AD-765 470

SPEECH INTELLIGIBILITY TESTING WITH THE MODIFIED RHYME TEST IN AVIATION TYPE NOISE

James D. Mosko

Army Medical Research Laboratory
Fort Knox, Kentucky

30 March 1973

AD

US ARMY
MEDICAL RESEARCH LABORATORY
FORT KNOX, KENTUCKY 40121

REPORT NO. 1,027

SPEECH INTELLIGIBILITY TESTING WITH THE MODIFIED RHYME TEST IN AVIATION TYPE NOISE

(Interim Report)

by

James D. Mosko, Ph.D.

30 March 1973

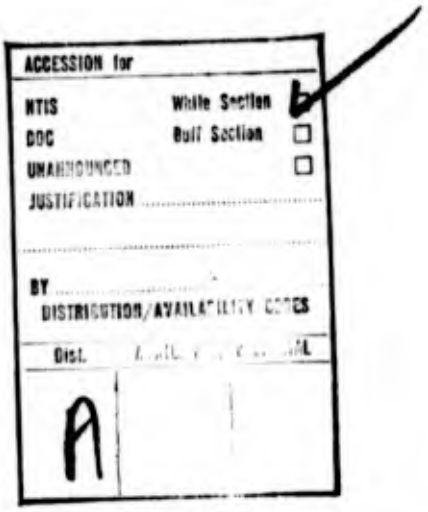
Approved for public release; distribution unlimited.

UNITED STATES ARMY
MEDICAL RESEARCH AND DEVELOPMENT COMMAND

DISPOSITION

Destroy this report when no longer needed.
Do not return it to the originator.

Citation of specific commercial equipment, materials, or trade name: in this report does not constitute an official endorsement or approval of the use of such commercial products.



UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*

US Army Medical Research Laboratory
Fort Knox, Kentucky 40121

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

SPEECH INTELLIGIBILITY TESTING WITH THE MODIFIED RHYME TEST IN AVIATION TYPE NOISE

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Interim Report

5. AUTHOR(S) *(First name, middle initial, last name)*

James D. Mosko, Ph.D.

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
30 March 1973	6 12	1

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. 3A061102B71P	1,027
c. Task No. 08	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d. Work Unit No. 089	

10. DISTRIBUTION STATEMENT

Approved for public release; distribution unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	US Army Medical Research and Development Command, Washington, D. C. 20314

13. ABSTRACT

Twenty-eight young adult male subjects listened to several versions of the Modified Rhyme Test (MRT) at three different S/N ratios and three levels of background noise. The average percent correct data were evaluated in terms of ear receiving signals, noise level, and S/N ratio. The data indicate an appropriateness of the MRT paradigm for evaluating the auditory capabilities of military personnel. The lack of talker differences provides a large family of test lists for the purpose of such evaluations. However, close attention should be given to the presentation level of the lists.

DD FORM 1 NOV 68 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

UNCLASSIFIED
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Acoustics						
Speech Intelligibility						
Hearing						

*U.S.Government Printing Office: 1973 — 759-823/3086 Region 5-11

AD _____

REPORT NO. 1,027

SPEECH INTELLIGIBILITY TESTING WITH THE MODIFIED RHYME TEST IN AVIATION TYPE NOISE

(Interim Report)

by

James D. Mosko, Ph.D.

US ARMY MEDICAL RESEARCH LABORATORY
Fort Knox, Kentucky 40121

30 March 1973

Military Performance:
Auditory Perception and Psychophysics
Work Unit No. 089
Physiology
Task No. 08
Basic Research in Support of Military Medicine
DA Project No. 3A061102B71P

USAMRL REPORT NO. 1,027
DA PROJECT NO. 3A061102B71P

ABSTRACT

SPEECH INTELLIGIBILITY TESTING WITH THE MODIFIED RHYME TEST IN AVIATION TYPE NOISE

OBJECTIVE

To evaluate the use of Modified Rhyme Test (MRT) for application to testing auditory integrity of military personnel.

