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A TEST OF AUDITORY-VISUAL SPEECH PERCEPTION

FOR HEARING-IMPAIRED CHILDREN

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ABSTRACT

Twenty-five video-taped sentences (S-V-DO-prep. phrase) were presented audio-visually to 55 hearing-impaired children of HTL range 63-128 dB. Written responses were scored on the basis of four key words per sentence. Children with HTLs 95 dB or better typically scored high (68-95%); scores varied widely (0-88%) for those with HTLs 96 dB or poorer. Results may be used for class grouping and for judging likelihood for success in a "mainstreamed" program.

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The importance of auditory-visual perception of speech to hearing-impaired persons is well known: receptive oral communication usually involves watching the face of the talker and listening through a hearing aid to receive speech information. That is, observation of both auditory and visual cues probably is the typical mode of speech perception for most hearing-impaired persons (Erber, 1975). It follows from this that an important sensory condition for clinical evaluation is that of speech perception through both auditory and visual modalities simultaneously. Combined auditory-visual (A-V) perception is not only used by deaf children in most daily situations, but also is the usual process through which they acquire speech-encoded language. Thus, a child's ability to perceive speech audiovisually could be used to estimate his performance in daily conversation (Erber, 1977a).

A hearing-impaired child typically is exposed to speech stimuli in the form of sentences presented to his eyes and ears; therefore, his performance on an A-V test of sentence perception may indicate his everyday receptive communication ability as well as predict his ability to acquire information on his own. Few tests[5] currently are available for evaluating the combined auditory-visual speech perception of hearing-impaired children with sentences as the test material. Many laboratory

studies have used words as stimuli in examining the auditory, visual, and auditory-visual speech perception abilities of hearing-impaired children (Numbers and Hudgins, 1948; Hopkins, 1953; Quick, 1953; Hudgins, 1954; Prall, 1957; Hutton, Curry, and Armstrong, 1959; Evans, 1960; Sanders, 1968; Ross, Kessler, Phillips, and Lerman, 1972; Danielsen, 1973; Ritsma, 1974). Only a few investigators have used sentences as stimuli in stidying A-V speech perception (Craig, 1964; Binnie, 1974; Gammel, 1974; Hasselrot, 1974; Ludvigsen, 1974). The reason for this is that the construction and reliable scoring of sentences is very difficult. However, even though syllables and words allow precision and ease of measurement, sentences represent the typical content of daily conversation encountered by a hearing-impaired child and therefore are more desirable as test materials (Binnie, 1974; Erber, 1977a). A test of key-word recognition samples a deaf child's ability to extract information from a sentence while avoiding most of the difficulties in scoring whole-sentence responses (Erber and McMahon, 1976).

A child's score on a test of A-V speech perception containing sentences represents a relatively unbiased estimate of the child's daily communication ability and would be significant information for the teacher or clinician responsible for that child. For example, A-V speech perception test scores may be useful in grouping hearing-impaired children into classes for presentation of content material or for aural rehabilitation work, in evaluating a child's progress or improvement over a period of instruction or therapy, and in making decisions regarding a child's readiness for integration into a regular public school program. The purpose of this study was to develop a simple test of A-V speech perception and evaluate its usefulness.

Method

Subjects

Fifty-five hearing-impaired children (age range 9-15 years) from classes at Central Institute for the Deaf participated in this study. Their average hearing-threshold levels in the better ear for 500-1000-2000 Hz ranged from 63 to 128 dB. All of the children used lipreading and hearing aids for daily conversation. The only criterion for selection of subjects was that they be able to write the stimulus sentences quickly and legibly after they were presented.

Speech Stimuli

Words were selected for use in the test sentences on the basis of two criteria: familiarity to the subjects and a high frequency of occurrence in English. The familiarity of the words was determined by giving the subjects a list of 166 words containing a variety of nouns and verbs at a rather simple vocabulary level (e.g., cat, father, bedroom), and asking the children to indicate the words they did not know. (This list is included in the Appendix.) The frequency of occurrence of the same 166 words was obtained from the word frequency count of Carroll, Davies, and Richman (1971). The criteria used for selecting words from the list for use in the test sentences were: (1) that not more than two children out of 55 indicated that they were unfamiliar with the word, OR (2) that the words were within the first 5000 most frequently-occurring words in English. From the 162 words selected in this way, 120 words (90 nouns and 30 verbs) were used to construct 30 sentences of the form subject-verb-direct object-prepositional phrase. This sentence type is one of the first sentence-types learned by deaf children and is commonly

used in classes for hearing-impaired children. It therefore was very familiar to the subjects. Sentences were constructed with only animate nouns in the subject position because it has been found that animate nouns are more intelligible through lipreading than are inanimate nouns when used as subjects in sentences (Erber and McMahon, 1976). All sentences contained transitive verbs and ranged in length from 8 to 12 syllables (8 to 10 words). An attempt was made to construct sentences with moderate contextual redundancy. (See Appendix.)

Test Procedure

A black and white video tape was made of an experienced female teacher of the deaf saying the 30 sentences. The talker sat before a black cloth screen, while special lighting provided mouth-level illumination of the interior of her mouth. The talker said each of the sentences once, without exaggeration and with normal vocal effort, stress, and rhythm. She did not know how the test was to be scored and therefore gave no special emphasis to the key words. A 30-second pause followed each sentence to allow the subjects to write their responses. When necessary, the length of this response interval was extended in order to permit all of the children to complete their written responses. Timed signal lights, automatically triggered by a 7000-Hz tone on the video tape, defined for the subjects the intervals during which they were to get ready, to listen and watch the video monitor, and to write their responses.

The test was presented to groups of two to four children. They each received amplified binaural auditory signals through a wired group hearing aid system and TDH-49 earphones, and simultaneously watched a

life-size playback image on a 19-inch video monitor six to ten feet away. They were instructed to look at the talker on the monitor, to listen through the earphones, and to write what they thought the talker said, even if they weren't sure. Each child adjusted his own binaural attenuators for most comfortable listening level during presentation of five practice sentences prior to testing. Although the children were told that there were 35 sentences on the test and their answer sheets provided spaces for 35 responses, there were actually only 30 sentences presented on the video tape. It has been observed that some children's performance in particular test situations tends to diminish when they near the end of the test session. This procedure was used to maintain the subjects' level of motivation throughout all test items.

