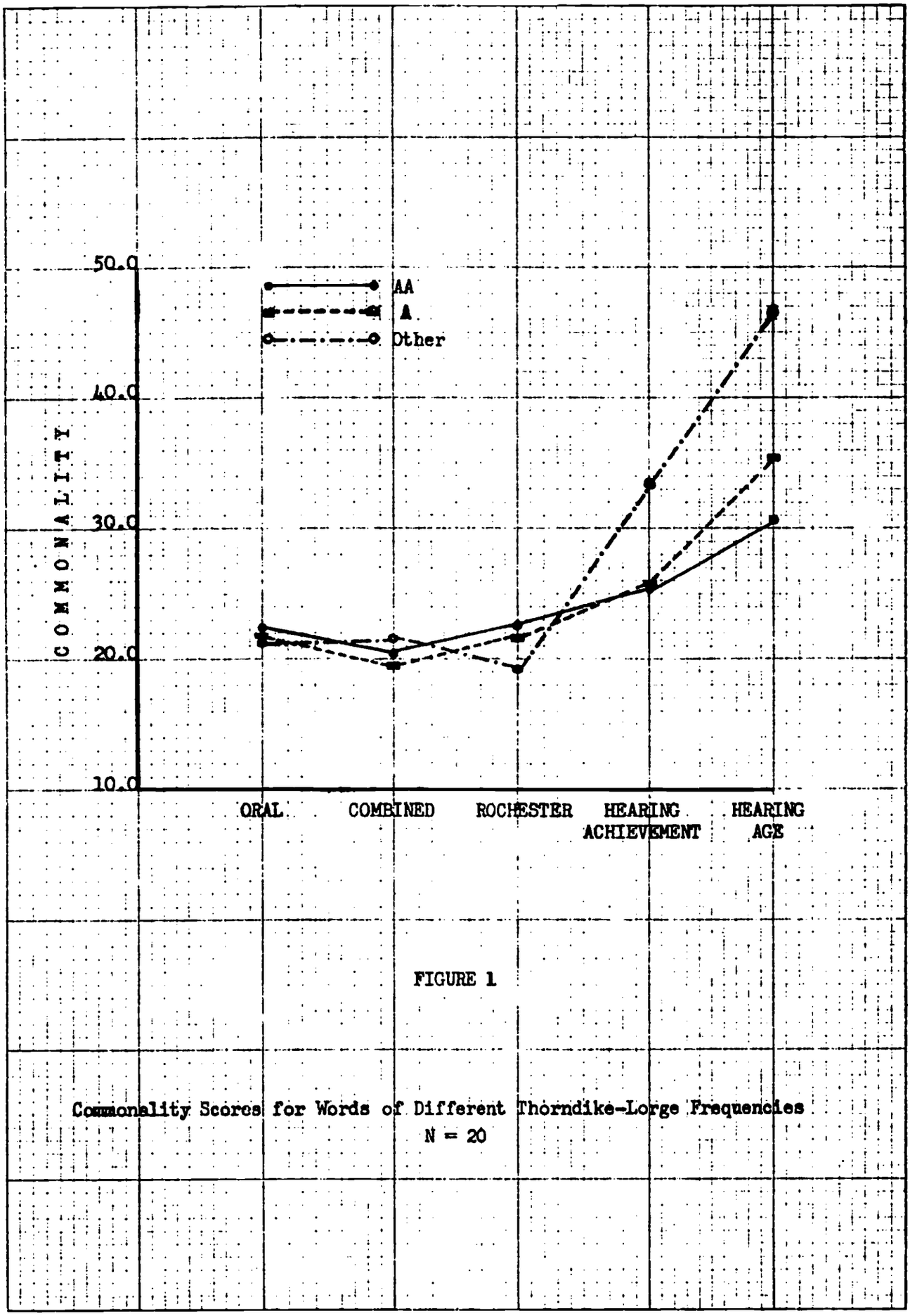

FIGURE 1

Commonality Scores for Words of Different Thorndike-Lorge Frequencies
N = 20

TABLE 6

WORD ASSOCIATION - PHASE I

Analysis of Variance - Idiosyncrasy (Proportions)
(N = 20)

SV	df	ss	ms	F
Total	299	8.97		
Between Ss	99	7.00		
Groups	4	3.60	.898	25.00*
S/G	95	3.41	.036	
Within S	200	1.96		
WF	2	.84	.42	105.0*
G x WF	8	.40	.05	13.0*
SWF/G	190	.72	.004	

* Significant at .001 level.

Duncan Range Test - Total Idiosyncrasy Score

		H.Age	H.Ach	Comb	Roch	Oral	Shortest Significant Ranges
	Means	43.85	69.95	97.30	101.00	105.60	
H.Age	43.85		26.10	53.45	57.15	61.75	R2 = 15.57
H.Ach	69.95			27.35	31.05	35.65	R3 = 16.39
Comb	97.30				3.70	8.30	R4 = 16.89
Roch	101.00					4.60	R5 = 17.27

Underlined figures indicate significant differences between the respective groups.

TABLE 7

WORD ASSOCIATION - PHASE I

Means and SDs of Idiosyncratic Responses for AA, A, and Lower T-L Frequency Words and for Overall Totals. N = 20

		Idiosyncracy According to Thorndike-Lorge Frequency			Total Idiosyncracy Score
		AA	A	Other	
Oral	Mean	.37[a]	.44[b]	.56[c]	105.60[d]
	SD	.11	.17	.16	30.40
Combined	Mean	.35	.39	.52	97.30
	SD	.09	.11	.14	23.06
Rochester	Mean	.36	.40	.56	101.00
	SD	.08	.11	.16	23.91
Hearing Achievement	Mean	.27	.28	.34	69.95
	SD	.09	.10	.11	20.08
Hearing Age	Mean	.19	.15	.17	43.85
	SD	.08	.10	.13	21.97

a Proportion for 141 stimuli.
b Proportion for 58 stimuli.
c Proportion for 49 stimuli.
d Mean of raw total for 248 stimuli.

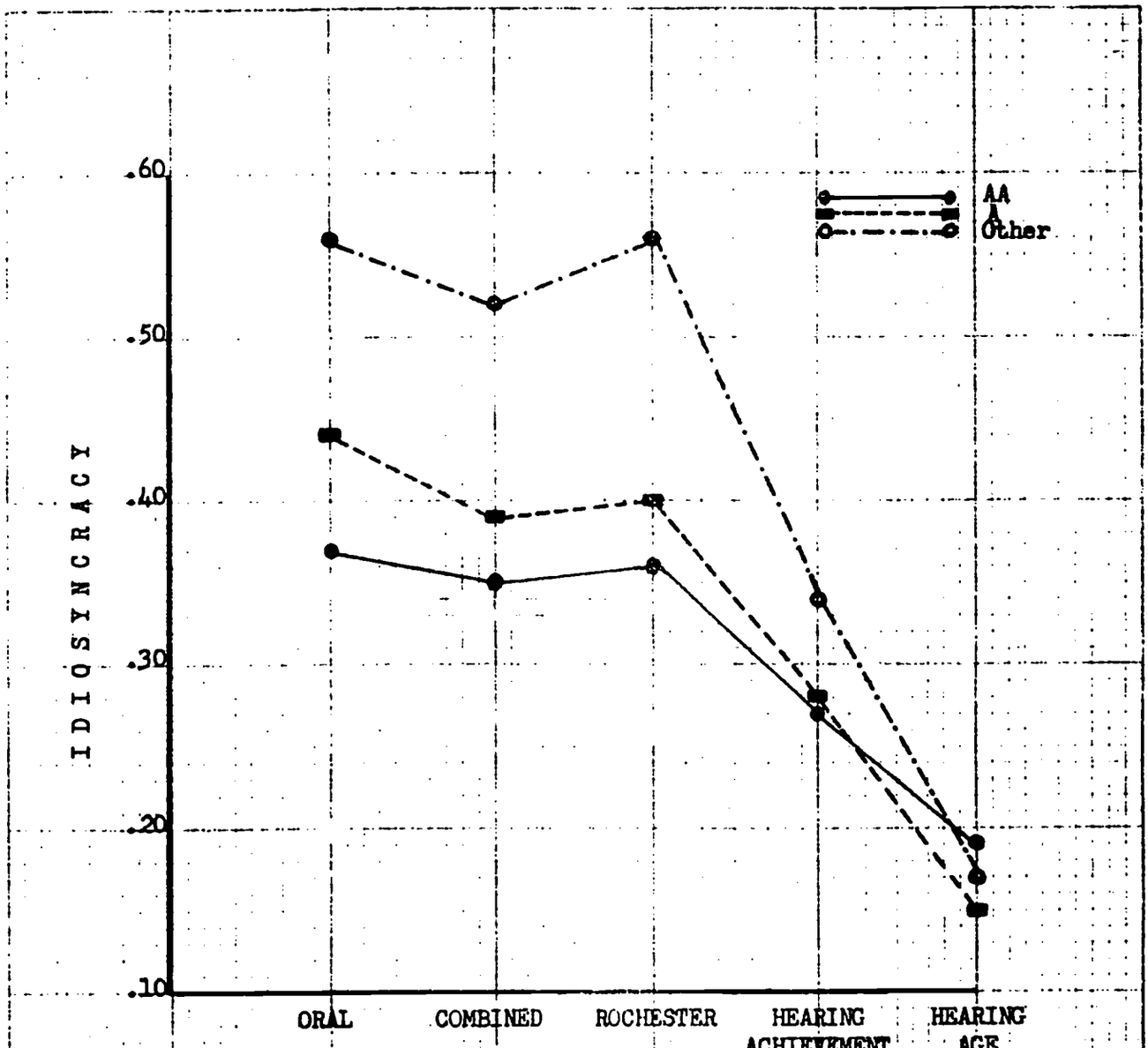

FIGURE 2

Idiosyncratic Scores (Proportions) for Words of Different Thorndike-Lorge Frequencies

N = 20

TABLE 8

WORD ASSOCIATION SUBJECTS - PHASE II

Age, Written Language Achievement and Socioeconomic Status

Group (N = 50)	Age	Stanford[a] Reading Achievement	SES[b]
Oral			
$\bar{X}$	13 - 9	4.2	3.9
SD	23 mo.	.9	1.7
Combined			
$\bar{X}$	14 - 6	4.3	4.2
SD	28 mo.	1.1	1.5
Rochester			
$\bar{X}$	14 - 6	4.3	4.4
SD	22 mo.	1.0	1.3
Hear. Achievement			
$\bar{X}$	9 - 8	4.3	4.1
SD	14 mo.	1.0	1.6
Hear. Age			
$\bar{X}$	13 - 9	--	4.5
SD	23 mo.		1.4

[a] In Grade Level.

[b] Hollingshead Index.