METHOD

Twenty-eight young adult male subjects listened to several versions of the Modified Rhyme Test at three different S/N ratios and three levels of background noise. The average percent correct data were evaluated in terms of the ear receiving the signals, noise level, and S/N ratio.

CONCLUSIONS

The data indicate an appropriateness of the MRT paradigm for evaluating the auditory capabilities of military personnel. The lack of talker differences provides a large family of test lists for the purpose of such evaluations. However, close attention should be given to the presentation level of the lists.

SPEECH INTELLIGIBILITY TESTING WITH THE MODIFIED RHYME TEST IN AVIATION TYPE NOISE

INTRODUCTION

This report presents data relevant to the evaluations of a relatively recent set of test materials designed to evaluate the integrity of the human auditory system for communication purposes. The materials to be evaluated were presented in a manner designed to represent a military communication environment, i.e., communication in aircraft noise environment.

PROCEDURES

Materials. The test materials were contained on a set of two reels of magnetic tape supplied through Working Group 52 of the Committee on Hearing, Bioacoustics, and Biomechanics (CHABA). Each reel of tape contained five recordings of word lists from the Modified Rhyme Test (MRT).[1] Four of the five word lists on each tape were embedded in noise with the last word list on each tape reel being noise free. The spectral characteristics of the noise are depicted in Figure 1.

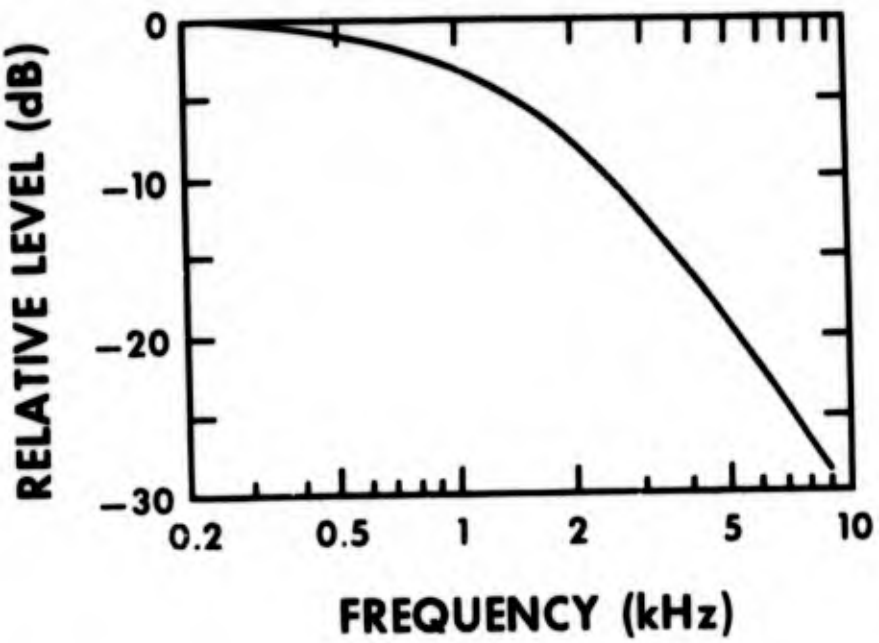


Fig. 1. Measured characteristics of the noise used in the recording of the word lists.

[1] House, A. S., et al. Articulation-testing methods: consonantal differentiation with a closed response set. J. Acoust. Soc. Amer. 37: 158-166, 1965.

On both tape reels the speech-to-noise ratios of the first four tests were +4 dB, 0 dB, +4 dB, and +8 dB, respectively.

Two talkers and several test lists appeared in the recordings. Each talker recorded different forms of the same test lists.

