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A Comparison of the Responses of Adults on Two Competing Message Tasks

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A COMPARISON OF THE RESPONSES OF ADULTS ON TWO COMPETING MESSAGE TASKS

by
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This thesis submitted by Jacque I. Schmidt in partial fulfillment of the requirements for the Degree of Master of Science from the University of North Dakota is hereby approved by the Faculty Advisory Committee under whom the work has been done.

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Date July 25, 1973

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ABSTRACT

The purpose of the study was to compare scores obtained on the Staggered Spondaic Word Test (SSW) with scores obtained on the speech-in-noise subtest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW). Another purpose was to determine test-retest reliability and internal reliability of the GFW.

Thirty subjects between the ages of twenty to twenty-four years, eleven months with normal hearing and speech were administered the SSW and the speech-in-noise subtest of the GFW. The GFW was re-administered twenty-four to thirty-six hours following the initial administration.

Data were treated with the use of mean, standard deviation and correlation coefficient. Statistical analysis yielded a low correlation between the test-retest of the GFW. A moderate, significant correlation was found to exist between the initial administration of the GFW and the SSW. Results of statistical analysis of internal consistency yielded low and moderate correlations between individual items and total GFW score. Results of the study indicated that the speech-in-noise subtest was not reliable and hence not valid for this age group.

CHAPTER I

INTRODUCTION

It is of particular importance to professional people in the area of Speech Pathology and Audiology as well as those involved in various facets of special education, to assess an individual's ability to perceive speech in various environmental situations. Deficits in reading (Critchley, 1964; and Money, 1962), poor articulation, (Mange, 1960; and Sherman and Geith, 1967) and language disorders (Rechner and Wilson, 1967; and Bannatyne, 1971) have been related to deficits in the perception of speech. Goetzinger (1972, p. 157) stated:

> The ability to hear and understand speech implies a consideration of three fundamental variables. First, that the message of the sender to the receiver is sufficiently loud to be perceived; second, that the units comprising the message can be discriminated; and third, that one has a knowledge of the language.

It is the second of these variables, more specifically an individual's ability to selectively differentiate a speech stimulus presented in a complex manner that is of clinical importance in diagnosing central auditory dysfunctions.

The purpose of this study was to investigate the relationship between the Staggered Spondaic Word Test (SSW) and the speech-in-noise sub-test of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW).

According to Ades (1959), research pertaining to the central auditory pathway goes back only a few years into the last century.

This research has a much shorter history than the study of other sensory systems and the bulk of the more significant work has been accomplished only in the last three decades. The work has been done primarily through the use of pure tones, which are measured in the parameters of frequency and intensity. Recently there has been a trend away from pure tone studies of the central auditory system, with an increasing awareness that studying the perception of speech may reveal central auditory problems that pure tone studies do not. Bocca (1958, p. 304) states that there was

> . . .a wide difference between the recognition of the physical qualities of a sound and the process of identification of a verbal pattern. The former depends upon the working of the auditory apparatus as a whole; the latter is a specific function of the auditory cortex.

Holroyd and Riess (1968, p. 211) regarding methods used to assess the central auditory system stated:

> Auditory integration defects are not adequately detected by traditional pure tone audiometry methods that have as their main role the detection of defects in the end organ itself and in the auditory nerve leading to the cochlear nuclei. Defects above the level of the cochlear nuclei are manifested only with more difficult or complex tasks.

The authors listed several techniques for investigating auditory problems related to minimal neurological dysfunction. These were as follows:

1. Speech versus nonspeech; in this method one is exposed to a variety of types of distorted speech (filtered, compressed, etc.), which are compared with one another and with pure tone and noise nonspeech sounds.
2. Monaural versus binaural speech stimulation with or without distortion.

3. Threshold versus above-threshold (supraliminal); the minimum intensity required for the signal to be heard or understood.

It has been demonstrated that in cases of central auditory lesions, in order to balance loudness in the ipsilateral ear to the lesion at suprathreshold levels, some patients need more intensity in the contralateral ear (Jerger, 1963).