TABLE 9

WORD ASSOCIATION - PHASE II

Stimulus Words and Scoring Categories

	Subordinate	Superordinate	Whole	Part	Contrast
BALL		X			
CALF		X			
CAP (50)					
CORN		X			
CRY (50)					
DOWN					X
DRESS (50)	X	X			
DUCK		X			
CLOSE					X
COLD					X
FAST					X
FLY (50)		X			
FOOT			X	X	
GAME	X				
HAND			X	X	
HEAD			X	X	
HOUSE		X			
IRON		X			
LAST					X
LEAF			X		
MAIL (50)					
PAGE			X		
PLANT	X			X	
RIGHT					X
ROSE		X		X	
SAW		X		X	
SEASON	X				
SECOND			X		
SHOP	X				
TABLE		X		X	
TIRE			X		
TOP		X			X
WATCH (50)					

All 33 words were scored for Commonality and Idiosyncrasy.
Four words (cap, cry, mail, watch) did not elicit the above scoring categories.

TABLE 10

WORD ASSOCIATION - PHASE II: COMMONALITY

(N = 50)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	41.36	38.74	46.04	45.32	50.46
SD	11.96	13.09	9.92	11.27	10.55

Analysis of Variance

	df	ss	ms	F
Between	4	4076.78	1019.19	7.82*
Within	245	31934.36	130.34	
Total	249	36011.14		

* Significant at .01 level.

Duncan Range Test

	Means	Comb 38.74	Oral 41.36	H.Ach 45.32	Roch 46.02	H.Age 50.46	Shortest Significant Ranges
Comb	38.74		2.62	<u>6.58</u>	<u>7.28</u>	<u>11.72</u>	R2 = 4.48
Oral	41.36			3.96	4.66	<u>9.10</u>	R3 = 4.72
H.Ach	45.32				.70	<u>5.14</u>	R4 = 4.88
Roch	46.02					4.42	R5 = 4.99

Underlined figures indicate significant differences between the respective groups.

TABLE 11

WORD ASSOCIATION - PHASE II: IDIOSYNCRASY

(N = 50)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	6.62	7.40	6.60	5.72	3.90
SD	3.26	4.17	2.51	3.13	2.82

Analysis of Variance

	df	ss	ms	F
Between	4	359.06	89.77	8.62*
Within	245	2552.36	10.42	
Total	249	2911.42		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 3.90	H.Ach 5.72	Roch 6.60	Oral 6.62	Comb 7.40	Shortest Significant Ranges
H.Age	3.90		1.82	2.70	2.72	3.50	R2 = 1.260
H.Ach	5.72			.88	.90	1.68	R3 = 1.327
Roch	6.60				.02	.80	R4 = 1.372
Oral	6.62					.78	R5 = 1.404

Underlined figures indicate significant differences between the respective groups.

TABLE 12

WORD ASSOCIATION - PHASE II: SUPERORDINATE RESPONSES

(N = 50)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	3.08	2.88	3.66	1.82	1.58
SD	1.54	1.88	1.66	1.29	1.55

Analysis of Variance

	df	ss	ms	F
Between	4	154.06	38.51	15.16*
Within	245	623.74	2.54	
Total	249	777.80		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 1.58	H.Ach 1.82	Comb 2.88	Oral 3.08	Roch 3.66	Shortest Significant Ranges
H.Age	1.58		.24	1.30	1.50	2.08	R2 = .616
H.Ach	1.82			1.06	1.26	1.84	R3 = .649
Comb	2.88				.20	.78	R4 = .671
Oral	3.08					.58	R5 = .686

Underlined figures indicate significant differences between the respective groups.

TABLE 13

WORD ASSOCIATION - PHASE II: SUBORDINATE RESPONSES

(N = 50)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	1.34	1.22	1.50	1.14	1.74
SD	.98	.89	.99	.91	1.01

Analysis of Variance

	df	ss	ms	F
Between	4	11.42	2.86	3.12*
Within	245	223.94	0.91	
Total	249	235.36		

* Significant at .05 level.

Duncan Range Test

	Means	H.Ach 1.14	Comb 1.22	Oral 1.34	Roch 1.50	H.Age 1.74	Shortest Significant Ranges
H.Ach	1.14		.08	.20	<u>.36</u>	<u>.60</u>	R2 = .364
Comb	1.22			.12	.28	<u>.52</u>	R3 = .384
Oral	1.34				.16	<u>.40</u>	R4 = .397
Roch	1.50					.24	R5 = .406

Underlined figures indicate significant differences between the respective groups.

TABLE 14

WORD ASSOCIATION - PHASE II: CONTRAST RESPONSES

(N = 50)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	3.50	2.94	3.92	3.54	4.48
SD	2.24	2.40	2.02	2.01	1.64

Analysis of Variance

	df	ss	ms	F
Between	4	64.86	16.21	3.84*
Within	245	1035.90	4.22	
Total	249	1100.76		

* Significant at .01 level.

Duncan Range Test

	Means	Comb 2.94	Oral 3.50	H.Ach 3.54	Roch 3.92	H.Age 4.48	Shortest Significant Ranges
Comb	2.94		.56	.60	.98	1.54	R2 = .812
Oral	3.50			.04	.42	.98	R3 = .856
H.Ach	3.54				.38	.94	R4 = .885
Roch	3.92					.56	R5 = .905

Underlined figures indicate significant differences between the respective groups.

TABLE 15

RECALL AND RECOGNITION MEMORY STUDY

Means and SDs of Matching Variables For All Experimental Groups.
For Males N = 15; For Females N = 14.

Experimental Groups		Reading Achievement Grade Level			Age in Months			I.Q.			Socio-Economic Level		
		Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total
Oral Deaf	Mean	4.31	4.48	4.39	174.67	164.79	169.90	107.28	111.77	109.44	3.53	3.43	3.48
	SD	0.47	0.72	0.61	25.83	17.47	22.74	13.14	11.82	12.72	1.54	1.55	1.55
Combined Deaf	Mean	4.21	4.51	4.35	174.20	166.43	170.45	110.00	112.25	111.08	4.47	4.86	4.66
	SD	0.44	0.61	0.55	25.63	15.39	21.66	14.22	9.44	12.27	1.78	1.12	1.51
Rochester Deaf	Mean	4.36	4.62	4.49	177.93	166.93	172.62	110.00	106.64	108.38	4.13	4.00	4.07
	SD	0.50	0.73	0.63	20.79	15.75	19.33	10.39	12.81	11.74	1.15	1.73	1.46
Hearing-Achievement	Mean	4.37	4.55	4.46	108.93	109.43	109.17	105.54	110.50	108.11	4.13	3.29	3.72
	SD	0.68	0.57	0.64	8.89	6.41	7.80	8.79	8.13	8.81	1.50	1.10	1.39
Hearing-Age	Mean	—	—	—	177.20	166.07	171.83	111.00	112.64	111.79	3.47	4.14	3.79
	SD	—	—	—	23.67	15.67	20.96	8.79	6.37	7.75	1.45	1.12	1.35

TABLE 16

RECALL AND RECOGNITION MEMORY STUDY

Target Words, Primary and Secondary Associations and Association Frequency From Kates Norms

Target Word	Primary and Secondary	Association Frequency				
		ORAL	COMBINED	ROCHESTER	HEARING ACHIEVEMENT	HEARING AGE
BAND	music	.30	.32	.32	.18	.24
	drum	.10	.06	.08	.10	.06
CALF	cow	.68	.48	.78	.72	.80
	animal	.08	.12	.14	.06	.10
COLD	hot	.38	.28	.48	.52	.50
	freeze	.16	.14	.06	.14	.04
DRIVE	car	.54	.36	.60	.58	.60
	ride	.16	.12	.14	.06	.06
FAST	slow	.44	.42	.62	.44	.50
	quick	.10	.10	.06	.06	.16
PAGE	book	.46	.40	.44	.50	.50
	paper	.08	.20	.06	.12	.10
PEN	pencil	.38	.42	.52	.28	.38
	write	.22	.10	.14	.24	.08
PLANT	flower	.56	.48	.52	.42	.22
	grow	.04	.04	.08	.10	.08
PLATE	dish	.58	.40	.50	.30	.34
	food	.06	.10	.10	.18	.26
PRESENT	gift	.26	.34	.50	.34	.30
	birthday	.08	.04	.04	.12	.06
ROCK	stone	.64	.58	.74	.42	.34
	hard	.08	.08	.06	.14	.14
SHOP	store	.40	.48	.42	.48	.30
	work	.14	.06	.12	.06	.10
SUIT	clothes	.20	.34	.22	.22	.22
	coat	.10	.10	.10	.06	.10
TAX	money	.40	.44	.52	.38	.40
	pay	.10	.08	.10	.28	.08

TABLE 17

RECALL AND RECOGNITION MEMORY STUDY

Target Words, Primary and Secondary Associations and Association Frequency From Entwisle Norms

Target Word	Primary and Secondary	Association Frequency
ALWAYS	never	.27
	sometimes	.08
BEGIN	start	.50
	end	.06
BLACK	white	.45
	dark	.07
CARRY	hold	.22
	heavy	.06
CHAIR	table	.29
	desk	.13
CLEAN	dirty	.45
	wash	.06
JOIN	together	.26
	club	.06
LISTEN	hear	.47
	quiet	.05
MAN	woman	.51
	person	.06
NEEDLE	thread	.31
	sharp	.06
NET	fish	.30
	catch	.09
PREPARE	ready	.21
	fix	.11
SOUR	sweet	.35
	bitter	.04
TALL	short	.51
	high	.06

TABLE 18

RECALL AND RECOGNITION MEMORY STUDY

Means and SDs of Primary and Secondary Association Frequency (in Proportions) for all Target Words

	Kates Norms*					Entwisle
	Deaf Groups			Hearing Groups		5th Grade
	Oral	Combined	Rochester	Achievement	Age	Norms**
Primary						
Mean	.44	.41	.51	.41	.40	.36
SD	.14	.08	.14	.14	.16	.11
Secondary						
Mean	.11	.10	.09	.12	.10	.07
SD	.05	.04	.03	.07	.05	.02

* N = 50 for each group.

** N = 280

TABLE 19

RECALL AND RECOGNITION MEMORY STUDY

Target, Primary, Secondary, and Control Words

Target Word[a,b]	Primary[b]	Secondary[b]	Control[b]
	Kates Words		
BAND A[c]	music AA	drum 40	ticket A
CALF 14	cow A	animal AA	spring AA
COLD AA	hot AA	freeze 32	shake A
DRIVE AA	car AA	ride AA	hotel A
FAST AA	slow A	quick AA	busy AA
PAGE AA	book AA	paper AA	college AA
PEN A	pencil 40	write AA	eight AA
PLANT AA	flower AA	grow AA	hill AA
PLATE A	dish A	food AA	noon A
PRESENT AA	gift A	birthday 37	wish AA
ROCK AA	stone AA	hard AA	shell A
SHOP AA	store AA	work AA	sign AA
SUIT AA	clothes AA	coat AA	uncle AA
TAX A	money AA	pay AA	year AA
	Entwisle Words		
ALWAYS AA	never AA	sometimes AA	week AA
BEGIN AA	start AA	end AA	place AA
BLACK AA	white AA	dark AA	art AA
CARRY AA	hold AA	heavy AA	pack AA
CHAIR AA	table AA	desk A	window AA
CLEAN AA	dirty 31	wash AA	city AA
JOIN AA	together AA	club AA	class AA
LISTEN AA	hear AA	quiet A	brain A
MAN AA	woman AA	person AA	queen AA
NEEDLE 34	thread A	sharp A	hole AA
NET A	fish AA	catch AA	tent A
PREPARE AA	ready AA	fix A	above AA
SOUR 15	sweet AA	bitter A	coffee A
TALL AA	short AA	high AA	poor A

[a] Target Words only were used in the recall task.
[b] Each line in the recognition task was composed of the Target word, primary, secondary, and control words shown in each row.
[c] Thorndike-Lorge Frequency.