In addition to measuring the children's A-V speech perception abilities with the video-taped sentences, evaluations from their teachers also were obtained. Each child's teacher was asked to rate him on his ability to understand spoken language when he both looks at the speaker and listens through his hearing aid. A five-point rating scale from (1) poor to (5) excellent was used. The children were rated in five different communication situations: (A) when the speaker is familiar to the child and the context of the communication situation is known; (B) when the speaker is unfamiliar to the child but accustomed to talking to deaf children, and the context is known; (C) when the speaker is familiar to the child and the context is unknown; (D) when the speaker is unfamiliar to the child but accustomed to talking to deaf children, and the context is unknown; and (E) when the speaker is unfamiliar to the child and unaccustomed to talking to deaf children, and the context is unknown. These teacher-ratings then were compared with the results

obtained under laboratory conditions.

Results

Scoring Procedure

The children's written responses were scored on the basis of correctness of key words. Only the four key words in each sentence were scored (subject, verb, direct object, object of the preposition). This yielded a maximum score of 100 points (4 words x 25 sentences). Two methods of scoring the subjects' responses were used which differed with respect to the strictness of the scoring rules. "Strict" scoring was accomplished according to the following rules: Credit was given for key words which were properly written, regardless of whether they were written in the correct position in the sentence. That is, despite incorrect word order, these responses were considered correct identification of the key words. Misspelled words were considered correct. Secondary spellings referred to on the Northampton charts were allowed (e.g., "fead" for "fed", or "cloues" for "clothes"); however, if more than half of the phonetic elements either were missing or were transformed in some way, the word was considered in error (e.g., "chri" for "Christmas" or "ploic" for "policeman"). Homophenous words were scored as errors (e.g., "through" for "threw"). Misspelled words which formed other words were considered errors (e.g., "super" for "supper"). Reversals of the root words of a compound word (e.g., "ballbase" for "baseball") were considered correct. The creation of a morphological change was scored as incorrect (e.g., the addition or deletion of -s, -ed, or -ing), as was a change in verb tense (e.g., "rode" for "ride").

The "lax" scoring method followed the same rules for word order,

misspellings, secondary Northampton spellings, and root-word reversal as in the strict scoring procedure. In addition, homophenous words were scored as correct responses. Verb-tense changes also were considered correct (e.g., "give" for "gave"). Modifications of morphological endings, such as plural markers and tense markers, were ignored (e.g., "teacher" was accepted for "teachers," and "drop" for "dropped"). Credit was given for parts of compound words (e.g., "police" for "policeman") and for synonymous words resembling the key words (e.g., "bike" for "bicycles"). In general, under the lax scoring method, credit was given for any word in a subject's responses which resembled the key words. Even gross deviations in the phonologic and linguistic structure of the key words were accepted.

Findings

Scores obtained on the test ranged from 0 to 95% correct (strict scoring). The distribution of scores was skewed, with almost half (26) of the children correctly identifying 60-85% of the key words. As Figure 1 illustrates, children with mean 3-frequency HTLs 95 dB or better typically scored high (68-95%); scores varied widely (0-88%) for those with HTLs 96 dB or poorer.

This pattern of scores is virtually unchanged when the scores using the lax scoring method are examined (Figure 2). Although the scores are somewhat elevated when the lax scoring method is used, the configuration of the distribution remains basically the same (Figures 1 and 2). The increments in test scores that result from using the lax scoring method ranged from 0-21 points, with the mean increase equal to 9.8 points. A comparison of test scores obtained with the strict and lax scoring

methods is shown in Figure 3.

As Figure 4 shows, there was a close relation between the children's test scores and the teachers' ratings of their A-V speech perception abilities in the situation most comparable to that of the test: that in which the speaker was unfamiliar to the children but accustomed to talking to deaf children, and the context was unknown (situation D). The A-V speech perception abilities of most of the children seemed to be rated lower than their test performance indicates. (Only the teacher-ratings for situation D have been graphed since that context is most comparable to the test. Ratings for situations A, B, C, and E are presented in the Appendix.)

Discussion

Distribution of Scores

The obtained test scores are distributed roughly into two groups: moderately high scores (68-95%) for children with mean 3-frequency HTLs 95 dB or better, and a wide range of scores (0-88%) for children with HTLs 96 dB or poorer (Figure 1). These results can be interpreted as indicating that children with mild-to-moderate hearing impairments (mean HTLs 95 dB or better) are able to use the minimal information available in the amplified auditory signal to complement lipreading and thus achieve high A-V performance.

There are many plausible explanations for the great dispersion of scores for children with mean HTLs 96 dB or poorer. For example, this dispersion may reflect a wide range of lipreading ability among children with profound hearing impairments. Research findings indicate that children with HTLs in this range receive very little spectral information

from acoustic speech signals. Their principal acoustic cues for speech are the time and intensity patterns contained in the waveform envelope, and they may receive this information tactually (Erber, 1972, 1977b). Thus, the principal method of speech perception for an oral, profoundly deaf child is lipreading (Erber, 1974b). A wide range of lipreading ability is known to exist among children with profound impairments (Berger, 1972; Jeffers and Barley, 1971). The dispersion of scores for the children with HTLs 96 dB+ may reflect this range.

It may be that the group of subjects with mean HTLs 96 dB or poorer contains a mixture of two kinds of children who function differently auditorily. These two groups have been described by Erber (1974a) as children who possess true hearing and can perceive some spectral cues of speech ("hearers"), and children who receive only vibrotactile information through their ears and can perceive mainly the time and intensity patterns of speech ("feelers"). Those in the 96+ group who scored high on the test may be "hearers," and those children who scored low may be "feelers." Some of the children who scored low may, in fact, possess true hearing, but may not yet have developed the ability to use their hearing along with lipreading to help them understand speech. These children may be capable of better A-V performance after receiving specific training in the use of the auditory sense for speech perception.

Because testing with connected material, such as sentences, confounds speech perception with knowledge of language (Erber, 1977a), the wide variability in scores for the profoundly deaf children may be a reflection of a wide range of language ability. The syntactic and semantic redundancy of language should help the observer resolve ambiguities and fill gaps in the perceived speech signal (Jeffers and Barley, 1971). Miller, Heise,

and Lichten (1951) demonstrated that normal-hearing adults, who listened to speech in noise, could understand words heard in sentences considerably better than they could understand the same words presented in isolation. But the linguistic organization of a sentence cannot help an observer identify constituent words unless he has sufficient knowledge of typical language patterns to make use of this information (Erber and McMahon, 1976). Without knowledge of the rules of language, a child may not know, for example, that the last word of a prepositional phrase is a noun. (He may not even know what a prepositional phrase is.) This is knowledge which could aid his receptive oral communication ability. Children with poor receptive or expressive language may not have sufficient knowledge to make use of the linguistic redundancy of sentences, whereas children with higher levels of language ability can benefit from this redundancy.

