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By-Ross, Mark; Lerman, Jay

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The Word Intelligibility by Picture Identification Test (WIPI) was developed to measure speech discrimination ability in hearing impaired children. In the first phase of development, the word stimuli were evaluated to determine whether they were within the recognition vocabulary of 15 hearing impaired children (aged 6 to 12) and whether the pictorial representations of the words were adequate. The test was revised prior to the second phase to consist of 25 plates with six pictures on each plate, with only four of the pictures on each plate utilized as test stimuli. These four lists were given to 61 hearing impaired children (a mean age of 10-2 with a range from 4-7 to 13-9 years; a hearing level in excess of 30 decibels at one or more of the speech frequencies; and an average speech threshold of 522 decibels) on two separate occasions. There was a learning effect ($p<.01$) for three of the lists in the 1- to 3-week interval between tests. The results indicate reliability coefficients in excess of 87 for all four lists, with mean differences of less than 3% and correlation coefficients between lists greater than 84. (Author/JD)

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Mark Ross, Ph.D.

Jay Lerman, Ph.D.

University of Connecticut
Storrs, Connecticut 06268

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SUMMARY

The need for speech discrimination tests with hearing-impaired adults is well recognized and many such tests have been developed. These tests have not been developed with hearing-impaired children because of their usual language retardation and because they are frequently incapable of giving valid oral or written responses to a stimulus word. In order to construct a workable speech discrimination test for use with these children, word stimuli have to be selected which can be pictorially represented and which are within the recognition vocabulary of the children. In addition, the response must require neither speech nor writing. The response criteria can be met with a picture-identification test, for which the children simply point to one of several pictures upon hearing the stimulus word. To determine whether the stimuli are within their recognition vocabulary and whether the pictorial representations are adequate, the development of any such test should include a preliminary phase.

The purpose of the present study was to develop a picture-identification speech discrimination test which would meet the above requirements. The authors modified a test they had previously developed to construct the test stimuli evaluated in the preliminary phase of the investigation. These consisted of twenty-six plates with six pictures on each plate. Every picture on each plate was utilized in a different test list, which resulted in six test lists of twenty-six words each. In the first phase of the study, these lists were administered via earphones to fifteen hearing-impaired youngsters. All errors were noted and at the conclusion of this step the children were retested on all the words they had failed to recognize auditorially, this time utilizing both visual and auditory clues.

Again all errors were noted. After this step, the pictures of the words the children failed to recognize in the visual/auditory condition were shown to the children and they were asked to name the corresponding word. The purpose of these steps was to determine whether the words were within the recognition vocabulary of the group of hearing-impaired children and whether the pictorial representations were adequate.

The results of this phase were used to modify the test lists, utilizing only those stimuli within the recognition vocabulary of the children and for which no pictorial confusions existed. The final version of the test consisted of four word lists of twenty-five words in each list. The six-picture matrix was retained, however, thus providing two extra foils for the closed-set discrimination task. In the second phase of the study, sixty-one hearing-impaired children ranging in age from four to thirteen years were utilized as subjects and tested on two separate occasions. The purpose of this phase was to evaluate the reliability, equivalency, and, as much as possible, the validity of the final version of the test. The reliability coefficients of the four lists ranged from .87 to .94 with errors of measurement ranging from 4.7 to 7.7 percent. The equivalency of the lists were evaluated by computing the means of the four lists as well as the intercorrelations between lists. The means ranged from 75.7 to 78.4 percent with standard deviations ranging from 18.8 to 21.9 percent. The correlation coefficients between lists ranged from .84 to .96, with five of the six correlations at .92 or higher. A moderately high validity can be inferred from the negative correlations of -.60 to -.65 between list scores and degree of hearing loss, with the greater degree of hearing loss associated with lower speech discrimination scores.