Apparatus. One output channel of a two-channel data recorder (magnetic tape recorder) (General Radio, Type 1525-A) was circuited through an impedance matching device to a decade attenuator (General Radio, Type 1450-T). The attenuator output passed to an amplifier (H. H. Scott, Type 250-BRL), which fed the signal to a locally constructed two-channel mixing unit. Each of the two output channels of the mixing unit presented the signal to a TDH-39 earphone inserted in an MX/41AR cushion. The mixing unit permitted either monaural or binaural presentation of the test signal to the subject. The subject's earphones were located in a sound treated booth (Industrial Acoustics Company, Model 1200).

Method. The investigation was partitioned into two sections for data collection. The initial section was used to determine the existence, if any, of differences in the intelligibility of the tapes which might be attributed to talker differences, copying discrepancies, and other recording abnormalities. The second section dealt with intelligibility as a function of noise level, aural configuration of presentation, and speech-to-noise ratio.

Part I. In the initial section, the noise level was set to 65 dB SPL, and each tape was binaurally presented to a total of four subjects. The noise level was ascertained by monitoring the output of each earphone in a 6 cc coupler with a condenser microphone connected to a spectrum analyzer (Brüel and Kjaer, Type 4132 microphone, Type 2111 Audio Frequency Spectrometer, and associated cathode follower). The noise level was set to 100 dB SPL using the initial noise portions of each tape and appropriately attenuated to provide the 65 dB noise level condition. Each subject heard each tape twice. The order of tape presentation was different for each of the two listening sessions, and the speech-to-noise sequence from each tape was reversed at each testing session. The no-noise segment of each of the tapes was used as a practice presentation for each subject in order to acquaint the subject with the task of listening for either a change in the initial phoneme in a word or the final phoneme in a word.

An analysis of variance performed on the data (see Table 1) from this section indicated no statistically significant differences between the two tapes. In addition, no differences appeared when the two separate presentations of the tapes were contrasted. An informal perusal of the incorrect responses of the subjects did not reveal any systematic errors due to the different talkers. Therefore, in the second section of the investigation the two tapes were considered to contain one talker presenting two different forms of the same word order.

TABLE 1

Summary of Analysis of Variance of Pilot Study Data Which Indicated No Difference Between the Two Talkers Represented on the Tapes: A = Order of Tape Presentation, B = Talker, and C = S/N Ratio

	SS	df	MS	F
Between Subjects				
	193.86	7		
A	0.76	1	0.76	
S/A	193.10	6	32.18	
Within Subjects				
	3151.62	56		
B	0.14	1	0.14	
AB	0.39	1	0.39	
S/AB	210.83	6	35.14	
C	2807.67	3	935.89	111.15
AC	29.93	3	9.98	
S/AC	151.52	18	8.42	
BC	15.55	3	5.18	
ABC	1.79	3	0.50	
SA/BC	127.29	18	7.07	

Part II. In the second section of the investigation, the word lists were presented to 28 subjects at each speech-to-noise ratio at three noise levels--35 dB, 65 dB, and 95 dB. The noise levels were set in each instance in the manner described earlier. Each noise level was presented once to each subject, monaurally and binaurally. The aural configurations were randomly assigned to each subject, as were the speech-to-noise ratios.

Results. The analysis of variance applied to the data is tabulated in Table 2. As may be noted, significant main effects were obtained for both the SPL of the noise and the S/N ratio. The differences related to S/N ratio were to be expected since intelligibility is expected to

TABLE 2

Summary of Analysis of Variance of Data on 27 Subjects on MRT:
A = Ear, B = SPL of Noise, and C = S/N Ratio, S = Subject

SOURCE	SS	df	MS	F
Total	50244.46			
A	14.00	1	14.00	0.59
B	6542.68	2	3271.34	115.35*
C	34547.29	3	11515.76	820.21*
S	1129.75	27		
AB	25.22	2	12.61	0.77
AC	23.53	3	7.84	1.01
BC	420.94	6	70.16	10.21*
AS	636.96	27	23.59	
BS	1531.66	54	28.36	
CS	1137.59	81	14.04	
ABS	878.94	54	16.28	
ACS	630.67	81	7.79	
BCS	1113.05	162	6.87	
ABC	9.05	6	1.51	
ABCS	1603.13	162	9.90	

*$p > 0.001$

increase. Inspection of Figure 2 will point to the obvious improvements as the S/N ratio increases.