A child's language knowledge also may be related to his perception of smaller morphological units such as plural markers (-s, -es) and verb-tense markers (-ed, -ing). These word endings typically are not visible on the lips of the speaker, are usually unstressed, and may even disappear in normal, running speech. Since they are both difficult to see and to hear, a deaf child's language ability may determine whether or not he is aware of their presence. For example, he may correctly perceive the plural verb "are," but he may not have sufficient language knowledge to know that the subject also must be plural, and then to add an appropriate plural ending to the subject even though he did not actually perceive it. (It could also be argued that he has not developed mastery of these aspects of language because he does not or cannot perceive them. Regardless, the important point is not the directionality of the relation

between language and speech perception, but rather that a relation exists.

Materials, Environment, and Scoring Factors

The omission of morphological endings was an extremely common error among the subjects tested. It resulted in the loss of many points under the strict scoring method and, conversely, the gain of many points under the lax scoring method. The majority of the increments in test scores obtained with the lax procedure (see Figure 3) represent credit given for words with omitted morphological endings. The examiner's familiarity with the children in the study led to the general observation that children with lower levels of language, relative to the other subjects, were those who exhibited many of these types of errors in their responses. The children with higher language levels had relatively fewer of these errors. Children with greater language ability probably achieved higher A-V performance than those with less language skill because of an ability to exploit linguistic redundancy and knowledge of morphological word endings. In this way, a child's language ability is likely to be reflected in his speech perception performance.

Other factors influencing test performance are related to the test situation and to the test itself. Some of the children's test scores may indicate poorer A-V speech perception than they are actually capable of in real-life communication situations because they were obtained in a laboratory situation. Special test equipment, earphones, and changing light signals are elements of the testing situation which may have caused a child to perform differently. Even though optical and acoustic conditions during the test were optimal for A-V speech perception, the situation itself may have had a distracting effect on the child which could have

adversely influenced his performance on the test.

The response mode itself also may have affected performance. Children typically are not asked to write verbatim what someone says to them; they usually respond to someone's speech with an action or an oral response. The response mode used for the test was therefore one with which they were unfamiliar, and may have affected performance. Still, written responses are easily and accurately scored.

Test performance also may have been influenced by certain aspects of the test material. The length of the stimulus sentences and the rate at which the speaker said the sentences may have had minor effects on performance. More important, however, may be the fact that the sentences were presented only once. Many children may be accustomed to receiving two or even three presentations of speech stimuli. Erber and Greer (1973) and Erber and Zeiser (1974) found that repetition of all or part of an utterance was one of the most commonly used strategies used by teachers of the hearing impaired following difficulty in oral communication with their students. Since this is a common response pattern, many hearing-impaired children may be accustomed to and even dependent upon the advantage of having an utterance repeated. Their educational experience may have rarely required them to respond to the first presentation of anything. That is, they may have always gotten at least two chances to lipread and listen. This practice may establish a dependency on multiple presentations of speech material, with the child unable to understand or cope with a single presentation.

Another important feature of the test which may have adversely influenced a child's ability to identify the stimuli audiovisually is that the test sentences were unrelated, and therefore the test contained no

overall contextual cues. A hearing-impaired person can get valuable speech-related information that may aid his understanding of what is being said from non-verbal sources such as gestures, facial expression, and situational cues. The latter include the physical environment in which the conversation takes place, objects in the environment, and knowledge of the roles of the participants in the conversation (Berger, 1972). Recognition of these situational and contextual cues often assists the hearing-impaired individual by increasing the probability of successfully guessing the subject matter under discussion and even by increasing expectancy for certain words, phrases, or topics. The value of these contextual cues was pointed out by the findings of Smith and Kitchen (1972) in which lipreading performance for sentences improved as contextual cues were presented. The strategy of providing supplementary information in the form of additional situational cues was one of the basic response patterns of the teachers studied by Erber and Greer (1973).

The information provided by situational cues typically is available to the hearing-impaired observer in most everyday communication situations. The test of A-V speech perception in this study, however, contains virtually none of this helpful information, and the resulting test scores therefore may be unreasonably low estimates of A-V speech perception in real-life communication situations. Some of the children in this study may be "situation readers"; i.e., they may rely a great deal on this kind of information for their understanding of speech. Their scores may reflect the absence of context more than those of other children who rely less on situational cues. The extremely low scorers (below 20) shown in Figure 1 may be children who, although they may actually have rather poor A-V speech perception abilities, appear to understand more in

everyday situations because they can get a lot of information from the situational context. When these clues are absent, as they are in the test, their speech perception abilities seem to be even poorer.

The apparent importance of situational or contextual cues to the perception of speech by hearing-impaired individuals may be an important argument for including such cues in tests of A-V speech perception. A few investigators have suggested the use of tests which depict normal, everyday communication situations for evaluating the A-V speech perception abilities of hearing-impaired persons. Byman (1974) advocates the use of a "life-like" test on the basis of its validity in evaluating the overall communicative functioning of a hearing-impaired person. He suggests that, without including situational context, a test cannot approximate real-life communication. Binnie (1974) also suggested the use of sentences to measure how hearing-impaired persons receive everyday speech in person-to-person communication situations. Svendsen (1974) has used films of people in everyday communication situations (e.g., one centered around breakfast and another around dinner) to examine hearing-impaired persons' capacities to understand spoken language.

The value of real-life communication tests such as these can readily be seen. However, a test of A-V speech perception which contains unrelated sentences certainly is closer to an everyday communication situation than are most conventional (auditory) audiometric methods existing at the present time.

Teacher Ratings

Although there appeared to be a close relation between the children's test scores and the ratings of their speech perception abilities made by

their teachers, their performance on the test seemed to be better than what would have been expected based on the teacher-ratings; i.e., the children were generally underrated by their teachers. There may be several reasons for this discrepancy. First, each child was rated only once by a single teacher, and ten different teachers participated in the rating of the 55 subjects. The reliability of the ratings is therefore questionable. Second, the teachers may not have had the opportunity to observe the children they rated in the five different situations described. Ratings for situations other than those the teachers have direct knowledge of probably were based on the teachers' impressions of the children's speech perception abilities while in their classes. These impressions probably were influenced by the intelligibility of the teachers themselves, and also the content area in which the teachers typically interact with the children. For example, a child's A-V speech perception ability may appear to be better in a content subject in which he is adept (e.g., social studies) than in a subject in which he has less facility (e.g., science). In this example, the social studies teacher probably would have rated that child's speech perception ability higher than the science teacher would have. Since the teachers were asked to estimate their students' speech perception abilities in situations in which they may not have actually observed the children, some of their ratings may be inaccurate because they were required to extrapolate from familiar experience.