The results of the evaluation suggest the test to be a feasible clinical tool for the measurement of speech discrimination in hearing-impaired children. Insofar as age limitations are concerned, the test can be used most effectively with moderately hearing-impaired children at ages five or six and higher, and with severely hearing-impaired children at ages seven or eight and higher. Below these ages, we do not presently have sufficient information regarding the utility of the test.

Finally, to simplify recall, we suggest the test be called the WIPI Test, for Word Intelligibility by Picture Identification.

INTRODUCTION

One of the unmet needs in the field of pediatric audiology is a test which can be used to assess the speech discrimination ability of hearing-inpaired children. It is not possible to utilize conventional speech discrimination tests with them for several reasons: (1) With their probable retardation in language development, the test words are unfamiliar and thus the task can no longer be considered one of auditory discrimination; (2) Children with a long-standing or congenital hearing loss usually exhibit articulatory problems which frequently make their oral response to a word unintelligible to the examiner; and (3) Because of their ages, written responses are not feasible. Thus it has been the unfamiliarity of the stimuli and their inability to make suitable responses which have prevented the development of a speech discrimination test with young hearing-impaired children. In order to construct a workable speech discrimination test for use with these children, stimuli have to be selected which are within their recognition vocabulary, and the response must require neither speech nor writing.

The response criterion can be met with a picture identification task. In such a task the child simply points to one of several pictures upon hearing the associated word, instead of repeating or writing the word. The major difficulty in devising such a test has centered around the selection of a sufficient number of stimulus words. The hallmark of this population is retarded and/or deviant language development and it is no easy task to find words which can both be recognized by this population and also be adequately portrayed pictorially. The inclusion of any stimulus item has to be considered tentative until its suitability for a hearing-impaired population is confirmed by direct investigation. If the probability of chance selections are to be reduced, a sufficient number of appropriate stimuli should be included on each picture matrix from which the child makes a selection; and if the test is to provide a range of auditory discrimination difficulty, then an adequate number of matrices have to be developed.

The search for a sufficient number of stimuli to meet these requirements is a frustrating one, with unwelcome compromises often the order of the day. Although there have been many previous attempts to develop a useful test (Dale, 1962, p. 33), these difficulties are no doubt responsible for the fact that to date there is no widely accepted picture-identification speech discrimination test for use with young hearing-impaired children.

The test developed by Siegenthaler and Haspiel (1966) represents the most recent of these attempts. Their test, "Discrimination by Identification of Pictures" (DIP) consists of 48 cards with two pictures on each card. The test was administered to 295 normal hearing children, ages three to eight, at sensation levels of zero, five, and ten db. Three test lists were constructed from the two-picture matrix. Reliabilities of the three test lists at the three sensation levels ranged from .36 to .50, with an error of measurement of five items (approximately 10%). Chance selections would produce a 50% score since only two choices are involved in any one matrix. An interesting feature of this test is the selection of test words based on contrasting acoustic dimensions rather than on phonetic balance (PB) concept. In a personal communication (1968) these authors indicate that they have since administered the test to a large number of young hearing-impaired children with satisfactory results in terms of reliability, recognition of the stimulus words, and articulation-gain function.

Our own attempt to develop a suitable test dates from 1965, when we revised a test which had been developed with normal hearing and mentally retarded children (Myatt and Landes, 1963) and administered it to a group of hearing-impaired children. Our results (Lerman, Ross, and McLauchlin, 1965) indicated that the test could be a useful clinical tool, but also that revisions would be necessary before the maximum potential of the test could be realized. Specifically, we found that some of the words were too difficult, that some of the pictures were poor representations of the words, and that chance scores were too high in a four-picture matrix. The present study represents a revision and extension of this previous study, with the goal of developing a clinically useful picture-pointing speech discrimination test.