TABLE 20

RECALL AND RECOGNITION MEMORY STUDY

Number of Target Words Correctly Recalled

Means and Standard Deviations

		Deaf Groups			Hearing Groups	
		Oral	Combined	Rochester	Achievement	Age
Kates* Norms	Mean	2.38	2.07	2.14	2.03	2.69
	SD	1.29	1.34	1.22	1.25	1.53
Entwisle* Norms	Mean	2.69	2.21	2.97	2.86	3.48
	SD	1.32	1.54	1.38	1.46	1.94
Total**	Mean	5.07	4.28	5.10	4.90	6.17
	SD	2.10	2.26	2.02	1.90	2.51

* 14 Target Words
** 28 Target Words

Analysis of Variance

Source of Variance	df	Mean Square	F
Groups (G)	4	6.7845	2.79, $p<.05$
S/G	140	2.4328	
Norm (N)	1	24.3310	13.03, $p<.001$
G X N	4	1.5810	<1
SN/G	140	1.8667	

Newman-Keuls Test

		Comb 124.12	H.Ach 142.10	Oral 146.74	Roch 147.90	H.Age 179.22	
Comb	124.12		17.98	22.62	23.78	<u>55.10</u>	R2 = 32.90
H.Ach	142.10			4.64	5.80	37.12	R3 = 39.32
Oral	146.74				1.16	32.48	R4 = 43.12
Roch	147.90					31.32	R5 = 45.85

Underlined figures indicate significant differences between the respective groups.

TABLE 21

RECALL AND RECOGNITION MEMORY STUDY

Number of Recognition Errors

Means and Standard Deviations

		Deaf Groups			Hearing Groups	
		Oral	Combined	Rochester	Achievement	Age
Kates* Norms	Mean	6.38	6.66	7.69	6.24	6.24
	SD	2.47	2.54	2.82	1.99	2.82
Entwisle* Norms	Mean	5.76	6.62	6.34	6.21	5.55
	SD	1.74	2.14	2.78	2.76	2.71
Total**	Mean	12.14	13.28	14.03	12.45	11.79
	SD	3.36	4.09	4.87	4.16	4.90

* 14 Target Words
** 28 Target Words

Analysis of Variance

Source of Variance	df	Mean Square	F
Groups (G)	4	11.99	1.25, n.s.
S/G	140	9.63	
Norm (N)	1	21.52	6.40, $p<.025$
GN	4	4.31	1.28, n.s.
SN/G	140	3.36	

TABLE 22

RECALL AND RECOGNITION MEMORY STUDY

Different Kinds of Recognition Errors

Means and Standard Deviations

Group		Type of Error		
		Primary Association	Secondary Association	Control Word
Oral Deaf	Mean	3.90	5.21	3.03
	SD	1.88	1.99	1.63
Combined Deaf	Mean	4.28	4.90	4.10
	SD	1.93	2.45	2.54
Rochester Deaf	Mean	4.24	5.14	4.66
	SD	2.33	2.45	3.96
Hearing-Achievement	Mean	4.41	4.34	3.69
	SD	2.30	1.90	2.24
Hearing-Age	Mean	4.17	4.00	3.62
	SD	2.36	2.13	4.22

Analysis of Variance

Source of Variance	df	Mean Square	F
Groups (G)	4	3.9960	1.24, n.s.
S/G	140	3.2097	
Norms (N)	1	7.1736	6.40, $p<.025$
GN	4	1.4351	1.28, n.s.
SN/G	140	1.1209	
Error Type (E)	2	14.6839	4.41, $p<.025$
GE	8	2.8951	<1
SE/G	280	3.3303	
NE	2	12.0218	5.58, $p<.005$
GNE	8	1.8221	<1
SNE/G	280	2.1537	

TABLE 23

NOUN PAIRS STUDY

Means and Standard Deviations for Age, IQ, Written Language Comprehension, and Socio-economic Background
N = 30

Group	Age	IQ	Stanford Reading Achievement[a]	SE[b]
Oral				
$\bar{X}$	14-5	110.2	5.0	3.5
SD	22 mo.	11.4	1.2	1.6
Combined				
$\bar{X}$	14-0	116.5	4.6	3.7
SD	22 mo.	14.5	0.8	1.8
Rochester				
$\bar{X}$	14-4	106.9	5.0	4.0
SD	21 mo.	10.0	1.0	1.4
H. Achievement				
$\bar{X}$	9-6	113.4	4.9	4.0
SD	10 mo.	8.9	1.1	1.4
H. Age				
$\bar{X}$	14-4	113.4	--	3.7
SD	21 mo.	9.2	--	1.4

[a] In grade level.

[b] Hollingshead Socio-economic Index.

TABLE 24

NOUN PAIRS STUDY: TEST MATERIALS

Examples:	The white DUCK caught the FISH. The white DUCK caught the _____.
1st presentation	The quiet WIFE sewed the SHIRT. The brown TURKEY ate the CORN. The fast PLANE carried the PEOPLE.
2nd presentation	The brown TURKEY ate the _____. The fast PLANE carried the _____. The quiet WIFE sewed the _____.
(Test)	The old KING bought the BOAT. The bad BOY broke the SLED.
1st presentation (study trial)	The young SISTER found the RABBIT. The funny CLOWN had the BALL. The soft KITTEN saw the TREE. The strong FARMER used the TRUCK. The happy CHILD liked the PIANO. The big ANIMAL wanted the MEAT. The tall GIRL needed the BOOTS. The good FRIEND fixed the BIKE. The little DOG lost the SHOE. The nice AUNT made the SCARF. The black HORSE kicked the WALL. The busy NURSE took the BLANKET.
2nd presentation (test trial)	1. The funny CLOWN had the _____. 2. The soft KITTEN saw the _____. 3. The happy CHILD liked the _____. 4. The black HORSE kicked the _____. 5. The busy NURSE took the _____. 6. The good FRIEND fixed the _____. 7. The bad BOY broke the _____. 8. The tall GIRL needed the _____. 9. The little DOG lost the _____. 10. The nice AUNT made the _____. 11. The big ANIMAL wanted the _____. 12. The old KING bought the _____. 13. The young SISTER found the _____. 14. The strong FARMER used the _____.

TABLE 25

NOUN PAIRS STUDY - RECALL PHASE

Correct Response (The missing noun of that pair)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	8.70	9.53	8.23	7.33	8.37
SD	3.22	3.21	3.46	2.94	2.74

Analysis of Variance

	df	ss	ms	F	
Between	4	76.07	19.02	1.95	n.s.
Within	145	1414.77	9.76		
Total	149	1490.83			

TABLE 26

MEMORY FOR NOUN PAIRS STUDY - RECALL PHASE

An Incorrect Response, Imported From Outside the Test

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	1.90	1.63	1.57	3.10	2.87
SD	2.28	2.28	2.62	2.14	2.06

Analysis of Variance

	df	ss	ms	F
Between	4	61.97	15.49	2.97*
Within	145	757.20	5.22	
Total	149	819.17		

* Significant at .05 level.

Duncan Range Test

	Means	Roch 1.57	Comb 1.63	Oral 1.90	H.Age 2.87	H.Ach 3.10	Shortest Significant Range
Roch	1.57		.06	.33	<u>1.30</u>	<u>1.53</u>	R2 = 1.176
Comb	1.63			.27	<u>1.24</u>	<u>1.47</u>	R3 = 1.239
Oral	1.90				.97	1.20	R4 = 1.281
H.Age	2.87					.23	R5 = 1.310

Underlined figures indicate significant differences between the respective groups.

TABLE 27

NOUN PAIRS STUDY - RECALL PHASE

Incorrect But One of the 13 Other Missing Nouns

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	.50	.43	.83	.90	.63
SD	.73	.68	1.23	1.21	.96

Analysis of Variance

	df	ss	ms	F
Between	4	4.96	1.24	1.26 n.s.
Within	145	142.70	.98	
Total	149	147.66		

TABLE 28

MEMORY FOR NOUN PAIRS STUDY - RECALL PHASE

Incorrect But One of the First Nouns of Any of the Pairs

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	.47	.33	.50	.40	.17
SD	.67	.66	.73	.85	.37

Analysis of Variance

	df	ss	ms	F
Between	4	2.09	.52	1.13 n.s.
Within	145	67.00	.46	
Total	149	69.09		

TABLE 29

NOUN PAIRS STUDY - RECALL PHASE

An Incorrect Response Imported From Any 14 Test Sentences or From the Test Examples

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	.03	.17	.17	.07	.03
SD	.03	.14	.14	.13	.03

Analysis of Variance

	df	ss	ms	F
Between	4	.56	.14	1.44 n.s.
Within	145	14.13	.10	
Total	149	14.69		

TABLE 30

MEMORY FOR NOUN PAIRS STUDY - RECALL PHASE

Blanks

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	2.40	1.90	2.70	2.20	1.93
SD	2.11	2.31	2.45	2.06	2.06

Analysis of Variance

	df	ss	ms	F
Between	4	13.43	3.36	.69 n.s.
Within	145	704.87	4.86	
Total	149	718.29		

TABLE 31

NOUN PAIRS STUDY - RECALL PHASE

Commonality With College Students

Average Association Value (College) For Incorrect Responses (Excluding Blanks)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	10.30	5.07	6.27	14.03	17.67
SD	47.72	8.66	11.68	14.58	15.86

Analysis of Variance

	df	ss	ms	F
Between	4	3092.31	773.08	4.30*
Within	145	26098.87	179.99	
Total	149	29191.18		

* Significant at .01 level.

Duncan Range Tests

	Means	Comb 5.07	Roch 6.27	Oral 10.30	H.Ach 14.03	H.Age 17.67	Shortest Significant Ranges
Comb	5.07		1.20	5.23	8.96	12.60	R2 = 6.8040
Roch	6.27			4.03	7.76	11.40	R3 = 7.1685
Oral	10.30				3.73	7.37	R4 = 7.4115
H.Ach	14.03					3.64	R5 = 7.5816

Underlined figures indicate significant differences between the respective groups.