Holroyd and Riess (1968) noted that methods of diagnosing central auditory dysfunction that involve speech, reduce the redundancy of the message by a variety of means including filters, time compressions, periodic interruption, rapid oscillation, unusual verbal messages, intensity distortion or background noise.

Bocca and Calearo (1963, p. 344) defined central auditory nervous system (CANS) disorder as a defect in the

> . . .process of formal integration which takes place in the relays situated at different stages along the auditory pathway, and does. . .concern the process of symbolization or memorization.

They separated CANS function both from the processes of the end organ of hearing and from the language function of the brain.

Hodgson (1972, p. 313) pointed out five possible effects of CANS pathology. They are as follows:

1. Little or no change in threshold for pure tones or speech.
2. Little or no change in performance on suprathreshold pure tone tests.
3. Reduction in speech discrimination ability on the ear contralateral to the lesion, particularly when the speech is made more difficult by distortion.

4. Reduction in discrimination of binaural messages when part of the information is presented to one ear and part to the other.

5. Reduction in discrimination of monaural messages in the presence of a competing signal to the other ear.

Lasky and Tobin (1973) investigated the effects of linguistic and nonlinguistic auditory messages on the performance of children with learning disabilities as compared to the performance of normal children. They found that linguistic competing auditory messages interfered with the performance of children with suspected learning disabilities but did not interfere with the performance of normal children and that competing auditory messages that are nonlinguistic (broad band white noise at 0 dB signal/noise) did not interfere with the performance of either group.

Two tests which are presently used to assess an individual's performance on competing message tasks are the Staggered Spondaic Word Test (SSW) (Katz, 1968) and the noise subtest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW) (Goldman, Fristoe and Woodcock, 1970).

The SSW test is a dichotic procedure, that is, different signals are presented to each ear. Each test item is composed of two spondees recorded in a partially over-lapped fashion. The subject is required to repeat both messages in the order that he hears them. The test is designed to be applicable to an age range of 11 years to 60 years and

takes approximately 20 minutes to administer. It has been standardized on normal subjects as well as patients with a variety of peripheral and central problems.

The speech-in-noise subtest of the GFW requires the listener to respond to words which are presented in a background of environmental noise by pointing to one of four pictures which correspond to the stimulus word. Administration time is 3½ minutes. According to the GFW Test Manual, the GFW was standardized on subjects in the general population without regard to the presence or absence of auditory discrimination problems.

Clinically, questions have arisen concerning the interpretation and reliability of results obtained on the noise-subtest of the GFW.

This study was designed to answer the following questions:

1. What relationship exists between the speech-in-noise subtest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination and the Staggered Spondaic Word Test.
2. What relationship exists between the scores obtained on the initial administration and the retest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination.
3. What is the degree of relationship between each item of the speech-in-noise subtest and the total score obtained by each subject.

CHAPTER II

PROCEDURE

Subjects

Subjects were thirty college students or recent college graduates ranging in age from twenty years to twenty-four years, eleven months, selected from the population of Grand Forks, North Dakota. All subjects were required to pass a pure tone screening test throughout the speech frequencies 500 Hz to 4000 Hz at an intensity level of 25 dB ISO. Only native born, white Americans with speech representative of general American English were included.

Equipment

All testing was conducted in an IAC single-wall sound treated room. An Allison clinical audiometer, Model 22, was used for presenting all test stimuli. A Viking stereophonic tape deck, Model 87, provided the input for the Staggered Spondaic Word Test and the speech-in-noise subtest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination. The output from the speech audiometer was fed through TDH-39 earphones.

General Procedure

Five measures were obtained from each of the thirty subjects. Each subject was evaluated on the basis of a pure tone screening test, a speech reception test, word discrimination tests in quiet, the speech-in-noise

subtest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW), and the Staggered Spondaic Word Test (SSW). The pure tone screening test was presented first, followed by the speech reception threshold test. The word discrimination test, GFW and the SSW were presented in a systematically varied order to avoid the accumulation of fatigue or order effects on any one of the tests. Standardized instructions were given each subject prior to the administration of individual tests (Appendix A). Total time for testing was approximately 40 minutes.