Another possible reason for the discrepancy between ratings and test scores may be due to the nature of the test sentences; i.e., their simple vocabulary and sentence form. The teachers may have rated the children on their abilities to understand the kind of speech material typically presented to the children in class, which may be at a higher

language level. Here again, the relation between language and speech perception seems to be important. A child's ability to perceive speech audiovisually when the stimuli are at a basic language level (e.g., the test) may in fact be better than his ability to understand when the stimuli represent more complex language (e.g., the teachers' ratings).

Grouping and Placement

Speech perception through audition and vision simultaneously is an important sensory condition for clinical evaluation (Erber, 1977a). A test of A-V speech perception of the kind described in this study may provide the clinician or educator with a valuable estimate of a hearing-impaired child's receptive communication skills under certain conditions. (In this instance, the talker was an experienced teacher, optical and acoustic conditions were optimal, and the sentences were unrelated, were of basic form, and contained simple vocabulary.) The information gained from such a brief, video-taped test may be useful in several contexts.

A-V speech perception scores may be used in grouping hearing-impaired children into classes for presentation of content material or for aural rehabilitation work. For most purposes of oral education, a classification based on speech perception ability possesses more validity than does one based on detection of nonspeech stimuli such as tones (Erber, 1974a).

A test of A-V speech perception may be very useful as a screening device. A brief video-taped test is practical for group administration and can rapidly provide a description of a child's abilities. If a child's performance does not meet some predetermined criterion, the teacher or clinician will want to specify the child's particular perceptual

problems before beginning special instruction or therapy in speech perception. Auditory and visual recognition of video-taped sentences which differ in length and syntactic form could be used for this sort of diagnostic evaluation (Erber, 1977a). This kind of test would describe, for each modality, how a child's speech perception abilities and his knowledge of language interact. In addition, combined A-V perception when compared with perception through either mode alone, helps the clinician understand which sensory system the child tends to rely on in communication, and how well he is able to combine cues for speech that he obtains separately through the two modalities. The information obtained through such diagnostic testing would be useful to the teacher or therapist in planning remedial training programs in speech perception, in choosing the sensory system to be emphasized, and in selecting speech-perception practice materials (Brink, 1974; Erber, 1977a). An A-V test could then be given at the end of the period of training to evaluate the child's progress or improvement in speech perception ability.

Hasselrot (1974) has suggested obtaining articulation curves with A-V tests and expressing a person's A-V speech perception capacity in terms of a threshold value. Whether a hearing-impaired person's A-V speech perception ability is expressed as a percentage score or as a threshold value, the description of this ability is an important piece of information for the teacher or clinician working with that individual.

Another clinical use of a test of A-V speech perception may be within the context of hearing aid selection. Brink (1974) suggests using an A-V test to check the effects of listening through different hearing aids on a client's speech perception performance. The hearing aid which yields the best speech perception performance may then be considered (along with other factors) for selection.

A child's A-V speech perception test score may also be a valuable piece of objective data useful when making decisions regarding the readiness of that child for integration into a regular public school program. Many other factors, of course, also will be taken into consideration, notably, the child's language ability, reading level, and speech intelligibility. After gaining experience with particular tests of A-V speech perception, educators and administrators involved in these decisions may determine that a child should maintain an A-V speech perception score of an established minimum value in order for integration to be recommended. This determination will come after the tests have been used with many hearing-impaired children in schools, and the educators have had experience with a wide variety of children and have seen the results of integrating some of these children. A minimum level of A-V speech perception proficiency may then be determined on the basis of the success and failure of these children in public school programs.

In conclusion, a test of A-V speech perception such as the one described in this paper can provide the teacher or clinician with useful information regarding the receptive communication ability of hearing-impaired children. The test is short, easily administered, can be used with children 9 to 15 years of age with hearing impairments ranging from moderate to profound, and provides objective data that is useful in a variety of ways. Similar video-taped A-V tests may eventually form part of the audiological test battery administered in hearing clinics and schools for the deaf. Future development of speech-perception test should have as its goal the creation of measures that give specific information about a child's perceptual strengths and weaknesses and that suggest directions or strategies for instruction.

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Figures

Figure Titles

Figure 1

Test scores obtained using strict scoring method as a function of subjects' mean 3-frequency HTLs in the better ear.

Figure 2

Test scores obtained using lax scoring method as a function of subjects' mean 3-frequency HTLs in the better ear.

Figure 3

Comparison of test scores obtained with strict and lax scoring methods. (Diagonal line represents equal test scores under the two scoring methods.)

Figure 4

Test scores (strict method) as a function of teacher-ratings of subjects' speech perception abilities in situation D: unfamiliar speaker unaccustomed to talking to deaf children and unknown context.