PRELIMINARY EVALUATION

Selection of stimulus words: Children's books and word-count lists were perused in order to select simple monosyllabic words which could be adequately represented pictorially. Questionable choices were shown to experienced kindergarten and nursery school teachers for their judgments regarding inclusion. The words on our previous test which had proved to be satisfactory were included whenever possible. The remaining words were then arranged in twenty-six sets of six words each, with some of the matrices arranged to present a gross discrimination task and others arranged to present a fine discrimination task. The limited number of suitable words which could be used with this population sometimes severely restricted the possible choices. On an *a priori* basis, each of the six twenty-six word lists were equalized in terms of presenting the same number of difficult and easy discrimination tasks (Table 1).

Pictorial representation: A commercial artist drew pictorial representations of each word after lengthy prior consultations with the authors. Pictures which were ambiguous, poorly drawn, or confusing in terms of foreground-background differentiation were redrawn. Six color pictures were placed on 8 x 10 drawing paper and photographed. The twenty-six sets of 8 x 10 glossy color photo reproductions were placed in a loose-leaf binder to form a test book.

TABLE 1

Test lists utilized during the preliminary phase.

	A	B	C	D	E	F
1.	bowl	bow	bell	boat	belt	ball
2.	coat	coke	cone	comb	goat	smoke
3.	horn	door	fork	house	floor	corn
4.	clock	box	socks	blocks	rocks	fox
5.	bath	bag	flag	hat	black	match
6.	bat	cat	cap	glass	rat	grass
7.	can	fan	man	hand	sand	pan
8.	bed	head	sled	bread	red	thread
9.	leg	neck	nest	egg	desk	dress
10.	pear	hair	chair	bear	stair	ear
11.	tie	fly	pie	eye	kite	pipe
12.	tree	bee	key	knee	bean	tea
13.	meat	feet	street	teeth	beet	leaf
14.	king	ring	spring	swing	wing	string
15.	moon	spoon	broom	school	boot	shoe
16.	house	mouse	mouth	clown	crown	cow
17.	shirt	church	girl	bird	skirt	dirt
18.	duck	truck	thumb	gun	gum	sun
19.	cup	rug	bug	bus	book	nut
20.	plate	plane	train	snake	cake	lake
21.	star	car	barn	arm	heart	farm
22.	fish	dish	stick	milk	ink	chick
23.	bib	lip	crib	ship	hill	pig
24.	wheel	queen	sheep	green	seal	screen
25.	wall	ball	straw	dog	frog	saw
26.	pail	nail	mail	tail	jail	sail

Subjects: Fifteen hearing-impaired children were used as subjects during the preliminary stage of the study. The children ranged in age from six through twelve, with three of the children six years old, two children seven years old, two children eight years old, one child nine years old, one child ten years old, four children eleven years old, and two children twelve years old. Twelve of the children had bilateral sensori-neural hearing losses, while three had bilateral mixed or conductive hearing losses. Their loss in the test ear exceeded 30 db (1964 ISO standards) at one of the speech frequencies. The test ear was selected arbitrarily, provided it met the above criterion. Where both ears met this criterion, the better ear was selected as the test ear.

Test procedures: Air-conduction thresholds were measured at 250, 500, 1000, 2000, 4000, and 8000 Hz for both ears. Bone-conduction thresholds were measured in all cases which presented diagnostic questions (i.e., no consistent previous results). An equivalent SRT was computed in the test ear by averaging the two best of the three speech frequencies. The six test lists were delivered live voice through a calibrated GS162 speech audiometer by one examiner exclusively. The list order was rotated among the subjects, with subject one receiving lists one, two, three, four, five, and six in that order, while subject two received lists two, three, four, five, six, and one in that order, and so on. The lists were delivered at a sensation level of 40 db when possible; limitations imposed by a child's uncomfortable loudness listening (UCL) level necessitated delivering the lists for seven of the children at a lower sensation level, which ranged from 20 to 36 db sensation level. This level was maintained for all six of the lists. Each test word was preceded by either the carrier phrase "show me" or "point to." Testing was accomplished in a two-room sound-treated audiometric testing suite. The child was seated in the test room with his back to the examiner in the control room. A test assistant faced the child in the test room and was also in visual contact with the examiner. The test assistant turned the pages as the child made a selection, and also attempted to maintain the child's interest in the task. Each child was given verbal and/or pantomime instructions in the test by being told or shown to point to a picture as they heard a word through the earphones.