Pure tone screening tests were administered to each subject at 25 dB ISO at 500, 1000, 2000 and 4000 Hz bilaterally. The order of presentation was 1000, 500, 2000 and 4000 Hz, beginning with the right ear. Subjects were included in the study if the hearing screening was passed at all frequencies.

Speech reception thresholds were obtained by beginning with maximum attenuation and presenting three spondaic words at increasing intensity steps of 2 dB. The lowest intensity at which the subject could repeat two of the three spondaic words was determined to be speech reception threshold for that ear and was used to determine the attenuator settings for sensation level required in the experimental procedures.

Scrambled versions of the Harvard PB-50 Test, Lists I and II were presented at 40 dB HL to obtain word discrimination scores (WDS). The lists were presented monaurally. List I was presented to the right ear and List II was presented to the left ear of even numbered subjects. List I was presented to the left ear and List II was presented to the right ear of odd numbered subjects. Subjects wrote the word they thought

they heard on prepared test forms to eliminate experimental bias in judging and recording verbal responses. Problems encountered with deciphering handwriting were checked with subjects at the conclusion of the listening session. All errors were recorded and a percentage score for correct responses computed.

The pre-recorded noise subtest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW) was presented to each subject at 66 dB SPL. The test tape provided a 1000 Hz tone as a means of calibration check. The speech-in-noise subtest consisted of thirty words (one syllable in length and of a consonant-vowel-consonant or consonant-vowel form) presented in background noise 9 dB less intense than the signal. The background noise used on the GFW tape was obtained by recording environmental noise in a busy school cafeteria.

Standardized test instructions were provided on the tape. Each subject was required to listen to the stimuli and respond with the number corresponding to that stimuli presented on the test plate. Each test plate consisted of four pictures numbered 1-4. The four words represented on each test plate were similiar in sound except for a single phoneme.

Prior to administration, the GFW training procedure was followed in order to acquaint the subject with the test pictures. Total number of errors was recorded and translated into percentile scores according to the GFW noise subtest norms for the twenty to twenty-four years, eleven months age group.

The noise subtest of the GFW was again administered to each subject from twenty-four to thirty-six hours following the initial

administration. Identical test conditions and procedures were utilized for the retest.

The Staggered Spondaic Word Test (SSW) consists of 40 pre-recorded items which represent 160 monosyllabic words. Each test item is composed of two spondees recorded in a partially over-lapped fashion. The competing message task incorporated into the SSW test required the subject to attend first to one side, then to both sides simultaneously with different information presented concurrently to each ear, and then only to the second side. The initial syllable of the first spondaic word if combined with the second syllable of the second spondaic word forms a third spondaic word. The following is an example of an SSW test item.

1	2	3
(Rt. Non-competing)	(Rt. Competing)	
BED	SPREAD	
	MUSH	ROOM
	(Lft. Competing)	(Lft. Non-competing)

Standardized test instructions were used (Katz, 1963). Four practice items precede the test items. An introductory phrase "Are you ready?" preceded each spondee group. A high fidelity stereo tape recorder routed through a two-channel speech audiometer allowed independent control of presentation level for each ear. The test was presented at 50 dB HL for each ear. Subjects were required to repeat all of the words. An error was counted for each monosyllable or half-spondee incorrect. Errors for the Right-Competing, Right Non-Competing,

Left-Competing, and Left Non-Competing conditions were summed. The errors were then converted to percentage of error and subtracted from 100 to get the percentage correct.

CHAPTER III

RESULTS AND DISCUSSION

Introduction

In this chapter, the results of the experimental tasks are presented in the form of tabled data. Analysis of the data was based on raw scores obtained on the initial administration of the speech-in-noise subtest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW), a retest of the GFW administered twenty-four to thirty-six hours after the initial administration, the total number of errors made on the Staggered Spondaic Word Test (SSW), and a breakdown of the SSW into number of errors on the competing items and number of errors on the non-competing items.