Figure 1

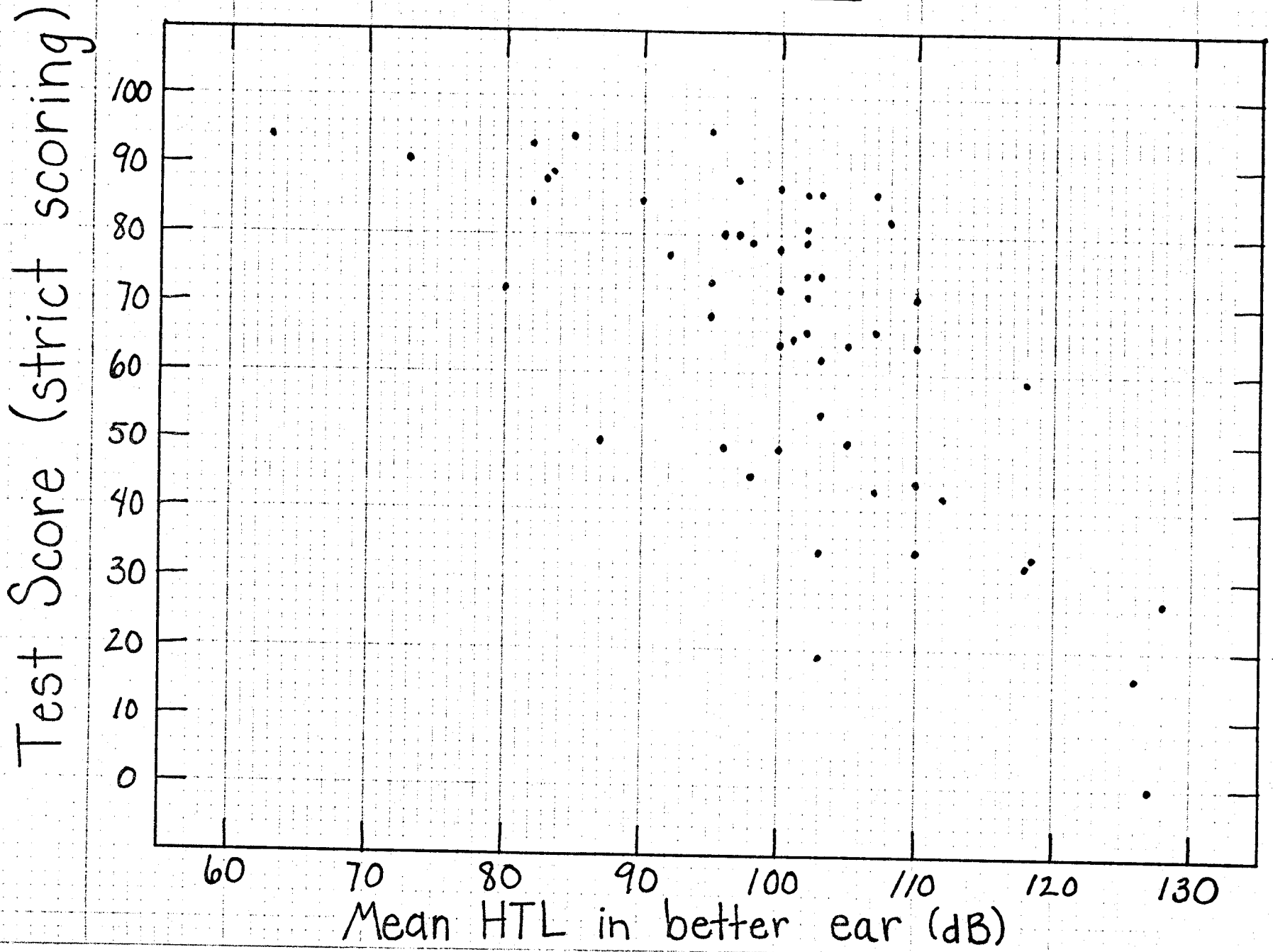

Test Score (strict scoring)
100
90
80
70
60
50
40
30
20
10
0
60
70
80
90
100
110
120
130
Mean HTL in better ear (dB)

Figure 2

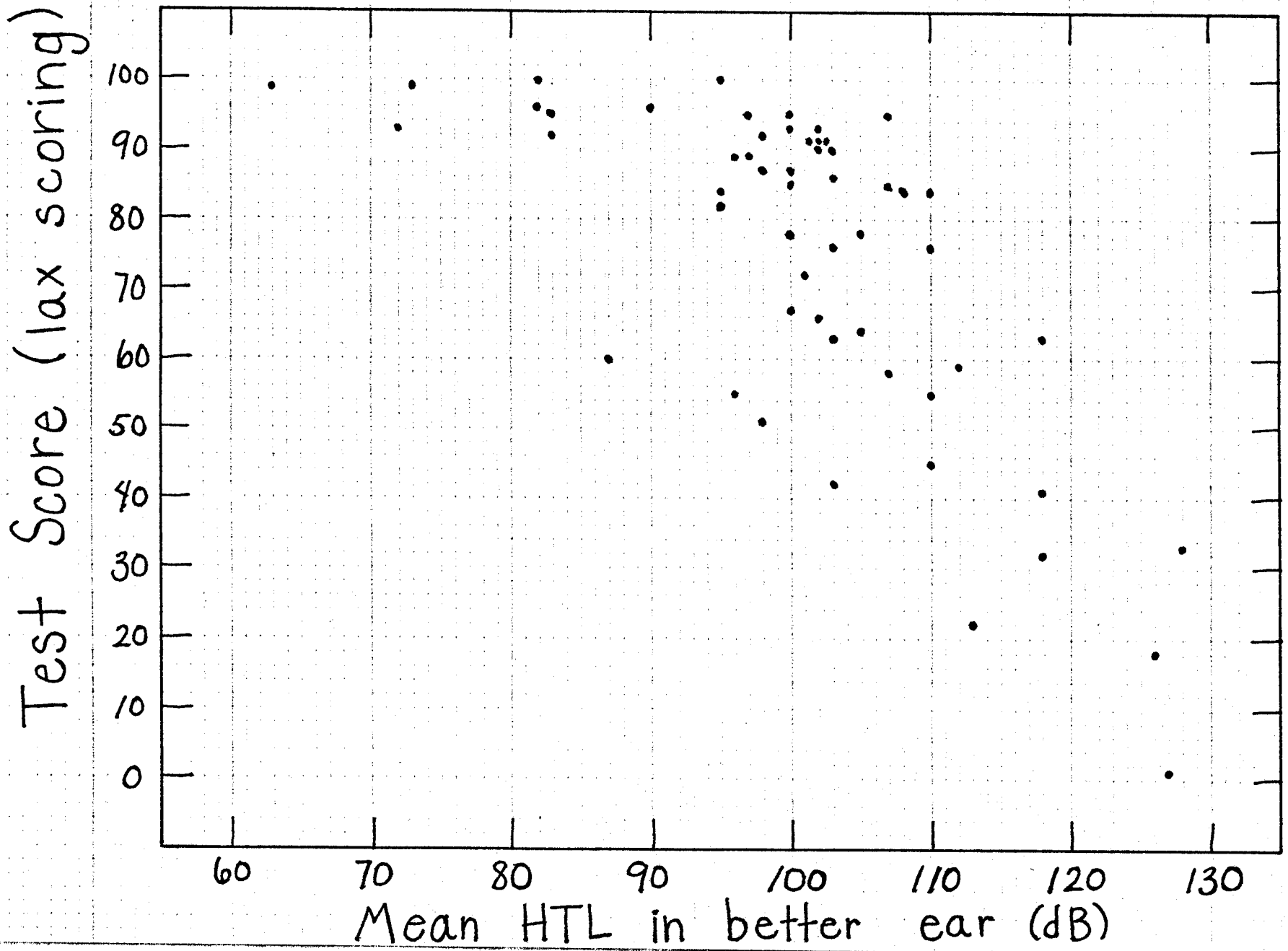

Test Score (lax scoring)
100
90
80
70
60
50
40
30
20
10
0
60
70
80
90
100
110
120
130
Mean HTL in better ear (dB)