TABLE 32

NOUN PAIRS STUDY - RECALL PHASE

Number of Incorrect Responses - That Appeared on College List

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	1.77	1.37	1.47	2.33	2.53
SD	1.70	1.88	1.93	1.77	2.01

Analysis of Variance

	df	ss	ms	F
Between	4	32.36	8.09	2.37 n.s.
Within	145	495.93	3.42	
Total	149	528.29		

TABLE 33

NOUN PAIRS STUDY - INCIDENTAL RECALL

Incidental Recall of First Nouns

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	8.10	7.40	6.80	5.20	8.23
SD	2.48	3.37	2.60	2.31	2.63

Analysis of Variance

	df	ss	ms	F
Between	4	181.91	45.47	6.22*
Within	145	1058.87	7.30	
Total	149	1240.78		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 5.20	Roch 6.80	Comb 7.40	Oral 8.10	H.Age 8.23	Shortest Significant Ranges
H.Ach	5.20		1.60	2.20	2.90	3.03	R2 = 1.3730
Roch	6.80			.60	1.30	1.43	R3 = 1.4455
Comb	7.40				.70	.83	R4 = 1.4945
Oral	8.10					.13	R5 = 1.5288

Underlined figures indicate significant differences between the respective groups.

TABLE 34

NOUN PAIRS STUDY - INCIDENTAL RECALL

Incidental Recall of Second Nouns

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	7.10	6.56	6.33	4.53	6.46
SD	3.12	3.94	3.00	2.16	2.78

Analysis of Variance

	df	ss	ms	F
Between	4	114.32	28.58	3.06*
Within	145	1351.68	9.32	
Total	149	1466.00		

* Significant at .05 level.

Duncan Range Test

	Means	H.Ach 4.53	Roch 6.33	H.Age 6.46	Comb 6.56	Oral 7.10	Shortest Significant Ranges
H.Ach	4.53		1.80	1.93	2.03	2.57	R2 = 1.5400
Roch	6.33			.13	.23	.77	R3 = 1.6225
H.Age	6.46				.10	.64	R4 = 1.6775
Comb	6.56					.54	R5 = 1.7160

Underlined figures indicate significant differences between the respective groups.

TABLE 35

NOUN PAIRS STUDY - INCIDENTAL RECALL

Incidental Recall of First and Second Nouns Together

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	6.16	5.66	5.13	3.83	5.73
SD	2.80	3.76	2.75	2.09	2.75

Analysis of Variance

	df	s	ms	F
Between	4	97.55	24.38	2.94*
Within	145	1200.35	8.27	
Total	149	1297.90		

* Significant at .05 level.

Duncan Range Test

	Means	H.Ach 3.83	Roch 5.13	Comb 5.66	H.Age 5.73	Oral 6.16	Shortest Significant Ranges
H.Ach	3.83		1.30	1.83	1.90	2.33	R2 = 1.4560
Roch	5.13			.53	.60	1.03	R3 = 1.5340
Comb	5.66				.07	.50	R4 = 1.5860
H.Age	5.73					.43	R5 = 1.6224

Underlined figures indicate significant differences between the respective groups.

TABLE 36

NOUN PAIRS STUDY -- INCIDENTAL RECALL

Incidental Recall of Test Adjectives

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	5.70	4.73	4.27	2.87	5.93
SD	2.84	2.96	2.39	2.40	2.57

Analysis of Variance

	df	ss	ms	F
Between	4	182.13	45.53	6.52*
Within	145	1013.37	6.99	
Total	149	1195.50		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 2.87	Roch 4.27	Comb 4.73	Oral 5.70	H.Age 5.93	Shortest Significant Ranges
H.Ach	2.87		1.40	1.86	2.83	3.06	R2 = 1.346
Roch	4.27			.46	1.43	1.66	R3 = 1.419
Comb	4.73				.97	1.20	R4 = 1.467
Oral	5.70					.23	R5 = 1.501

Underlined figures indicate significant differences between the respective groups.

TABLE 37

NOUN PAIRS STUDY - INCIDENTAL RECALL

Number of Test Verbs Recalled

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	5.43	4.53	4.50	4.40	7.13
SD	2.57	3.31	2.21	2.34	2.79

Analysis of Variance

	df	ss	ms	F
Between	4	161.00	40.25	5.64*
Within	145	1035.00	7.14	
Total	149	1196.00		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 4.40	Roch 4.50	Comb 4.53	Oral 5.43	H.Age 7.13	Shortest Significant Ranges
H.Ach	4.40		.10	.13	1.03	<u>2.73</u>	R2 = 1.361
Roch	4.50			.03	.93	<u>2.63</u>	R3 = 1.434
Comb	4.53				.90	<u>2.60</u>	R4 = 1.482
Oral	5.43					<u>1.70</u>	R5 = 1.516

Underlined figures indicate significant differences between the respective groups.

TABLE 38

NOUN PAIRS STUDY - INCIDENTAL RECALL

Number of Test Adjectives and Verbs Recalled

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	11.13	9.27	8.77	7.27	13.07
SD	4.83	5.87	4.21	4.49	5.06

Analysis of Variance

	df	ss	ms	F
Between	4	605.07	151.27	6.23*
Within	145	3520.43	24.29	
Total	149	4125.50		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 7.27	Roch 8.77	Comb 9.27	Oral 11.13	H.Age 13.07	Shortest Significant Ranges
H.Ach	7.27		1.50	2.00	3.86	5.80	R2 = 2.509
Roch	8.77			.50	2.36	4.30	R3 = 2.643
Comb	9.27				1.86	3.80	R4 = 2.733
Oral	11.13					1.94	R5 = 2.796

Underlined figures indicate significant differences between the respective groups.

TABLE 39

NOUN PAIRS STUDY - INCIDENTAL RECALL

Incidental Recall of First and Second Nouns, Test Adjectives and Verbs

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	27.67	24.80	23.23	17.27	27.90
SD	8.65	13.00	9.47	8.43	10.05

Analysis of Variance

	df	ss	ms	F
Between	4	2252.09	563.02	5.57*
Within	145	14663.40	101.13	
Total	149	16915.49		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 17.27	Roch 23.23	Comb 24.80	Oral 27.67	H.Age 27.90	Shortest Significant Ranges
H.Ach	17.27		5.96	7.53	10.40	10.63	R2 = 507
Roch	23.23			1.57	4.44	4.67	R3 = 534
Comb	24.80				2.87	3.10	R4 = 552
Oral	27.67					.23	R5 = 564

Underlined figures indicate significant differences between the respective groups.

TABLE 40

SENTENCE MEMORY STUDY

Means and Standard Deviations for Age, IQ, Written Language Comprehension, and Socio-economic Background
N = 30

Group	Age	IQ	Stanford Reading Achievement[a]	SE[b]
Oral				
$\bar{X}$	14-5	110.2	5.0	3.5
SD	22 mo.	11.4	1.2	1.6
Combined				
$\bar{X}$	14-0	116.5	4.6	3.7
SD	22 mo.	14.5	0.8	1.8
Rochester				
$\bar{X}$	14-4	106.9	5.0	4.0
SD	21 mo.	10.0	1.0	1.4
H. Achievement				
$\bar{X}$	9-6	113.4	4.9	4.0
SD	10 mo.	8.9	1.1	1.4
H. Age				
$\bar{X}$	14-4	113.4	--	3.7
SD	21 mo.	9.2	--	1.4

[a] In grade level.

[b] Hollingshead Socio-economic Index.

TABLE 41

SENTENCE MEMORY STUDY

List of Examples and Test Sentences and Scrambles with the Exposure Time

			Exposure Time
Examples:	1.	the sun went behind a gray cloud	.2 sec.
	2.	she made a cake for the party	.2 sec.
	3.	swim desks very doll go	.2 sec.
	4.	there were two pictures on the wall	.2 sec.
	5.	cup smile went first dark	.2 sec.
	6.	the baby drank a bottle of milk	.1 sec.
	7.	noise play paper run book	.2 sec.
Test Sentences and Word Strings	1.	three brave men went to the moon	.2 sec.
	2.	movie was dish is near	.2 sec.
	3.	about to supper pretty dropped	.2 sec.
	4.	the yellow pencil fell on the floor	.2 sec.
	5.	lion children not school green	.2 sec.
	6.	my mother dropped a dish at supper	.1 sec.
	7.	they teacher fun chair went	.2 sec.
	8.	the flower in the garden is pretty	.1 sec.
	9.	watched men door three in	.2 sec.
	10.	mother yellow circus my had	.2 sec.
	11.	the teacher did not come to school	.1 sec.
	12.	moon have flower pencil on	.2 sec.
	13.	the green chair was near the door	.1 sec.
	14.	garden did floor come fell	.1 sec.
	15.	they watched a movie about a lion	.1 sec.
	16.	the children had fun at the circus	.1 sec.

TABLE 42

SENTENCE MEMORY STUDY

Scoring Key for Sentence Memory Study

Minimal Meaning of Sentences*

1. men went moon
4. pencil fell
6. mother dropped dish
8. flower pretty
11. teacher not come
13. chair near door
15. watched movies
16. children circus (or)
children fun

Essential Minimum Sense of Noun Phrase

1. men
4. pencil
6. mother
8. flower
11. teacher
13. chair
15. they
16. children

Essential Minimum Sense of Verb Phrase

1. went moon
4. fell
6. dropped dish
8. pretty
11. not come (or)
not school
13. near door
15. watched movie
16. had fun (or)
circus

* This key is based on the opinions of 4 independent judges; all the judges agreed exactly on sentences 4, 6, 8, 13, 15, and 16.

3 out of 4 judges agreed on sentences 1, and 11.

TABLE 43

SENTENCE MEMORY STUDY

Correct Responses, Regardless of Position
For Sentences and Word Strings (Grammatical Shifts Included)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	74.33	69.00	66.50	62.97	82.43
SD	13.26	11.98	9.63	14.08	13.06

Analysis of Variance

	df	ss	ms	F
Between	4	6918.17	1729.54	11.10*
Within	145	22592.50	155.81	
Total	149	29510.67		

* Significant at .01 level

Duncan Range Test

	Means	H.Ach 62.97	Roch 66.50	Comb 69.00	Oral 74.33	H.Age 82.43
H.Ach	62.97		3.53	6.03	11.36	19.46
Roch	66.50			2.50	7.83	15.93
Comb	69.00				5.33	13.43
Oral	74.33					8.10

Underlined figures indicate significant differences between the respective groups.

TABLE 44

SENTENCE MEMORY STUDY

Correct Responses, Regardless of Position
For Sentences (Grammatical Shifts Included)

Means and Standard Deviations

	Oral	Comb	Ro n	H.Ach	H.Age
$\bar{X}$	48.77	43.27	42.40	40.70	50.50
SD	10.09	7.76	6.48	9.67	7.52

Analysis of Variance

	df	ss	ms	F
Between	4	2178.36	544.59	7.69*
Within	145	10270.23	70.83	
Total	149	12448.59		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 40.70	Roch 42.40	Comb 43.27	Oral 48.77	H.Age 50.50
H.Ach	40.70		1.70	2.57	8.07	9.80
Roch	42.40			0.87	6.37	8.10
Comb	43.27				5.50	7.23
Oral	48.77					1.73

Underlined figures indicate significant differences between the respective groups.