Results

The mean number of errors for the word discrimination test was 1.1 or 98.9 percent correct. The high discrimination in quiet scores indicated lack of appreciable auditory distortion attributable to peripheral lesions.

Means and standard deviations for error scores from the testing conditions are presented in Table 1. The total number of possible errors on the GFW was thirty. There were a total of eighty possible errors on the competing items and eighty possible errors on the non-competing items of the SSW with 160 possible errors on both portions combined.

TABLE 1

MEAN NUMBER OF ERRORS
AND STANDARD DEVIATIONS
OF EACH TEST

Test	No. of Test Items	Mean	Standard Deviation
GFW (initial testing)	30	7.1	2.5
GFW (retest)	30	5.8	2.4
SSW (competing)	80	2.8	2.4
SSW (non-competing)	80	1.5	1.8
SSW (total score)	160	4.3	4

Means for the test-retest of the GFW were 7.1 and 5.8 respectively. A statistical analysis of the difference between the means yielded a t-value of 2.53 which was significant at the .05 level. This information is presented in Table 2.

TABLE 2

MEANS, STANDARD DEVIATIONS, DEGREES OF FREEDOM
AND t-VALUE OF THE TEST-RETEST OF THE GFW.

	Test	Retest	t-Value
Mean	7.1	5.8	2.53[a]
Standard Deviation	2.5	2.4	
Degrees of Freedom	29	29	

[a] t with 29 d.f. at .05 level = 2.05
t with 29 d.f. at .01 level = 2.76

Correlation coefficients obtained from the raw scores were computed to indicate the degree of relationship between each of the

five measures. Correlation coefficients are presented in Table 3. Results indicated a low, nonsignificant correlation between the initial administration and the retest of the GFW. There was a moderate correlation between the initial administration of the GFW and the three SSW scores. These correlations were significant at the .05 level. Results indicated a low, nonsignificant correlation between the retest of the GFW and the SSW scores. High correlations were found between the competing and non-competing portions of the SSW as well as with the total SSW score. These correlations were significant beyond the .01 level.

TABLE 3

CORRELATION COEFFICIENTS COMPUTED AMONG THE 5 TEST CONDITIONS

Test	GFW (retest)	SSW (competing)	SSW (non-com.)	SSW (total)
GFW (initial testing)	.34	.45[a]	.43[a]	.45[a]
GFW (retest)		.18	.07	.14
SSW (competing)			.91[b]	.98[b]
SSW (non-competing)				.97[b]

[a]significant at the .05 level with 29 degrees of freedom
[b]significant at the .01 level with 29 degrees of freedom

Table 4 reports internal consistency data and item difficulty levels for the 30 items comprising the speech-in-noise subtest of the GFW. On the initial administration, items 55, 60 and 75 were in the middle range of difficulty (40-60%) as were items 55, 64, 71, and 73 on the retest. The remainder of the items yielded either very high or very low levels of difficulty on both the test and retest.

TABLE 4

MEAN DIFFICULTY LEVELS (PERCENT CORRECT) AND CORRELATION OF EACH ITEM AND TOTAL SCORE FOR FIRST (a) AND SECOND (b) TESTING

Item	Mean (a)	Mean (b)	Corr. Item and Total Score	Corr. Item and Total
50	.90	.93	.31	.27
51	.17	.27	.06	.29
52	.97	.93	.37[a]	.27
53	.20	.20	.01	.37[a]
54	.80	.87	.25	.17
55	.40	.50	.26	.12
56	.90	1.00	.08	.00
57	.97	1.00	.37[a]	.00
58	.93	.97	.15	.52[a]
59	.93	.97	.01	.27
60	.47	.23	.48[a]	.09
61	.70	.83	.42[a]	.61[a]
62	.97	1.00	.37[a]	.00
63	.93	1.00	.15	.00
64	.27	.53	.21	.36
65	.93	.97	.43[a]	.27
66	.83	.97	.27	.19
67	1.00	1.00	.00	.00
68	.97	.90	.14	.49[a]
69	.87	.93	.27	.39[a]
70	.93	.93	.48[a]	.02
71	.33	.43	.64[a]	.26
72	1.00	1.00	.00	.00
73	.30	.43	.27	.17
74	.83	.90	.42[a]	.49[a]
75	.57	.63	.32	.42[a]
76	.97	1.00	.07	.00
77	.97	1.00	.30	.00
78	1.00	.97	.00	.52[a]
79	.90	.90	.26	.33