Figure 3

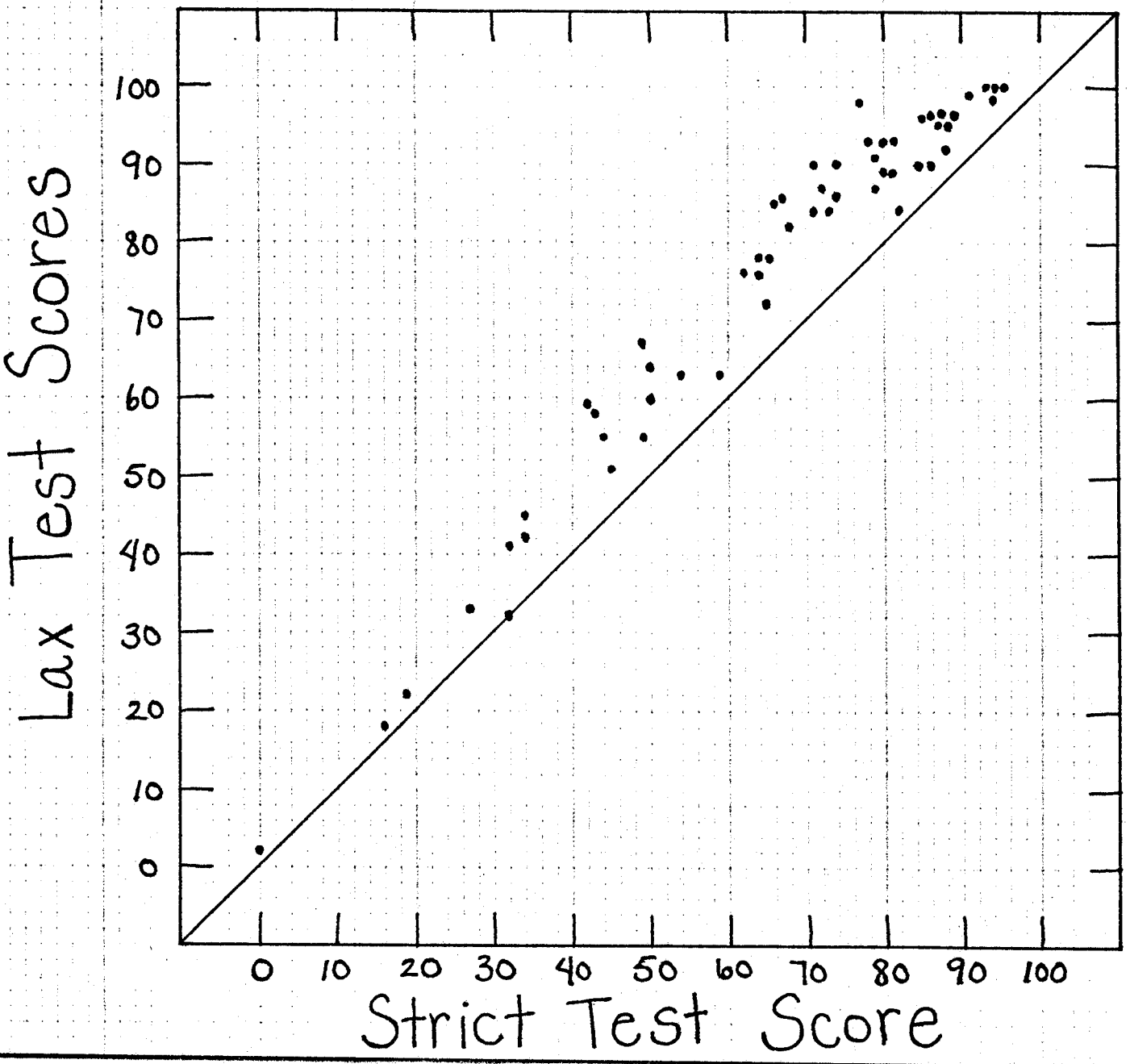
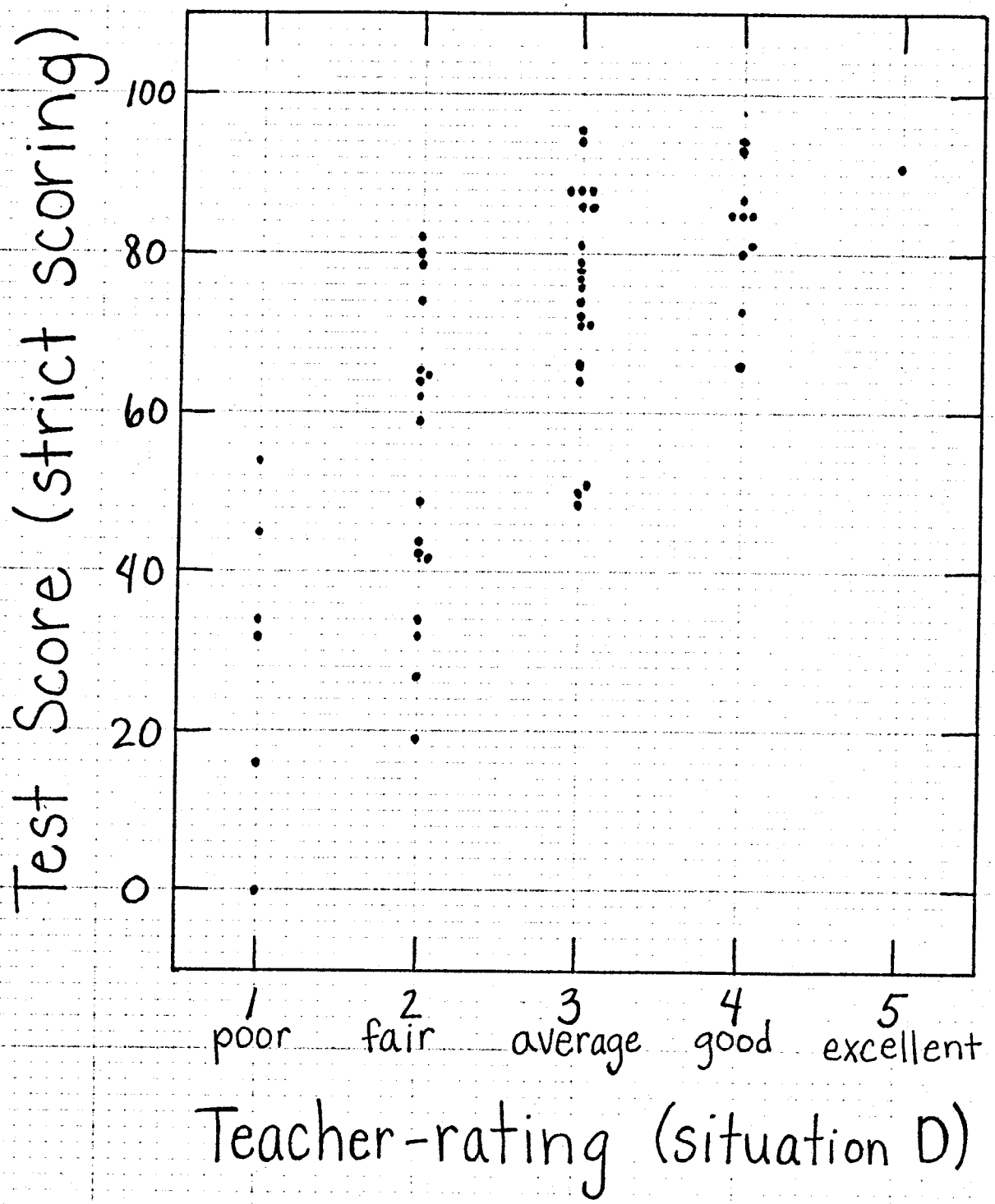