The differences related to the SPL of the noise were not as expected, since the S/N was held constant and, at even the lowest noise level, the overall level of the speech should have been sufficient for maximum intelligibility. Further inspection of Table 2 also indicates an interaction between SPL of the noise and S/N ratio. Figure 3 depicts the discrepancies between the presentation levels of the noise as a function of S/N ratio. The consistently lower scores for the 35 dB presentation level should be noted. These differences were all statistically significant ($p = 0.01$) and the differences obtained accounts for the majority of the variance noted for the SPL main effect and the SPL and S/N ratio interaction.

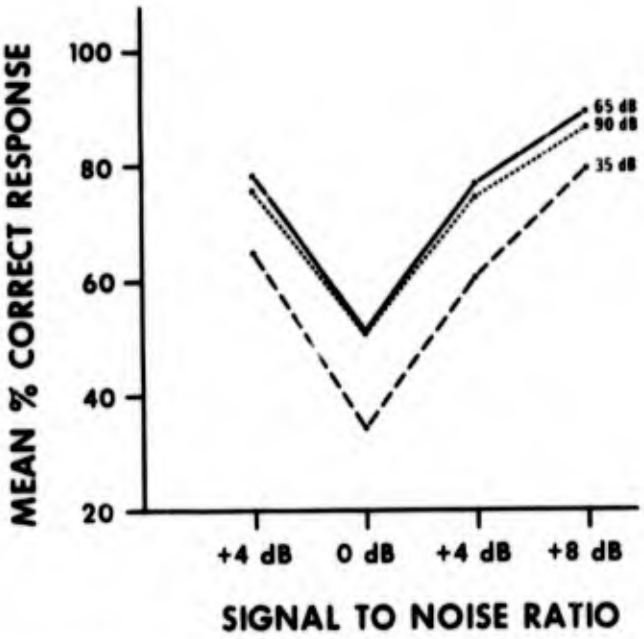


Fig. 2. Mean percent correct response as a function of S/N ratio. The parameter is presentation level of noise.

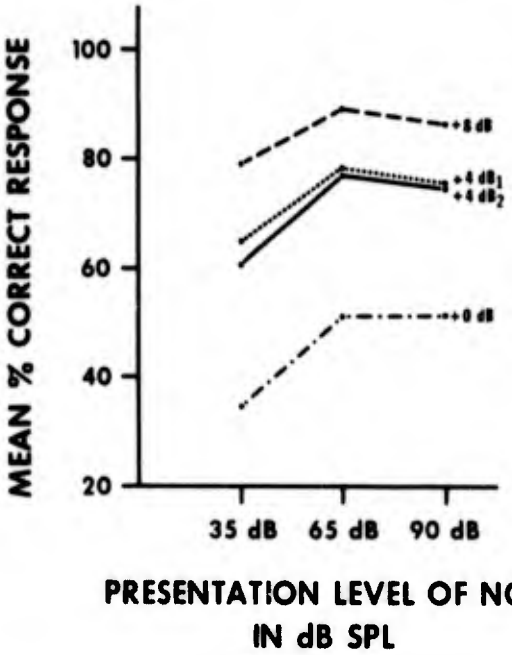


Fig. 3. Mean percent correct response as a function of presentation level of noise. The parameter is S/N ratio.

DISCUSSION

The renderings of the MRT used in this investigation appear to be appropriate for the purpose of testing the speech intelligibility capabilities of aviation personnel. The lack of apparent talker differences makes the lists interchangeable, and, therefore, provides a large family of lists for testing purposes. However, one caution must be cited. The poor scores at the lowest presentation level indicate the possibility of underestimating the intelligibility if close attention is not given to the level above threshold at which the lists are presented for testing.