Scoring: For scoring purposes, the six pictures were considered to be numbered from one to six, with number one at the upper left-hand corner and number six at the lower right-hand corner. As the examiner read a test word, he would check the appropriate column on his score sheet if the child selected the correct picture. If the child erred, the examiner would note the error by indicating the number of the incorrect choice. After delivering all six lists of twenty-six words each, the examiner entered the test room and faced the child. If the child had a hearing aid, he would first put it on. Then in a "moderately loud" voice the examiner would read each of the words from each of the lists the child had missed previously. If, in this "look and listen" situation, the child corrected his previous error, the examiner so noted it by checking an appropriate column on his score sheet. If the child still made an incorrect choice, the examiner noted the number of the error. After the "look and listen" stage had been completed, the examiner then went through all the lists again, this time asking the child to name all the pictures which were missed on the two previous occasions. If the child made a correct choice at this point, it was so noted. The purpose of this elaborate scoring procedure was to determine if the word used to name the picture was within the child's recognition vocabulary. In addition, to determine if the picture was a good representation of the word, consistent confusions, the child's spontaneous comments, and the examiner's on-the-spot judgments were recorded.

Results: Most of the errors which the children made in the "listen" condition were corrected in either the "look and listen" or "naming" conditions. Only three of the children (two of them six years old) made more than two errors on any list after all the conditions were completed, and only three of the plates had two pictures which were consistently confused (i.e., stimulus word "egg" would elicit pointing response to picture of the "nest," stimulus word "plate" elicited "cake," and "farm" elicited "barn"). Thus it appeared that in our task of constructing the final test version, we were able to consider most of the original stimuli for inclusion. We had very early decided not to be bound by the limitations imposed by the phonetic balance (PB) concept in the construction of our test lists, but rather to focus on the development of four reliable and comparable test lists which would be sensitive to different discrimination abilities of different individuals.

Each six-picture matrix was analyzed in conformance with our results and four pictures were selected as the final text stimuli. The other two pictures remained in the final matrix as additional foils, which served to increase the difficulty of the discrimination task from the subject's point of view. That is, upon hearing a word the subject would have to select the appropriate picture from a matrix of six rather than four pictures. To simplify scoring, one entire matrix of six pictures was omitted from the test. The result was twenty-five matrices in which four pictures in each matrix would be utilized as test stimuli.

Only one of these four pictures was included in a particular test list, and thus we were able to construct four completely different test lists of twenty-five words each (Table 2). The equalization of the test lists was accomplished partly on the basis of our experience, partly on the basis of acoustic phonetic considerations (Liberman, et al., 1967), and partly on an *a priori* basis. In the final evaluation phase our judgments would undergo empirical verification.

TABLE 2

The four test lists of twenty-five words in each list.

1.	school	broom	moon	spoon
2.	ball	bowl	bell	bow
3.	smoke	coat	coke	goat
4.	floor	door	corn	horn
5.	fox	socks	box	blocks
6.	hat	flag	bag	black
7.	pan	fan	can	man
8.	bread	red	thread	bed
9.	neck	desk	nest	dress
10.	stairs	bear	chair	pear
11.	eye	pie	fly	tie
12.	knee	tea	key	bee
13.	street	meat	feet	beet
14.	wing	string	spring	ring
15.	mouse	clown	crown	mouth
16.	shirt	church	dirt	skirt
17.	gun	thumb	sun	gum
18.	bus	rug	cup	bug
19.	train	cake	snake	plane
20.	arm	barn	car	star
21.	chick	stick	dish	fish
22.	crib	ship	bib	lip
23.	wheel	seal	queen	green
24.	straw	dog	saw	frog
25.	pail	nail	jail	tail