Lax Test Scores
100
90
80
70
60
50
40
30
20
10
0
0 10 20 30 40 50 60 70 80 90 100
Strict Test Score

Figure 4


Test Score (strict scoring)
100
80
60
40
20
0
1
poor
2
fair
3
average
4
good
5
excellent
Teacher-rating (situation D)

Appendices

Data

Subject	Test Score		Mean HTL (dB)		Teacher-rating*				
	Strict	Lax	Right	Left	A	B	C	D	E
1	34	45	110	115	2	2	1	1	1
2	79	87	105	98	4	4	3	3	2
3	93	100	82	97	5	5	4	4	4
4	54	63	≥ 115	≥ 113	4	3	2	1	1
5	50	64	110	105	4	4	3	3	2
6	80	93	87	72	4	3	2	2	1
7	64	78	108	100	3	2	2	2	1
8	79	91	102	103	3	3	2	2	1
9	77	98	92	92	5	4	4	3	2
10	80	89	96	98	5	5	4	4	3
11	68	82	95	103	4	4	3	3	2
12	32	32	≥ 130	118	3	2	2	2	1
13	73	84	97	95	5	5	4	4	3
14	62	76	≥ 128	103	4	3	2	2	1
15	80	89	97	105	5	4	4	4	3
16	86	90	105	103	4	4	3	3	2
17	71	90	102	103	4	4	3	3	2
18	72	87	100	100	4	4	3	3	2
19	85	96	90	92	5	5	4	4	4
20	64	78	120	105	3	3	2	2	1
21	74	86	103	103	4	4	4	3	3
22	94	100	93	85	5	4	4	3	2

* See page 5 in the text for descriptions of the rating situations.

Subject	Test Score		Mean HTL (dB)		Teacher-rating				
	Strict	Lax	Right	Left	A	B	C	D	E
23	49	67	105	100	4	3	2	2	2
24	65	72	101	105	4	4	3	2	2
25	74	90	108	102	5	4	3	2	2
26	34	42	103	107	2	2	2	2	1
27	45	51	107	98	2	1	1	1	1
28	81	93	102	≥107	5	4	4	3	3
29	94	99	≥125	63	5	5	4	4	3
30	64	76	110	110	4	3	3	3	3
31	88	92	88	83	4	4	3	3	2
32	50	60	87	88	4	4	3	3	2
33	16	18	≥126	≥132	2	2	1	1	1
34	19	22	103	105	4	3	2	2	1
35	71	84	110	110	5	4	4	3	2
36	95	100	100	95	5	4	4	3	2
37	85	90	102	108	5	5	5	4	3
38	66	85	107	≥122	5	4	4	4	3
39	87	95	102	100	5	5	4	4	4
40	85	96	82	87	5	5	4	4	4
41	49	55	96	100	3	3	3	3	2
42	32	41	120	118	5	4	3	1	1
43	86	95	107	107	5	4	4	3	2
44	88	95	83	87	5	4	4	3	2
45	88	95	105	97	5	4	4	3	3
46	0	1	≥127	≥128	3	2	1	1	1
47	27	33	≥130	≥128	3	3	2	2	2

Subject	Test Score		Mean HTL (dB)		Teacher-rating				
	Strict	Lax	Right	Left	A	B	C	D	E
48	44	55	110	≥122	5	4	3	2	2
49	82	84	110	108	4	4	3	2	2
50	59	63	120	118	4	4	3	2	2
51	43	58	107	110	5	4	3	2	2
52	78	93	100	107	5	4	3	3	2
53	91	99	73	77	5	5	5	5	5
54	42	59	118	112	4	3	3	2	2
55	66	85	105	102	4	4	3	3	2

Form Used to Determine Word Familiarity

Name _____

Look at each word and say it to yourself. Put a circle around the words you don't know. This is not a test. Please be honest.

airplane	box	coats	fixed
animals	boys	cocoa	flags
baby	bread	coffee	flashlight
backyard	breakfast	color	floor
bag	broke	cows	flowers
ball	building	cup	foot
ballgame	bus	cupcakes	found
balloons	cake	cut	friend
baseball	camp	dining room	frog
baskets	cards	dinner	fun
bathroom	carried	doctor	game
bathtub	cars	dog	gave
bed	cat	dollar	girl
bedroom	caught	dolls	got
bell	circus	dress	grass
bicycles	children	dropped	had
birdhouse	Christmas	farm	hall
birds	class	farmer	heard
blew	classroom	father	hole
boat	cleaned	fed	horse
books	clothes	fence	hospital
bought	clown	field	hot dogs

houses
ice cream
ladies
lady
lake
letter
light
liked
lost
made
mailman
man
meeting
men
milk
money
monkeys
moon
mother
mouse
movie
noise
nurse
office
paper
park
party
pencil
people
picnic
pie
plants
played
playroom
policeman
present
puppy
put
rabbit
ran
read
road
rode
room
rug
sale
sand
sandbox
saw
school
sent
sheets
shoe
sidewalk
skates
soap
soccer
spilled
store
story
supper
sweaters
swept
table
tablecloth
teachers
television
threw
took
tree
truck
turned out
wanted
washed
wastebasket
watched
water
wear
weather
wind
window
woman
women
wrote
yard
zoo

Test Sentences

1. The dog chewed a hole in the shoe.
2. My aunt blew out the candles on the birthday cake.
3. The cowboy lost his hat in the river.
4. My grandmother poured some milk into the glass.
5. My uncle gave some money to the church.