[a]significant at .05 level with 29 degrees of freedom

Moderate correlations of each item and total score were obtained for items 52, 57, 60, 61, 62, 65, 70, 71, and 74 on the initial GFW administration and items 53, 58, 61, 68, 69, 74, 75, and 78 on the retest. These correlations were significant at the .05 level. Coefficients Alpha for internal consistency for the two administrations of the GFW were .48 and .46 respectively. Acceptable reliability coefficients for valid tests are normally above .70 (Stanley and Hopkins, 1972).

Discussion

Group performance for the SSW was 98 percent correct with a range from 91 percent to 99 percent correct. The SSW strictly defines normalcy in the experimental group and supports previous research on the performance of normals on the SSW (Brunt, 1972). Group performance on the GFW was 76 percent correct on the initial testing and 80 percent correct on the retest with a range of 37 percentage points. Experimental subjects with high scores on the SSW ranged all the way from the first percentile to the 99th percentile on the initial administration of the GFW. The significant difference between the means and the low correlation coefficients on the test-retest raise questions as to the reliability of the speech-in-noise subtest of the GFW. It would then seem difficult to define normal central auditory functioning on the basis of this test.

Results of the item consistency analysis revealed that the majority of test items were either at very high or very low levels of difficulty. Correlation coefficients of each item and total score yielded nine items which were moderately correlated on the initial administration

of the GFW and eight items which were moderately correlated on the retest. Only two of the nine items which showed moderate correlations of the initial test were among those items which showed moderate correlations on the retest. All other test items yielded low or 0.0 correlation with the total score. Because the GFW test is designed for use with a wide range of ages, it is not unreasonable that some items be very easy for adults, but the items which the subjects found most difficult on the initial administration overlapped very little with those found most difficult on the second administration.

Results of the item consistency analysis and reliability measure for internal consistency as well as previously mentioned findings concerning test-retest reliability raise questions as to the GFW's usefulness as a clinical and research tool.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Thirty subjects ranging in age from twenty to twenty-four years, eleven months were administered the speech-in-noise subtest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination (GFW), the Staggered Spondaic Word Test (SSW), and Harvard PB-50 Word Lists I and II which yielded word discrimination scores in quiet for each ear. A retest of the GFW was administered twenty-four to thirty-six hours following the initial test procedure.

High word discrimination scores (group mean was 98 percent correct with a range of 92-100 percent) indicated lack of appreciable auditory distortion attributable to peripheral lesions. Mean group performance on the SSW test was 98 percent correct with a range of 8 percentage points. All subjects performed well within the normal range.

A low, nonsignificant correlation was found to exist between the test and retest of the GFW. A moderate, significant correlation was found to exist between the initial administration of the GFW and the SSW scores and a low, nonsignificant correlation existed between the retest of the GFW and the SSW scores. Results of statistical analysis of internal consistency yielded low, nonsignificant and moderate, significant correlations at the .05 level between individual items and total GFW score.

Conclusion

Results of the study indicated that the speech-in-noise subtest of the Goldman-Fristoe-Woodcock Test of Auditory Discrimination was not a reliable measure of central auditory function in the experimental subjects of this study and test validity is contingent upon test reliability. Further research is needed in order to ascertain information about its usefulness as a clinical tool.

Suggestions for Further Study

1. Replication of this study utilizing different age groups is suggested. This would yield further information as to the reliability of the speech-in-noise subtest of the GFW.
2. Comparisons of normal individual's performance with the performance of known cases of central auditory dysfunction on the GFW is suggested. These comparisons may yield information as to test interpretation.
3. A study to determine the degree of relationship between the quiet and noise subtests of the GFW is also suggested. A study of this type would provide further information regarding test validity and reliability.