FINAL EVALUATION

Subjects: Sixty-one subjects were tested for the final evaluation phase of the project, none of whom was used during the preliminary phase. Their ages ranged from 4 years 7 months to 13 years 9 months, with a mean age of 10 years 2 months. The hearing level in the better ear for all subjects exceeded 30 db (1964 ISO standard) at one or more of the speech frequencies. The better ear was used as the test ear in all cases except when the degree and configuration of the hearing loss were bilaterally similar; in these cases the test ear was selected arbitrarily. The average Speech Reception Threshold (SRT) in the test ear was 52.2 db, with a range from 5 to 90 db. Fifty-eight of the subjects had congenital sensori-neural hearing losses and the remaining three had long-standing conductive or mixed hearing losses.

Twenty-four of the subjects were students enrolled in a school for the deaf. These subjects were selected to be older than the average subject (with one exception) to reduce the effect of vocabulary limitations upon their performance. Their age range was 9 years 5 months to 13 years 9 months, with a mean age of 11 years 7 months. The personal data and performance results regarding each subject can be found in Appendix A.

Test procedures: Air-conduction thresholds were measured at 250, 500, 1000, 2000, 4000, and 8000 Hz for both ears. Bone-conduction thresholds were measured in all cases which presented diagnostic questions (i.e., no consistent previous results). An equivalent SRT was computed in the test ear by averaging the two best of the three speech frequencies. All discrimination tests were administered live-voice by the same examiner at a 40 db sensation level (SL). When the difference between the SRT and uncomfortable loudness level (UCL) was less than 40 db, the test was delivered at a level 5 db below the UCL. Four lists were administered to each subject. The order of presentation was rotated between lists. Testing arrangements were similar to those accomplished in the preliminary phase. The child was seated in the test room with his back to the examiner in the control room. A test assistant faced the child and also maintained visual contact with the examiner. The child was given verbal and/or pantomime instructions in the task. No practice list was given. Each word was preceded by the carrier phrase "show me." After the child's selection, the test assistant would name the picture pointed to by the child and turn the page in preparation for the next selection.

One to three weeks after the initial presentation, the subjects were recalled and the same four lists were re-administered with the test order again rotated during this second testing session. The same examiner administered the lists at the same sensation level as on the previous occasion.

RESULTS

Reliability: The test-retest reliability coefficient and the error of measurement of each of the four lists are shown in Table 3. The reliability coefficients range from .87 to .94 while the errors of measurement range from 4.7 to 7.7. These results indicate that all four lists of the test are highly reliable with comparable reliabilities for all four lists.

TABLE 3

Reliability and standard error of measurement of the four lists.

Lists	Reliability	Standard Error of Measurement
I	.89	6.59
II	.94	4.74
III	.87	7.74
IV	.88	7.61

Equivalency: The equivalency of the four lists was evaluated by assessing the mean differences and the correlations between lists. In Table 4 will be found the means and standard deviations of the two presentations of each list (A and B) as well as the average means and standard deviations.

The differences between the A and B presentations indicate that a learning effect took place between the first and second presentation of each list. These differences were evaluated by a standard sign test (Ostle, 1963, pp. 471-472) and, except for list III, found to be significant beyond the .01 level. The learning effect for list III was significant at the .06 level. Since the order of presentation of the four lists was rotated between them and all four of the lists show the learning effect, it suggests that this effect would still have been present even if a practice list had been utilized. In any event, the differences are no more than the equivalent one extra word correct (4% per word) during the second presentation of each list and should not be clinically significant.

The means and standard deviations of the four lists with presentations A and B averaged are also shown in Table 4. A comparison of the means and standard deviations of the four lists indicates that the average level and range of difficulty are very comparable. The only significant mean difference was at the .05 level and occurred between lists III and IV. However, this difference of 2.8 percent is less than a one-word variation and, as in the learning effect, cannot be considered clinically significant.

TABLE 4

Means and standard deviations.