(The above are practice sentences.)

6. The mailman brought a letter to my house.
7. The monkeys climbed the trees at the zoo.
8. The frog caught a bug in its mouth.
9. The children fed the ducks in the park.
10. The boy threw a baseball over the wall.
11. A cow ate some grass by the fence.
12. My mother dropped the soap on the floor.
13. The cat took some cupcakes off the table.
14. My brother played soccer in the backyard.
15. The policeman watched the cars in the street.
16. The girls cleaned their bedrooms after supper.
17. The clown wore funny clothes at the circus.
18. My father fixed the light in the bathroom.
19. The teachers had a meeting after school.
20. The puppy found a ball behind the chair.
21. A woman spilled coffee on the new rug.
22. The nurse heard some noise in the hospital.
23. The lady made some cookies in the kitchen.
24. My friend cut her foot at the picnic.
25. The man got a sweater for Christmas.

26. The doctor read a book in the library.

27. The farmer bought some hot dogs at the store.

28. Some people ride their bicycles on the sidewalk.

29. The baby broke the cup at breakfast.

30. My sister put the ice cream in a big bowl.

Speech Perception Rating Scale

Teacher _____ Date _____

Child _____

Please rate this child on his ability to understand speech in the five situations described below when he is lipreading and listening through his hearing aid. Your rating should be based only on his receptive understanding of what is said to him when he is lipreading and listening at the same time.

Please use the 5-point scale shown below for your rating. Assign one number to the child's speech perception ability in each of the following situations:

_____ A. when the speaker is familiar to the child and the context is known.

_____ B. when the speaker is unfamiliar to the child but accustomed to talking to deaf children, and the context is known.

_____ C. when the speaker is familiar to the child and the context is unknown.

_____ D. when the speaker is unfamiliar to the child but accustomed to talking to deaf children and the context is unknown.

_____ E. when the speaker is unfamiliar to the child and unaccustomed to talking to deaf children and the context is unknown.

Rating Scale:

1	2	3	4	5
poor; understands 1 to 20 % of the time	fair; understands 21 to 40% of the time	average; understands 41 to 60% of the time	good; understands 61 to 80% of the time	excellent; understands 81 to 100% of the time

Test Answer Sheet

Name _____

Date _____

attenuation
R ___ L ___

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

13.

14.

15.

16.

17.

18.

19.

20.

21.

22.

23.

24.

25.

26.

27. _____

_____

28. _____

_____

29. _____

_____

30. _____

_____

31. _____

_____

32. _____

_____

33. _____

_____

34. _____

_____

35. _____

_____

The following abstract and summary of this study were submitted to the American Speech and Hearing Association for their 1978 convention program.

1978 ASHA convention

A TEST OF AUDITORY-VISUAL SPEECH PERCEPTION FOR HEARING-IMPAIRED CHILDREN

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Norman P. Erber, Central Institute for the Deaf, St. Louis, Mo.

ABSTRACT

Twenty-five video-taped sentences (S-V-DO-prep. phrase) were presented audio-visually to 55 hearing-impaired children of HTL range 63-128 dB. Written responses were scored on the basis of four key words per sentence. Children with HTLs 95 dB or better typically scored high (68-95%); scores varied widely (0-88%) for those with HTLs 96 dB or poorer. Results may be used for class grouping and for judging likelihood for success in a "mainstreamed" program.

SUMMARY

Receptive oral communication usually involves observation of both auditory and visual cues and probably is the typical mode of speech perception for most hearing-impaired persons (Erber, 1975). It also is the usual process through which hearing-impaired children acquire speech-encoded language. A child's ability to perceive spoken connected language audiovisually (A-V) could be used to estimate his typical performance in daily conversation (Erber, 1977), and may be predictive of his ability to acquire information on his own. A-V speech perception test scores may be useful in several contexts: in grouping hearing-impaired children into classes for presentation of content material or for aural rehabilitation work, in evaluating a child's progress or improvement over a period of instruction or therapy, and in making decisions regarding a child's readiness for integration into a regular public school program. This paper describes the construction and administration of a test designed to examine A-V identification of sentences.

A female teacher of the deaf was video-taped while saying 25 test sentences plus five practice sentences. Special lighting provided illumination of the interior of the mouth. All sentences were of the form subject-verb-direct object-prepositional phrase. This sentence type is commonly used in classrooms for hearing-impaired children and therefore was very familiar to the children. In addition, test sentences contained vocabulary selected for familiarity. Subjects received amplified auditory signals through a wired binaural group hearing aid and simultaneously watched a 19-inch video monitor for the talker's optical speech cues (playback image = life-size). They adjusted attenuators for most comfortable

listening level during practice prior to presentation of the test sentences. The subjects attempted to write each sentence after it was presented. Only four "key" words (three nouns, one verb) in each sentence were scored (4 words x 25 sentences = 100 total points).

The test was presented to 55 hearing-impaired children of age range 9-15 years (HTL range: 63-128 dB). Resulting word-identification scores ranged from 0 to 95% correct. The distribution of scores was skewed, with almost half (26) of the children scoring between 60 and 85% correct. Children with mean 3-frequency HTLs 95 dB or better typically scored high (68-95%); scores varied widely (0-88%) for those with HTLs 96 dB or poorer. These results can be interpreted as indicating that children with moderate-to-severe hearing impairments (mean HTLs 95 dB or better) are able to use minimal information available in the amplified auditory signal to complement lipreading and thus achieve high A-V performance. The dispersion of scores for subjects with mean HTLs 96 dB or poorer can be interpreted as reflecting a wide range of lipreading ability among children with profound impairments.

A test of A-V speech perception of this kind may provide the clinician or educator with a valuable estimate of a hearing-impaired child's receptive communication skills under certain conditions. (In this instance: the talker was an experienced teacher; optical/acoustic conditions were optimal; the sentences were unrelated, were of basic form, and contained simple vocabulary.) A brief video-taped test also can rapidly provide a description of a child's abilities (i.e., screening), can allow a teacher to rank-order children regarding A-V performance, and can be used to check subjective evaluations. Similar video-taped tests may eventually form part of the audiological test battery administered in hearing clinics and schools for the deaf.