TABLE 45

SENTENCE MEMORY STUDY

Correct Responses, Regardless of Position
For Word Strings (Grammatical Shifts Included)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	25.90	25.73	24.10	22.27	31.93
SD	5.95	5.01	4.38	6.63	5.99

Analysis of Variance

	df	ss	ms	F
Between	4	1584.97	396.24	12.42*
Within	145	4627.00	31.91	
Total	149	6211.97		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 22.27	Roch 24.10	Comb 25.73	Oral 25.90	H.Age 31.93
H.Ach	22.27		1.83	3.46	3.63	9.66
Roch	24.10			1.63	1.80	7.83
Comb	25.73				0.17	6.20
Oral	25.90					6.03

Underlined figures indicate significant differences between the respective groups.

TABLE 46

SENTENCE MEMORY STUDY

Number of Correct Responses, In Correct Position for Sentences and Word Strings (Grammatical Shifts Included)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	51.53	47.90	45.53	43.63	69.43
SD	12.90	13.62	13.50	15.75	15.94

Analysis of Variance

	df	ss	ms	F
Between	4	12959.83	3239.96	15.62*
Within	145	30079.97	207.45	
Total	149	43039.80		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 43.63	Roch 45.53	Comb 47.90	Oral 51.53	H.Age 69.43
H.Ach	43.63		1.90	4.27	7.90	<u>25.80</u>
Roch	45.53			2.37	6.00	<u>23.90</u>
Comb	47.90				3.63	<u>21.53</u>
Oral	51.53					<u>17.90</u>

Underlined figures indicate significant differences between the respective groups.

TABLE 47

SENTENCE MEMORY STUDY

Correct Responses, In Correct Position for Sentences (Grammatical Shifts Included)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	37.73	34.10	31.93	30.47	45.00
SD	9.96	10.58	10.20	12.56	10.22

Analysis of Variance

	df	ss	ms	F
Between	4	4039.57	1009.89	8.76*
Within	145	16719.90	115.31	
Total	149	20759.47		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 30.47	Roch 31.93	Comb 34.10	Oral 37.73	H.Age 45.00
H.Ach	30.47		1.46	3.63	7.26	14.53
Roch	31.93			2.17	5.80	14.07
Comb	34.10				3.63	10.90
Oral	37.73					7.27

Underlined figures indicate significant differences between the respective groups.

TABLE 48

SENTENCE MEMORY STUDY

Correct Responses, In Correct Position for Word Strings (Grammatical Shifts Included)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	13.80	13.80	13.60	13.20	24.43
SD	4.82	5.03	4.88	5.91	7.04

Analysis of Variance

	df	ss	ms	F
Between	4	2823.87	705.97	22.51*
Within	145	4546.97	31.36	
Total	149	7370.84		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 13.20	Roch 13.60	Oral 13.80	Comb 13.80	H.Age 24.43
H.Ach	13.20		.40	.60	.60	<u>11.23</u>
Roch	13.60			.20	.20	<u>10.83</u>
Oral	13.80				.00	<u>10.63</u>
Comb	13.80					<u>10.63</u>

Underlined figures indicate significant differences between the respective groups.

TABLE 49

SENTENCE MEMORY STUDY

Number of Completely Correct Sentences and Scrambles

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	3.57	2.47	2.13	3.07	7.60
SD	1.75	1.78	2.21	2.00	3.66

Analysis of Variance

	df	ss	ms	F
Between	4	587.47	146.87	25.74*
Within	145	827.37	5.71	
Total	149	1414.84		

* Significant at .01 level.

Duncan Range Test

	Means	Roch 2.13	Comb 2.47	H.Ach 3.07	Oral 3.57	H.Age 7.60	Shortest Significant Ranges
Roch	2.13		.34	.94	<u>1.44</u>	<u>5.47</u>	R2 = 1.204
Comb	2.47			.60	1.10	<u>5.13</u>	R3 = 1.268
H.Ach	3.07				.50	<u>4.53</u>	R4 = 1.311
Oral	3.57					<u>4.03</u>	R5 = 1.341

Underlined figures indicate significant differences between the respective groups.

TABLE 50

SENTENCE MEMORY STUDY

Number of Completely Correct Sentences

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	3.37	2.30	1.90	2.73	5.40
SD	1.77	1.64	1.73	1.70	2.28

Analysis of Variance

	df	ss	ms	F
Between	4	227.03	56.76	16.76 *
Within	145	491.03	3.39	
Total	149	718.06		

* Significant at .01 level.

Duncan Range Test

	Means	Roch 1.90	Comb 2.30	H.Ach 2.73	Oral 3.37	H.Age 5.40	Shortest Significant Ranges
Roch	1.90		.40	.83	1.47	3.50	R2 = .924
Comb	2.30			.43	1.07	3.10	R3 = .973
H.Ach	2.73				.64	2.67	R4 = 1.006
Oral	3.37					2.03	R5 = 1.029

Underlined figures indicate significant differences between the respective groups.

TABLE 51

SENTENCE MEMORY STUDY

Number of Completely Correct Scrambles

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	.20	.17	.23	.33	2.20
SD	.48	.37	.68	.80	1.79

Analysis of Variance

	df	ss	ms	F
Between	4	93.29	23.32	24.92 *
Within	145	135.80	.94	
Total	149	229.09		

* Significant at .01 level.

Duncan Range Test

	Means	Comb .17	Oral .20	Roch .23	H.Ach .33	H.Age 2.20	Shortest Significant Ranges
Comb	.17		.03	.06	.16	2.03	R2 = .504
Oral	.20			.03	.13	2.00	R3 = .531
Roch	.23				.10	1.97	R4 = .549
H.Ach	.33					1.87	R5 = .562

Underlined figures indicate significant differences between the respective groups.

TABLE 52

SENTENCE MEMORY STUDY

Verb Phrase Meanings (for 8 Sentences)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	7.00	6.33	6.40	5.63	7.23
SD	1.23	1.63	1.31	1.52	1.33

Analysis of Variance

	df*	ss	ms	F
Between	4	47.24	11.81	5.94*
Within	145	288.20	1.99	
Total	149	335.44		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 5.63	Comb 6.33	Roch 6.40	Oral 7.00	H.Age 7.23
H.Ach	5.63		.70	.77	1.37	1.60
Comb	6.33			.07	.67	.90
Roch	6.40				.60	.83
Oral	7.00					.23

Underlined figures indicate significant differences between the respective groups.

TABLE 53

SENTENCE MEMORY STUDY

Noun Phrase Meanings (for 8 Sentences)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	7.20	7.23	7.37	6.53	7.67
SD	1.16	0.90	0.77	1.60	0.66

Analysis of Variance

	df	ss	ms	F
Between	4	20.73	5.18	4.55*
Within	145	165.27	1.14	
Total	149	186.00		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 6.53	Oral 7.20	Comb 7.23	Roch 7.37	H.Age 7.67
H.Ach	6.53		.67	.70	.84	1.14
Oral	7.20			.03	.17	.47
Comb	7.23				.14	.44
Roch	7.37					.30

Underlined figures indicate significant differences between the respective groups.

TABLE 54

SENTENCE MEMORY STUDY

Minimal Meanings (for 8 Sentences)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	6.63	6.13	6.07	5.13	7.03
SD	1.41	1.61	1.37	1.81	1.52

Analysis of Variance

	df	ss	ms	F
Between	4	61.27	15.32	6.37*
Within	145	348.74	2.41	
Total	149	410.00		

*Significant at .01 level.

Duncan Range Test

	Means	H.Ach 5.13	Roch 6.07	Comb 6.13	Oral 6.63	H.Age 7.03
H.Ach	5.13		.94	1.00	1.50	1.90
Roch	6.07			.06	.56	.96
Comb	6.13				.50	.90
Oral	6.63					.40

Underlined figures indicate significant differences between the respective groups.

TABLE 55

WORD COMPREHENSION STUDY

Means and SDs of Matching Variables For All Experimental Groups.
For Males N = 15; For Females N = 14.

Experimental Groups		Reading Achievement Grade Level			Age in Months			I.Q.			Socio-Economic Level		
		Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total
Oral Deaf	Mean	4.31	4.48	4.39	174.67	164.79	169.90	107.28	111.77	109.44	3.53	3.43	3.48
	SD	0.47	0.72	0.61	25.83	17.47	22.74	13.14	11.82	12.72	1.54	1.55	1.55
Combined Deaf	Mean	4.21	4.51	4.35	174.20	166.43	170.45	110.00	112.25	111.08	4.47	4.86	4.66
	SD	0.44	0.61	0.55	25.63	15.39	21.66	14.22	9.44	12.27	1.78	1.12	1.51
Rochester Deaf	Mean	4.36	4.62	4.49	177.93	166.93	172.62	110.00	106.64	108.38	4.13	4.00	4.07
	SD	0.50	0.73	0.63	20.79	15.75	19.33	10.39	12.81	11.74	1.15	1.73	1.46
Hearing-Achievement	Mean	4.37	4.55	4.46	108.93	109.43	109.17	105.54	110.50	108.11	4.13	3.29	3.72
	SD	0.68	0.57	0.64	8.89	6.41	7.80	8.79	8.13	8.81	1.50	1.10	1.39
Hearing-Age	Mean	—	—	—	177.20	166.07	171.83	111.00	112.64	111.79	3.47	4.14	3.79
	SD	—	—	—	23.67	15.67	20.96	8.79	6.37	7.75	1.45	1.12	1.35

TABLE 56

WORD COMPREHENSION STUDY

26 Target Words (13 with a primary association, 13 with a secondary association)

STIMULUS WORD	MEANING	MEANING	PRIMARY ASSOC.	CONTROL	CONTROL
1. back	part of body	behind	front	small city	top of hill
2. bright	shining	smart	light	enjoy	important
3. down	below	feathers	up	young child	train
4. fan	wind machine	admirer	cool	lesson	wooden house
5. fire	flame	end job	burn	glass of milk	walnut
6. fly	move in air	bug	bird	candy	put together
7. hand	part of arm	pointer on clock	finger	secret	end of story
8. last	at the end	continue	first	work hard	with surprise
9. leaf	part of plant	page	tree	street	some sunshine
10. let	give permission	rent	go	deep snow	keep out
11. stamp	postage	step on	letter	rain	parade
12. top	highest	toy	bottom	taste	many
13. wake	open eyes	funeral	sleep	pair of shoes	lock
			SECONDARY ASSOC.		
1. barrel	round container	part of gun	water	television	pretty picture
2. bat	flying animal	wooden stick	baseball	be funny	old train
3. bit	small piece	cut with teeth	hurt	calendar	many visitors
4. corn	vegetable	lump on foot	eat	on the desk	health
5. country	nation	open land	farm	try to win	today
6. cross	religious sign	angry	over	towel	widest part
7. cry	shed tears	call loudly	sad	wish	prize
8. party	happy gathering	political group	birthday	gold ring	long time
9. play	stage show	have fun	work	easy	busy office
10. run	move quickly	how	race	drink of water	want
11. skirt	clothing	go around	blouse	comb	pizza
12. slip	slide	underwear	dress	too much money	jump
13. smart	clever or intelligent	sting	stupid	large room	friendly

Control: ½ using single words - ½ using phrases

TABLE 57

WORD COMPREHENSION STUDY

Number of Meanings Chosen on Control Test (IC)

Analysis of Variance

Source of Variance	df	Mean Square	F
S	4	96.6164	24.20, p<.001
S/G	140	3.9921	--
List (L)	1	0.8345	< 1
GL	4	2.7009	2.32, n.s.
SL/G	140	1.1633	--
Strength (V)	1	444.9379	414.71, p<.001
GV	4	14.8388	13.83, p<.001
SV/G	140	1.0729	--
LV	1	53.4069	42.69, p<.001
GLV	4	5.9888	4.79, p<.005
SLV/G	140	1.2510	--

Duncan Range Test

	Means	Comb 40.83	Roch 42.82	Oral 44.96	H.Ach 45.37	H.Age 50.56	Shortest Significant Ranges
Comb	40.83		1.99	4.13	4.54	9.73	R1 = 1.04
Roch	42.82			2.14	2.55	7.74	R2 = 1.09
Oral	44.96				.41	5.60	R3 = 1.13
H.Ach	45.37					5.19	R4 = 1.15

Underlined figures indicate significant differences between the respective groups.