Lists		Means	Standard Deviations	Average Means	Standard Deviations
I	A	74.89	19.00	76.36	19.93
	B	77.84	20.70		
II	A	74.75	19.16	77.11	19.10
	B	79.48	18.74		
III	A	74.49	21.38	75.67	21.86
	B	76.85	22.27		
IV	A	76.66	18.32	78.43	18.78
	B	80.20	19.06		

The Pearson product-moment correlation coefficients of the four lists (A and B presentations collapsed) are given in Table 5. They range from .84 to .95 with five of the six correlations .92 or higher. Taken together with the negligible mean difference lists, these results indicate the four lists to be highly equivalent.

TABLE 5

Intercorrelations between collapsed lists.

	II	III	IV
I	.84	.96	.95
II		.95	.92
III			.92

Relationships between the discrimination scores and the SRT's: The Pearson product-movement correlation coefficients between the list scores and the SRT's are shown in Table 6. These correlations range from .60 to .65 and they are negative, indicating the more severe the hearing loss the poorer the list scores. These results are in agreement with similar findings obtained with adults tested with conventional speech discrimination lists (Ross, et al., 1965).

TABLE 6

Correlations between list scores and speech reception thresholds.

I	II	III	IV
-.65	-.63	-.64	-.60

CONCLUSIONS AND RECOMMENDATIONS

The purpose of the present study was to develop a picture identification test for the measurement of speech discrimination ability in hearing-impaired children. The results of the study indicate that we have been successful in developing a reliable test of four equivalent lists. The words used were within the recognition vocabulary of the subjects, and the pictures appear to be adequate representations of the words.

The study would have been strengthened if a larger number of younger hearing-impaired children were utilized as subjects. However, the practical problems of securing this type of subject precluded this desirable goal. Considering our experiences with the children of varying ages and hearing losses who were utilized as subjects, it appears that the test is suitable for children with moderate hearing losses from ages five or six and for children with severe hearing losses from ages seven or eight. These age limitations include a large number of hearing-impaired children for whom conventional speech discrimination testing is not possible. We have little information which indicates whether the test can be successful with children younger than five years of age. Below this age, it should be used cautiously.

Speech discrimination scores obtained with the use of this test cannot be considered equivalent to the scores obtained with conventional speech discrimination lists, and cannot be interpreted in the same way. In the present test, the subject is confronted with a closed-set discrimination task with chance scores ranging around eighteen percent, while conventional discrimination lists present to the listener an open-ended discrimination task with chance scores essentially zero percent. In addition, an acoustic analysis of the type and proportion of perceptual clues presented to listeners with both types of tests would undoubtedly show significant differences, and therefore differences in the scores obtained by the listeners would also be expected. Based on theoretical expectations, and the limited data we do have, discrimination scores obtained with the picture identification test should exceed conventional test scores by approximately twenty percent. A direct evaluation comparing scores obtained on the present test with scores obtained on different types of conventional speech discrimination tests would be a useful project for a future investigator to undertake.

The test can be used in the same manner as conventional speech discrimination tests. Scores obtained with this test can be used to compare an individual's discrimination ability to scores obtained by a similar population. The relative difference in discrimination ability between a subject's two ears can be evaluated, as well as the relative difference between different hearing aids and/or acoustical changes in the same hearing aid. The results of an auditory training program can be assessed by a longitudinal evaluation of the scores. In this respect, the test has a sufficient number of simple discrimination tasks to permit the measurement of a base speech discrimination score among a population of children from a school for the deaf. With this kind of information, a meaningful evaluation of auditory training programs in schools for the deaf can be accomplished.