APPENDIX A

INSTRUCTIONS GIVEN TO SUBJECTS PRIOR TO THE ADMINISTRATION OF EACH TEST

Speech Reception Threshold

Instructions:

I am going to say some words to you that have two parts; words like airplane, baseball, mushroom, eardrum. Just repeat the words after me. If you are not sure of a word, don't be afraid to guess.

Word Discrimination Test

Instructions:

I will say a series of words, like this "you will say hymn." You must repeat the last word that I say and write it on the paper in front of you.

Staggered Spondaic Word Test

Instructions:

You will hear a series of words. Listen carefully and repeat all of the words that you hear. You will have plenty of time to respond, so just say the words as accurately and as clearly as possible. Do not respond until all words are presented. If you are not quite sure of a word, take a guess. (Now, tell me what you are going to do.)

Goldman-Fristoe-Woodcock Test of Auditory Discrimination

Instructions:

Instructions provided on test tape.

APPENDIX B

TEST FORMS USED IN EXPERIMENTAL PROCEDURE

Name_____ Date_____Retest_____

Goldman-Fristoe-Woodcock Test of Auditory Discrimination

Noise Subtest

Practice items

47. light ___ ___
48. see ___ ___
49. comb ___ ___

Test items

50.	bear	___ 2 ___	60.	knee	___ 2 ___	70.	back	___ 3 ___
51.	we	___ 4 ___	61.	big	___ 2 ___	71.	hair	___ 1 ___
52.	lake	___ 3 ___	62.	vine	___ 2 ___	72.	cash	___ 3 ___
53.	coal	___ 4 ___	63.	night	___ 1 ___	73.	wake	___ 1 ___
54.	sign	___ 1 ___	64.	cone	___ 4 ___	74.	dig	___ 4 ___
55.	mail	___ 3 ___	65.	pail	___ 4 ___	75.	me	___ 4 ___
56.	pack	___ 2 ___	66.	cap	___ 2 ___	76.	fair	___ 2 ___
57.	sail	___ 4 ___	67.	shack	___ 3 ___	77.	catch	___ 3 ___
58.	bee	___ 2 ___	68.	tea	___ 3 ___	78.	tack	___ 4 ___
59.	Jack	___ 3 ___	69.	make	___ 2 ___	79.	rake	___ 1 ___

Initial administration

Total Errors_____

Percentile Rank_____

pauses_____

Incorrect items_____

_____

Retest

Total Errors_____

Percentile Rank_____

pauses_____

Incorrect items_____

_____

Harvard PB-lists

List I

1. pile
2. is
3. nook
4. cleanse
5. plush
6. creed
7. smile
8. pan
9. rise
10. crash
11. slip
12. cane
13. dike
14. toe
15. box
16. pants
17. bad
18. not
19. there
20. bar
21. feast
22. grove
23. clove
24. ford
25. use (yews)
26. wheat
27. end
28. folk
29. no
30. such
31. fern
32. ride
33. rag
34. rat
35. dish
36. hunt
37. fuss
38. heap
39. strife
40. then
41. bask
42. death
43. fraud
44. rub
45. pest
46. deed
47. are
48. hive
49. mange
50. hid

List II

1. rap
2. need
3. our
4. bud
5. rib
6. corpse
7. tan
8. pick
9. snuff
10. cloud
11. suck
12. bounce
13. else
14. vast
15. bought
16. pit
17. bait
18. perk
19. vamp
20. bean
21. frog
22. job
23. charge
24. hire
25. ways
26. wish
27. five
28. gloss
29. nut
30. them
31. gill
32. sludge
33. scythe
34. shoe
35. fate
36. nab
37. hock
38. log
39. tang
40. trash
41. blush
42. dab
43. hit
44. start
45. quart
46. earl
47. awe
48. mute
49. niece
50. moose

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