TABLE 58

WORD COMPREHENSION STUDY

Number of Strong Meanings and Weak Meanings Chosen on Control Test (IC)

Strong Meaning
Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	24.41	22.45	23.79	24.62	25.79
SD	1.61	3.29	1.54	1.10	.61

Weak Meaning
Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	20.55	18.38	19.03	20.76	24.76
SD	2.44	3.09	2.86	2.43	1.25

TABLE 59

WORD COMPREHENSION STUDY

Test IA - (Asked for meaning, when strong meaning, association and control word present.)

Number who chose Strong Meaning

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	18.93	16.34	17.52	20.76	24.62
SD	5.28	5.27	4.26	2.88	1.33

Analysis of Variance

	df	ss	ms	F
Between	4	1215.83	303.96	18.09*
Within	140	2351.80	16.80	
Total	144	3567.63		

* Significant at .01 level.

Duncan Range Test

	Means	Comb 16.34	Roch 17.52	Oral 18.93	H.Ach 20.76	H.Age 24.62	Shortest Significant Ranges
Comb	16.34		1.18	2.59	4.42	8.28	R2 = 2.128
Roch	17.52			1.41	3.24	7.10	R3 = 2.242
Oral	18.93				1.83	5.69	R4 = 2.318
H.Ach	20.76					3.86	R5 = 2.371

Underlined figures indicate significant differences between the respective groups.

TABLE 60

WORD COMPREHENSION STUDY

Test IA - (Asked for meaning, when weak meaning, association, and control word present.)

Number who chose Weak Meaning

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	11.59	8.79	9.00	12.10	21.28
SD	5.21	4.09	4.88	4.13	3.45

Analysis of Variance

	df	ss	ms	F
Between	4	3015.58	753.90	39.00*
Within	140	2706.28	19.33	
Total	144	5721.86		

* Significant at .01 level.

Duncan Range Test

	Means	Comb 8.79	Roch 9.00	Oral 11.59	H.Ach 12.10	H.Age 21.28	Shortest Significant Ranges
Comb	8.79		.21	2.80	3.31	12.49	R2 = 2.268
Roch	9.00			2.59	3.10	12.28	R3 = 2.389
Oral	11.59				.51	9.69	R4 = 2.470
H.Ach	12.10					9.18	R5 = 2.527

Underlined figures indicate significant differences between the respective groups.

TABLE 61

WORD COMPREHENSION STUDY

Test IA - (Asked for meaning, when strong meaning, association, and control word present.)

Number who chose Association

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	6.90	9.28	8.21	5.03	1.38
SD	5.28	5.18	4.41	2.86	1.32

Analysis of Variance

	df	ss	ms	F
Between	4	1118.31	279.58	16.62*
Within	140	2355.04	16.82	
Total	144	3473.35		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 1.38	H.Ach 5.03	Oral 6.90	Roch 8.21	Comb 9.28	Shortest Significant Ranges
H.Age	1.38		3.65	5.52	6.83	7.90	R2 = 2.128
H.Ach	5.03			1.87	3.18	4.25	R3 = 2.242
Oral	6.90				1.31	2.38	R4 = 2.318
Roch	8.21					1.07	R5 = 2.371

Underlined figures indicate significant differences between the respective groups.

TABLE 62

WORD COMPREHENSION STUDY

Test IA - (Asked for meaning, when weak meaning, association, and control word present.)

Number who chose Association

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	13.24	16.34	16.69	12.31	4.14
SD	5.91	4.68	5.14	4.05	3.20

Analysis of Variance

	df	ss	ms	F
Between	4	2982.23	745.56	33.92*
Within	140	3077.73	21.98	
Total	144	6059.96		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 4.14	H.Ach 12.31	Oral 13.24	Comb 16.34	Roch 16.69	Shortest Significant Ranges
H.Age	4.14		8.17	9.10	12.20	12.55	R2 = 2.436
H.Ach	12.31			.93	4.03	4.38	R3 = 2.566
Oral	13.24				3.10	3.45	R4 = 2.653
Comb	16.34					.35	R5 = 2.714

Underlined figures indicate significant differences between the respective groups.

TABLE 63

WORD COMPREHENSION STUDY

DIFFERENCE SCORE - Number of Strong Meanings chosen for Test IC MINUS Strong Meanings for IA.

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	9.48	10.10	10.28	7.86	5.17
SD	4.94	4.14	3.64	2.91	1.26

Analysis of Variance

	df	ss	ms	F
Between	4	526.03	131.51	10.13*
Within	140	1817.31	12.98	
Total	144	2343.34		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 5.17	H.Ach 7.86	Oral 9.48	Comb 10.10	Roch 10.28	Shortest Significant Ranges
H.Age	5.17		2.69	4.31	4.93	5.11	R2 = 1.876
H.Ach	7.86			1.62	2.24	2.42	R3 = 1.976
Oral	9.48				.62	.80	R4 = 2.043
Comb	10.10					.18	R5 = 2.090

Underlined figures indicate significant differences between the respective groups.

TABLE 64

WORD COMPREHENSION STUDY

DIFFERENCE SCORE - Number of Weak Meanings chosen for Test IC MINUS Weak Meanings for IA.

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	12.97	13.55	14.03	12.66	7.48
SD	3.16	3.53	4.43	3.29	2.68

Analysis of Variance

	df	ss	ms	F
Between	4	818.34	204.59	15.18*
Within	140	1886.90	13.48	
Total	144	2705.24		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 7.48	H.Ach 12.66	Oral 12.97	Comb 13.55	Roch 14.03	Shortest Significant Ranges
H.Age	7.48		5.18	5.49	6.07	6.55	R2 = 1.904
H.Ach	12.66			.31	.89	1.37	R3 = 2.006
Oral	12.97				.58	1.06	R4 = 2.074
Comb	13.55					.48	R5 = 2.121

Underlined figures indicate significant differences between the respective groups.

TABLE 65

CONTEXTUAL CUES STUDY

Means and Standard Deviations for Age, IQ, Written Language Comprehension, and Socio-economic Background
N = 30

Group	Age	IQ	Stanford Reading Achievement[a]	SE[b]
Oral				
$\bar{X}$	14-5	110.2	5.0	3.5
SD	22 mo.	11.4	1.2	1.6
Combined				
$\bar{X}$	14-0	116.5	4.6	3.7
SD	22 mo.	14.5	0.8	1.8
Rochester				
$\bar{X}$	14-4	106.9	5.0	4.0
SD	21 mo.	10.0	1.0	1.4
H. Achievement				
$\bar{X}$	9-6	113.4	4.9	4.0
SD	10 mo.	8.9	1.1	1.4
H.Age				
$\bar{X}$	14-4	113.4	--	3.7
SD	21 mo.	9.2	--	1.4

[a] In grade level.

[b] Hollingshead Socio-economic Index.

TABLE 66

SENTENCES IN CONTEXTUAL CUES STUDY

Key: s = strong meaning, w = weak meaning, a = association, c = control word

1. FAN				
	strong	a	amb	The fan blew.
		b	def	The fan blew the air.
	weak	c	amb	She is a fan.
		d	def	She is a fan of the actors.

s = wind machine w = admirer a = cool c = many visitors

---

2. FIRE				
	strong	a	amb	He will make a fire.
		b	def	He will make a fire with wood.
	weak	c	amb	He will fire you.
		d	def	He will fire you if you are lazy.

s = flame w = to end job a = burn c = some sunshine

---

3. FLY				
	strong	a	amb	The fly was small.
		b	def	The small fly was on the wall.
	weak	c	amb	He wanted to fly.
		d	def	He wanted to fly to the West.

s = insect w = to move through the air a = bird c = parade

---

4. HAND				
	strong	a	amb	His hand was cold.
		b	def	His hand was cold when he held the snowball.
	weak	c	amb	The hand stopped.
		d	def	The hand stopped at noon.

s = part of the body w = pointer on a clock a = finger
c = health

---

5. IRON				
	strong	a	amb	It was made of iron.
		b	def	The tool was made of iron.
	weak	c	amb	She will iron.
		d	def	She will iron the dress.

s = metal w = to press a = steel c = train

(Continued)

TABLE 66 (cont.)

(Sentences in Contextual Cues Study)

6. LAST			
	strong	a amb	He was last.
		b def	He was last in line.
	weak	c amb	It will last.
		d def	It will last a long time.

s = at the end w = continue a = first c = easy

---

7. STAMP			
	strong	a amb	He will buy a stamp.
		b def	He will buy a stamp to put on his package.
	weak	c amb	He wanted to stam[illegible].
		d def	He wanted to stamp on the floor.

s = small paper for mail w = to bang with foot a = letter
c = new camera

---

8. TOP			
	strong	a amb	He was at the top.
		b def	He was at the top of the building.
	weak	c amb	He had a top.
		d def	He had fun with the top.

s = highest place w = toy a = bottom c = ring

TABLE 67

CONTEXTUAL CUES STUDY

Selection of Appropriate Meaning Alternatives (Correct)

Analysis of Variance

	df	ss	ms	F
G	4	933.07	233.27	29.5*
S(G)	145	1143.47	7.89	
C	1	5.80	5.80	12.1*
GC	4	1.41	0.35	0.73
T	1	10.94	10.94	8.1*
GT	4	45.84	11.46	8.4*
CT	1	4.68	4.68	9.8*
GCT	4	2.83	0.71	1.5
SC(G)	145	69.54	0.48	
ST(G)	145	196.98	1.36	
SCT(G)	145	69.24	0.48	

* Significant at .01 level.
C = Definite-Ambiguous
T = Strong-Weak

Duncan Range Test

	Means	Comb 4.62	Roch 5.04	Oral 6.60	H.Ach 7.23	H.Age 7.85
Comb	4.62		.42	1.98	2.61	3.23
Roch	5.04			1.56	2.19	2.81
Oral	6.60				.63	1.25
H.Ach	7.23					.65
H.Age	7.85					

Underlined figures indicate significant differences between the respective groups.