The test will undoubtedly be too easy for a large number of hearing-impaired children. These children, perhaps with conductive or minimal sensori-neural type hearing losses, will consistently obtain scores at or close to 100 percent with the test. Since the test ceiling is too low for these children, differences in discrimination ability among them cannot be meaningfully evaluated. It is probable that most of the children who fall into these categories can be tested with conventional speech discrimination tests. Those who cannot, that is those who have good discrimination ability but still cannot give valid oral or written responses, are not suitable subjects for either the conventional or picture-pointing type of discrimination test. In order to test their discrimination ability, it would be desirable to develop new norms with the present test based on scores obtained when some type of noise is introduced into the listening situation.

Our experience with the test indicates that it is a simple and rapid test to administer and that the children have little difficulty in comprehending the nature of the task. When a test assistant is unavailable, we have found that parents can quickly be taught to act as test assistants. In many instances, we have administered the test without a test assistant by having the child turn the page after he makes a choice.

Finally, in order to develop a distinguishable acronym for the test based on its function and the nature of the task involved, we propose to call the test the WIPI Test, for Word Intelligibility by Picture Identification.

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APPENDIX A

Raw Data for Subjects in the Study

SUB-JECT	AGE	SEX	EAR	TYPE LOSS	SRT	SL	DISCRIMINATION SCORES I A	I B	II A	II B	III A	III B	IV A	IV B
1	6-3	M	R	S/N	32	40	80	84	80	80	76	84	84	72
2	8-4	F	L	S/N	40	40	84	76	80	88	80	88	88	92
3	11-11	M	L	S/N	45	30	80	84	96	92	88	96	92	88
4	11-5	M	L	S/N	25	40	92	96	92	96	96	92	92	92
5	10-11	M	R	S/N	65	30	72	76	80	64	72	80	84	84
6	11-4	M	R	S/N	50	30	84	88	80	96	80	80	88	88
7	7-5	F	L	S/N	60	30	76	68	80	76	72	60	76	68
8	9-4	M	L	S/N	22	40	100	92	96	96	96	96	96	96
9	4-7	M	L	Cond	15	40	84	96	84	92	92	88	84	100
10	8-5	M	R	S/N	5	40	88	92	88	96	100	88	92	100
11	10-5	F	L	S/N	20	40	92	96	92	92	96	92	92	100
12	6-8	M	L	Mixed	45	30	88	92	80	96	92	100	68	92
13	8-9	F	L	Cond	52	30	96	100	96	100	100	100	96	88
14	10-11	F	L	S/N	55	30	100	96	92	100	92	96	96	96
15	13-0	F	R	S/N	45	30	84	96	88	88	84	92	96	92
16	7-9	F	R	S/N	35	30	68	88	76	80	80	72	80	84
17	7-0	M	L	S/N	20	40	68	88	64	84	76	76	68	68
18	12-9	M	R	S/N	50	30	72	80	76	80	72	80	76	88
19	7-7	F	L	S/N	65	30	44	44	32	56	40	36	52	56
20	7-5	M	R	S/N	32	40	96	96	84	92	92	100	76	100
21	9-8	F	L	Mixed	20	40	92	100	96	92	100	100	100	92
22	11-9	F	L	S/N	20	40	100	100	96	96	96	100	96	100
23	10-10	M	R	S/N	35	40	84	92	100	96	96	100	88	92
24	10-11	F	R	S/N	60	30	76	72	72	84	76	68	88	80
25	8-3	M	R	S/N	38	40	84	64	72	84	92	84	88	84
26	7-2	M	L	S/N	58	30	76	72	80	76	64	76	76	80
27	10-5	M	L	S/N	45	30	100	100	92	100	96	100	96	96
28	9-8	F	R	S/N	22	40	96	96	92	92	96	96	96	96
29	7-6	F	R	S/N	50	30	76	92	84	92	76	88	88	100
30	11-3	M	L	S/N	60	30	68	84	76	84	84	76	96	96
31	12-8	M	L	S/N	28	40	80	96	80	92	80	92	80	84
32	5-6	F	L	S/N	60	30	72	76	64	84	68	64	80	88
33	7-7	M	R	S/N	55	30	92	92	84	92	88	92	92	100
34	11-7	M	L	S/N	60	30	68	80	80	88	84	88	64	76
35	11-10	M	R	S/N	58	30	96	92	100	96	100	96	92	96

APPENDIX A (continued)

Raw Data for Subjects in the Study

SUB-JECT	AGE	SEX	EAR	TYPE LOSS	SRT	SL	DISCRIMINATION SCORES I A	I B	II A	II B	III A	III B	IV A	IV B
36	6-3	F	R	S/N	48	30	68	68	88	80	64	68	76	80
37	6-7	M	L	S/N	15	40	88	92	96	96	92	92	92	92
38	11-6	F	L	S/N	80	20	40	32	36	40	36	28	44	28
39	10-9	M	R	S/N	90	16	40	52	44	56	48	56	52	64
40	13-9	M	R	S/N	58	30	80	84	84	84	76	80	68	80
41	11-6	M	L	S/N	65	30	72	80	48	72	60	64	80	84
42	10-4	M	L	S/N	55	30	92	92	72	80	84	76	68	72
43	10-2	F	L	S/N	80	20	40	32	44	40	28	20	40	28
44	12-3	F	R	S/N	65	30	92	100	84	92	96	92	92	88
45	12-8	F	L	S/N	65	30	72	88	80	84	68	84	64	92
46	12-7	M	L	S/N	70	30	56	60	80	72	48	60	68	76
47	12-7	F	R	S/N	52	40	88	80	88	88	76	84	96	88
48	11-10	M	L	S/N	55	30	76	80	72	84	80	96	88	80
49	12-2	M	R	S/N	65	30	48	64	64	72	52	52	52	60
50	11-3	F	L	S/N	68	30	88	92	80	88	84	92	84	96
51	11-3	F	R	S/N	70	30	76	92	64	84	80	88	72	76
52	9-8	F	R	S/N	82	20	56	60	52	52	40	60	56	72
53	9-5	M	L	S/N	68	30	96	96	84	88	96	96	88	96
54	11-9	M	L	S/N	72	28	72	72	64	80	84	84	72	84
55	11-5	M	R	S/N	75	26	56	56	76	56	48	52	68	64
56	11-9	F	R	S/N	70	30	28	28	20	32	24	16	36	48
57	12-4	M	R	S/N	60	40	56	56	64	64	56	76	64	64
58	11-5	F	R	S/N	62	40	32	28	28	16	24	20	40	20
59	12-1	M	L	S/N	70	30	48	28	44	48	44	40	48	60
60	11-0	F	R	S/N	70	30	68	60	64	68	48	60	48	64
61	12-2	F	R	S/N	70	30	32	40	36	40	36	36	24	32

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TITLE

A Picture-Identification Test for Hearing-Impaired Children

Final Report

PERSONAL AUTHOR(S)

Ross, Mark and Lerman, Jay W.

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Hearing-Impaired children, deaf, Hard-of-hearing.
Speech discrimination, speech intelligibility.
Pediatric audiology.

IDENTIFIERS

WIPI (Word Intelligibility by Picture Identification)

ABSTRACT

The project was devoted to the development of a picture identification test for the measurement of speech discrimination ability in hearing-impaired children. The usual tests are not appropriate for these children because of their vocabulary limitations and because they are frequently incapable of giving valid oral or written responses to a stimulus word. The test was developed in two phases. In the first phase the word stimuli were evaluated to determine whether they were within the recognition vocabulary of the children and whether the pictorial representations of the words were adequate. The test was revised prior to the second phase to consist of twenty-five plates with six pictures on each plate, with only four of the pictures on each plate utilized as test stimuli. These four lists were given to sixty-one hearing-impaired children on two separate occasions. The results indicate reliability coefficients in excess of .87 for all four lists, with mean differences of less than three percent and correlation coefficients between lists greater than .84. The test appears to have the potential of a valuable clinical tool in pediatric audiology. It is called the WIPI Test, for Word Intelligibility by Picture Identification.