TABLE 68

CONTEXTUAL CUES STUDY

Means for Selection of Appropriate Meaning Alternatives (Correct)

	When Strong Meaning is Correct			When Weak Meaning is Correct			Strong + Weak Subaverages		Overall Average
	Def	Ambig	Sub Aver	Def	Ambig	Sub Aver	Def	Ambig	
Oral	6.90	6.77	6.83	6.13	6.60	6.37	6.52	6.68	6.60
Comb	4.63	4.67	4.65	4.33	4.83	4.58	4.48	4.75	4.62
Roch	5.67	5.67	5.67	4.10	4.73	4.42	4.88	5.20	5.04
H.Ach	6.97	7.20	7.08	7.30	7.47	7.38	7.13	7.33	7.23
H.Age	7.80	7.77	7.78	7.87	7.97	7.92	7.83	7.87	7.85
Overall Average	6.39	6.42	6.40	5.95	6.32	6.13	6.17	6.37	6.27

TABLE 69

CONTEXTUAL CUES STUDY

Selection of Inappropriate Meaning Alternatives (Incorrect)

Analysis of Variance

Source	df	ss	ms	F
G	4	82.97	20.74	21.2*
S(G)	145	142.14	0.98	
C	1	0.88	0.88	3.7
GC	4	0.63	0.16	0.67
T	1	67.34	67.34	112.2*
GT	4	40.31	10.08	16.8*
CT	1	0.60	0.60	2.7
GCT	4	0.24	0.06	0.3
SC(G)	145	34.74	0.24	
ST(G)	145	87.61	0.60	
SCT(G)	145	32.41	0.22	

* Significant at .01 level.
C = Definite-Ambiguous
T = Strong-Weak

Duncan Range Test

	Means	H.Age .04	H.Ach .22	Oral .51	Comb .69	Roch 1.11
H.Age	.04		.18	.47	.65	1.07
H.Ach	.22			.29	.47	.89
Oral	.51				.18	.60
Comb	.69					.42

Underlined figures indicate significant differences between the respective groups.

TABLE 70

CONTEXTUAL CUES STUDY

Means for Selection of Inappropriate Meaning Alternatives (Incorrect)

	When Strong Meaning is Correct			When Weak Meaning is Correct			Strong + Weak Subaverages		Overall Average
	Def	Ambig	Sub Aver	Def	Ambig	Sub Aver	Def	Ambig	
Oral	.30	.17	.23	.87	.70	.78	.58	.43	.51
Comb	.23	.27	.25	1.20	1.07	1.13	.72	.67	.69
Roch	.27	.40	.33	1.93	1.83	1.88	1.10	1.12	1.11
H.Ach	.10	.03	.06	.50	.27	.38	.30	.15	.22
H.Age	.03	.00	.02	.10	.03	.07	.07	.02	.04
Overall Average	.19	.17	.18	.92	.78	.85	.55	.48	.51

TABLE 71

CONTEXTUAL CUES STUDY

Selection of Association Alternatives (Incorrect)

Analysis of Variance

	df	ss	ms	F
G	4	411.82	102.96	21.7*
S(G)	145	690.75	4.76	
C	1	0.43	0.43	1.1
GC	4	1.02	0.26	0.7
T	1	47.04	47.04	51.1*
GT	4	13.38	3.34	3.7*
CT	1	1.93	1.93	5.4**
GCT	4	2.66	0.66	1.8
SC(G)	145	56.05	0.39	
ST(G)	145	133.08	0.92	
SCT(G)	145	51.92	0.36	

* Significant at .01 level.
** Significant at .05 level.
C = Definite Ambiguous
T = Strong Weak

Duncan Range Test

	Means	H.Age .11	H.Ach .50	Oral .67	Roch 1.63	Comb 2.37
H.Age	.11		.39	.56	<u>1.52</u>	<u>2.26</u>
H.Ach	.50			.17	<u>1.13</u>	<u>1.87</u>
Oral	.67				.96	<u>1.70</u>
Roch	1.63					.74

Underlined figures indicate significant differences between the respective groups.

TABLE 72

CONTEXTUAL CUES STUDY

Means for Selection of Association Alternatives (Incorrect)

	When Strong Meaning is Correct			When Weak Meaning is Correct			Strong + Weak Subaverages		Overall Average
	Def	Ambig	Sub Aver	Def	Ambig	Sub Aver	Def	Ambig	
Oral	.73	1.07	.90	.57	.30	.43	.65	.68	.67
Comb	2.87	2.97	2.92	1.93	1.73	1.83	2.40	2.35	2.37
Roch	1.87	1.83	1.85	1.60	1.23	1.42	1.73	1.53	1.63
H.Ach	.90	.73	.82	.17	.20	.18	.53	.47	.50
H.Age	.17	.23	.20	.03	.00	.02	.10	.12	.11
Overall Average	1.31	1.37	1.34	.86	.60	.78	1.08	1.03	1.06

TABLE 73

SENTENCE CONSTRUCTION STUDY

Means and Standard Deviations for Age, IQ, Written Language Comprehension, and Socio-economic Background
N = 30

Group	Age	IQ	Stanford Reading Achievement[a]	SE[b]
Oral				
$\bar{X}$	14-5	110.2	5.0	3.5
SD	22 mo.	11.4	1.2	1.6
Combined				
$\bar{X}$	14-0	116.5	4.6	3.7
SD	22 mo.	14.5	0.8	1.8
Rochester				
$\bar{X}$	14-4	106.9	5.0	4.0
SD	21 mo.	10.0	1.0	1.4
H. Achievement				
$\bar{X}$	9-6	113.4	4.9	4.0
SD	10 mo.	8.9	1.1	1.4
H. Age				
$\bar{X}$	14-4	113.4	--	3.7
SD	21 mo.	9.2	--	1.4

[a] In grade level.

[b] Hollingshead Socio-economic Index.

TABLE 74

SENTENCE CONSTRUCTION STUDY

Stimulus Words

Related Pairs:	Adol. Eval.	College Eval.
1. father AA - dad 41	4.89	4.68
2. woman AA - lady AA	4.75	4.08
3. land AA - earth AA	4.05	4.08
4. horse AA - pony 22	3.89	3.80
5. music AA - song AA	3.89	3.61
6. mouse 34 - rat 37	3.43	3.70
7. hill AA - mountain AA	3.38	3.59
8. bath 49 - shower 41	3.33	3.52
Unrelated Pairs:		
1. kitchen AA - balloon 17	1.05	1.08
2. square AA - ocean AA	1.09	1.07
3. bread A - leg AA	1.09	1.15
4. button 39 - car AA	1.13	1.05
5. jelly 19 - bed AA	1.13	1.15
6. book AA - candy 44	1.17	1.18
7. church AA - dirt 21	1.13	1.07
8. baseball 15 - hole AA (ball-AA)	1.13	1.15

According to the Thorndike-Lorge word frequency count:
AA - 100 or more per million words
A - 50 or more per million words
Actual numbers indicate occurrence per million (from 1-49).

TABLE 75

SENTENCE CONSTRUCTION STUDY

Total Overlap

Means

	Related	Unrelated	Total
Oral	1.48	.87	1.17
Comb	1.82	1.10	1.46
Roch	1.79	1.05	1.42
H.Ach	2.34	1.41	1.88
H.Age	1.45	.94	1.19

Analysis of Variance

Source	df	ss	ms	F
Group (G)	4	19.54	4.89	9.07*
S/G	145	78.13	.54	
Relatedness (R)	1	37.04	37.04	146.83*
G X R	4	1.51	.38	1.50
SR(G)	145	36.59	.25	

* Significant at the .01 level.

Duncan Range Test

	Means	Oral 1.17	H.Age 1.19	Roch 1.42	Comb 1.46	H.Ach 1.88	Shortest Significant Ranges
Oral	1.17		.02	.25	.29	.71	R2 = .3724
H.Age	1.19			.23	.27	.69	R3 = .3923
Roch	1.42				.04	.46	R4 = .4056
Comb	1.46					.42	R5 = .4149

Underlined figures indicate significant differences between the respective groups.

TABLE 76

SENTENCE CONSTRUCTION STUDY

Function Word Overlap

Means

	Related	Unrelated	Total
Oral	2.97	2.25	2.61
Comb	3.95	3.03	3.49
Roch	4.02	2.86	3.44
H.Ach	4.16	3.22	3.69
H.Age	3.12	2.47	2.80

Analysis of Variance

Source	df	ss	ms	F
Group (G)	4	53.72	13.43	5.79*
S/G	145	336.59	2.32	
Relatedness (R)	1	57.72	51.72	50.25*
G X R	4	2.44	.61	.53
SR(G)	145	166.56	1.15	

* Significant at .01 level.

Duncan Range Test

	Means	Oral 2.61	H.Age 2.80	Roch 3.44	Comb 3.49	H.Ach 3.69	Shortest Significant Ranges
Oral	2.61		.19	.83	.88	1.08	R2 = .7728
H.Age	2.80			.64	.69	.89	R3 = .8142
Roch	3.44				.05	.25	R4 = .8418
Comb	3.49					.20	R5 = .8611

Underlined figures indicate significant differences between the respective groups.

TABLE 77

SENTENCE CONSTRUCTION STUDY

Content Word Overlap

Means

	Related	Unrelated	Total
Oral	.81	.24	.53
Comb	.80	.20	.51
Roch	.88	.24	.56
H.Ach	1.35	.43	.89
H.Age	.61	.27	.44

Analysis of Variance

Source	df	ss	ms	F
Group (G)	4	7.49	1.87	6.74**
S/G	145	40.29	.28	
Relatedness (R)	1	28.28	28.28	135.90**
G X R	4	2.48	.62	2.98*
SR(G)	145	30.17	.21	

** Significant at .01 level.
* Significant at .05 level.

Duncan Range Test

	Means	H.Age .44	Comb .51	Oral .53	Roch .56	H.Ach .89	Shortest Significant Ranges
H.Age	.44		.07	.09	.12	.45	R2 = .2184
Comb	.51			.02	.05	.38	R3 = .2301
Oral	.53				.03	.36	R4 = .2379
Roch	.56					.33	R5 = .2334

Underlined figures indicate significant differences between the respective groups.

TABLE 78

SENTENCE CONSTRUCTION STUDY

Number of Totally Clear Sentences

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	30.20	27.07	29.23	31.53	31.73
SD	2.12	4.70	2.61	.82	.60

Analysis of Variance

	df	ss	ms	F
Between	4	437.31	109.33	15.86*
Within	145	999.37	6.89	
Total	149	1436.68		

* Significant at .01 level.

Duncan Range Test

	Means	Comb 27.07	Roch 29.23	Oral 30.20	H.Ach 31.53	H.Age 31.73	Shortest Significant Ranges
Comb	27.07		2.16	3.13	4.46	4.66	R2 = 1.335
Roch	29.23			.97	2.30	2.50	R3 = 1.407
Oral	30.20				1.33	1.53	R4 = 1.454
H.Ach	31.53					.20	R5 = 1.488

Underlined figures indicate significant differences between the respective groups.

TABLE 79

SENTENCE CONSTRUCTION STUDY

Degree of Clarity

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	68.43	62.97	64.70	52.43	73.57
SD	9.29	6.42	7.48	12.15	6.58

Analysis of Variance

	df	ss	ms	F
Between	4	7369.17	1842.29	23.81*
Within	145	11221.37	77.39	
Total	149	18590.54		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 52.43	Comb 62.97	Roch 64.70	Oral 68.43	H.Age 73.57	Shortest Significant Ranges
H.Ach	52.43		10.54	12.27	16.00	21.14	R2 = 4.48
Comb	62.97			1.73	5.46	10.60	R3 = 4.72
Roch	64.70				3.73	8.87	R4 = 4.88
Oral	68.43					5.14	R5 = 4.99

Underlined figures indicate significant differences between the respective groups.

TABLE 80

SENTENCE CONSTRUCTION STUDY

Total Number of Words (all 32 sentences)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	267.80	231.80	230.93	179.07	333.03
SD	49.06	38.66	40.65	27.57	76.94

Analysis of Variance

	df	ss	ms	F
Between	4	387805.09	96951.27	38.63*
Within	145	363944.30	2509.96	
Total	149	751749.39		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 179.07	Roch 230.93	Comb 231.80	Oral 267.80	H.Age 333.03	Shortest Significant Ranges
H.Ach	179.07		51.96	52.73	88.73	153.96	R2 = 25.900
Roch	230.93			.87	36.87	102.10	R3 = 27.288
Comb	231.80				36.00	101.23	R4 = 28.213
Oral	267.80					65.23	R5 = 28.860

Underlined figures indicate significant differences between the respective groups.

TABLE 81

SENTENCE CONSTRUCTION STUDY

Average Number of Content Words Per Sentence

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	5.40	4.63	4.55	3.42	6.54
SD	1.03	.87	.77	.71	1.46

Analysis of Variance

	df	ss	ms	F
Between	4	159.38	39.84	39.15*
Within	145	147.57	1.02	
Total	149	306.95		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 3.42	Roch 4.55	Comb 4.63	Oral 5.40	H.Age 6.54	Shortest Significant Ranges
H.Ach	3.42		1.13	1.21	1.98	3.12	R2 = .5040
Roch	4.55			.08	.85	1.99	R3 = .5310
Comb	4.63				.77	1.91	R4 = .5490
Oral	5.40					1.14	R5 = .5616

Underlined figures indicate significant differences between the respective groups.

TABLE 82

SENTENCE CONSTRUCTION STUDY

Average Number of Function Words Per Sentence

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	2.97	2.60	2.66	2.16	3.86
SD	.59	.51	.61	.42	.98

Analysis of Variance

	df	ss	ms	F
Between	4	47.85	11.96	27.87*
Within	145	62.25	.43	
Total	149	110.10		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 2.16	Comb 2.60	Roch 2.66	Oral 2.97	H.Age 3.86	Shortest Significant Ranges
H.Ach	2.16		.44	.50	.81	1.70	R2 = .3360
Comb	2.60			.06	.37	1.26	R3 = .3540
Roch	2.66				.31	1.20	R4 = .3660
Oral	2.97					.89	R5 = .3744

Underlined figures indicate significant differences between the respective groups.

TABLE 83

SENTENCE CONSTRUCTION STUDY

Simple Sentences

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	27.70	28.77	28.67	30.27	23.50
SD	3.90	3.07	3.40	1.91	5.26

Analysis of Variance

	df	ss	ms	F
Between	4	788.04	197.01	14.58*
Within	145	1959.70	13.52	
Total	149	2747.74		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 23.50	Oral 27.70	Roch 28.67	Comb 28.77	H.Ach 30.27	Shortest Significant Ranges
H.Age	23.50		4.20	5.17	5.27	6.77	R2 = 1.873
Oral	27.70			.97	1.07	2.57	R3 = 1.974
Roch	28.67				.10	1.60	R4 = 2.040
Comb	28.77					1.50	R5 = 2.087

Underlined figures indicate significant differences between the respective groups.

TABLE 84

SENTENCE CONSTRUCTION STUDY

Compound, Complex and Compound-Complex Sentences (Total Number)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	4.23	3.17	3.33	1.40	8.50
SD	3.81	3.09	3.39	1.83	5.26

Analysis of Variance

	df	ss	ms	F
Between	4	843.69	210.92	15.82*
Within	145	1932.90	13.33	
Total	149	2776.59		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach 1.40	Comb 3.17	Roch 3.33	Oral 4.23	H.Age 8.50	Shortest Significant Ranges
H.Ach	1.40		1.77	1.93	2.83	7.10	R2 = .588
Comb	3.17			.16	1.06	5.33	R3 = .620
Roch	3.33				.90	5.17	R4 = .641
Oral	4.23					4.27	R5 = .655

Underlined figures indicate significant differences between the respective groups.

TABLE 85

SENTENCE CONSTRUCTION STUDY

Passive Sentences

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	.77	.97	.60	.10	3.00
SD	1.22	1.19	.90	.30	2.50

Analysis of Variance

	df	ss	ms	F
Between	4	149.64	37.41	18.70*
Within	145	290.23	2.00	
Total	149	439.87		

* Significant at .01 level.

Duncan Range Test

	Means	H.Ach .10	Roch .60	Oral .77	Comb .97	H.Age 3.00	Shortest Significant Ranges
H.Ach	.10		.50	.67	.87	2.90	R2 = .720
Roch	.60			.17	.37	2.40	R3 = .758
Oral	.77				.20	2.23	R4 = .784
Comb	.97					2.03	R5 = .802

Underlined figures indicate significant differences between the respective groups.

TABLE 86

SENTENCE CONSTRUCTION STUDY

Stereotyped Sentences (5 Words or Less)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	3.73	7.80	7.83	17.73	1.77
SD	2.84	5.61	6.55	8.22	3.52

Analysis of Variance

	df	ss	ms	F
Between	4	4548.23	1137.06	35.00*
Within	145	4710.07	32.48	
Total	149	9258.30		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 1.77	Oral 3.73	Comb 7.00	Roch 7.83	H.Ach 17.73	Shortest Significant Ranges
H.Age	1.77		1.96	6.03	6.06	15.46	R2 = 2.579
Oral	3.73			4.07	4.10	13.50	R3 = 2.717
Comb	7.80				.03	9.43	R4 = 2.809
Roch	7.83					9.40	R5 = 2.874

Underlined figures indicate significant differences between the respective groups.

TABLE 87

SENTENCE CONSTRUCTION STUDY

Grammatical Scoring - Minor Categorial Errors (Proportions)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	15.90	30.77	25.87	1.20	1.20
SD	13.15	19.50	16.60	3.08	2.63

Analysis of Variance

	df	ss	ms	F
Between	4	22450.84	5612.71	33.18*
Within	145	24529.13	169.17	
Total	149	46979.97		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 1.20	H.Ach 1.20	Oral 15.90	Roch 25.87	Comb 30.77	Shortest Significant Ranges
H.Age	1.20		.00	<u>14.70</u>	<u>24.67</u>	<u>29.57</u>	R2 = 6.608
H.Ach	1.20			<u>14.70</u>	<u>24.67</u>	<u>29.57</u>	R3 = 6.962
Oral	15.90				<u>9.97</u>	<u>14.87</u>	R4 = 7.198
Roch	25.87					4.90	R5 = 7.363

Underlined figures indicate significant differences between the respective groups.

TABLE 88

SENTENCE CONSTRUCTION STUDY

Grammatical Scoring - Strict Subcategorial Errors (Proportions)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	5.63	12.50	9.13	1.20	.10
SD	4.57	9.81	7.19	3.09	.55

Analysis of Variance

	df	ss	ms	F
Between	4	3289.24	822.31	23.00*
Within	145	5183.43	35.75	
Total	149	8472.67		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age .10	H.Ach 1.20	Oral 5.63	Roch 9.13	Comb 12.50	Shortest Significant Ranges
H.Age	.10		1.10	5.53	9.03	12.40	R2 = 3.024
H.Ach	1.20			4.43	7.93	11.30	R3 = 3.186
Oral	5.63				3.50	6.87	R4 = 3.294
Roch	9.13					3.37	R5 = 3.3696

Underlined figures indicate significant differences between the respective groups.

TABLE 89

SENTENCE CONSTRUCTION STUDY

Grammatical Scoring - Transformational Errors (Proportions)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	2.03	2.87	1.53	.33	.10
SD	3.13	6.97	2.91	1.22	.55

Analysis of Variance

	df	ss	ms	F
Between	4	161.83	40.46	2.94*
Within	145	1997.27	13.77	
Total	149	2159.09		

* Significant at .05 level.

Duncan Range Test

	Means	H.Age .10	H.Ach .33	Roch 1.53	Oral 2.03	Comb 2.87	Shortest Significant Ranges
H.Age	.10		.23	1.43	1.93	2.77	R2 = .596
H.Ach	.33			1.20	1.70	2.54	R3 = .628
Roch	1.53				.50	1.34	R4 = .650
Oral	2.03					.84	R5 = .665

Underlined figures indicate significant differences between the respective groups.

TABLE 90

SENTENCE CONSTRUCTION STUDY

Grammatical Scoring - Morphological Errors (Proportions)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	29.07	43.80	43.53	2.20	2.00
SD	17.08	23.50	17.74	3.43	3.38

Analysis of Variance

	df	ss	ms	F
Between	4	52752.91	13188.23	55.82*
Within	145	34256.93	236.25	
Total	149	87009.84		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 2.00	H.Ach 2.20	Oral 29.07	Roch 43.53	Comb 43.80	Shortest Significant Ranges
H.Age	2.00		.20	27.07	41.53	41.80	R2 = 7.812
H.Ach	2.20			26.87	41.33	41.60	R3 = 8.231
Oral	29.07				14.46	14.73	R4 = 8.510
Roch	43.53					.27	R5 = 8.705

Underlined figures indicate significant differences between the respective groups.

TABLE 91

SENTENCE CONSTRUCTION STUDY

Grammatical Scoring - Total Number of Errors (Proportions)

Means and Standard Deviations

	Oral	Comb	Roch	H.Ach	H.Age
$\bar{X}$	60.60	104.43	90.23	6.17	4.60
SD	32.59	54.02	31.02	8.45	5.21

Analysis of Variance

	df	ss	ms	F
Between	4	258755.29	64688.82	64.01*
Within	145	146537.30		
Total	149	405292.59		

* Significant at .01 level.

Duncan Range Test

	Means	H.Age 4.60	H.Ach 6.17	Oral 60.60	Roch 90.23	Comb 104.43	Shortest Significant Ranges
H.Age	4.60		1.57	56.00	85.63	99.83	R2 = 16.184
H.Ach	6.17			54.43	84.06	98.26	R3 = 17.051
Oral	60.60				29.63	43.83	R4 = 17.629
Roch	90.23					14.20	R5 = 18.034

Underlined figures indicate significant differences between the respective groups.