HEARING LOSS AT 3 KILOHERTZ AND THE CHABA "PROPOSED CLINICAL TEST OF SPEECH DISCRIMINATION IN NOISE"

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SUMMARY PAGE

THE PROBLEM

To determine the audiometric threshold criterion at 3 kiloHertz (kHz) for voice communications in noise.

FINDINGS

Moderate to severe audiometric loss at 3 kHz degraded speech reception in noise by about 10 words correct per hundred. The relationship however is not clear cut enough to reject any percentage of poor performers without at the same time also rejecting a substantial percentage of those men who can handle speech in noise with at least average competence. No audiometric criterion loss at 3 kHz should be set at this time for voice communications in engineroom noise.

APPLICATION

For the use of communications engineers designing interior voice communication (IVC) circuits, and for medical personnel concerned with physical standards for military duties.

ADMINISTRATIVE INFORMATION

This investigation was conducted as part of Bureau of Medicine and Surgery Work Unit M4305.08-3003DAC9. The present report is No. 8 on this work unit. It was approved for publication on 27 July 1972 and designated as NAVSUBMEDRSCHLAB Report No. 720. Miss Angermeier was employed under ONR Contract No. N00014-68-A-0197-001 with the University of Connecticut.

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ABSTRACT

Forty-eight young men, 21 with rather sharp audiometric losses above 2 kiloHertz, were given a standard test of monosyllables in noise. On the average, these 48 men scored 10 fewer words correct per 100 than has been reported for normal controls. Scattergrams of performance vs a variety of pure-tone and speech threshold data, however, showed that no audiometric information could predict performance in noise. It was concluded that the standardized speech-in-noise test itself should be considered as the predictor instead of threshold tests, and that it should be validated against actual job performance.

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INTRODUCTION

The Stanford Research Institute recently distributed a set of tapes incorporating a "Proposed Clinical Test of Speech Discrimination" (PCTSD). This test was sent to the members of the Working Group-50 of CHABA (Committee on Hearing and Bioacoustics, National Research Council — National Academy of Sciences), with a view to having several laboratories conduct an evaluation. As a member of this Group, Dr. J. D. Harris, head of the Auditory Research Branch of NavSubMedRschLab, received a set of the tapes and proceeded to effect an evaluation.

The PCTSD is a test of one-syllable word discrimination based upon the Modified Rhyme Test,[2] mixed at various sound-to-noise ratios with a noise approximating USA Standards Institute noise.[3] The test has high face validity for predicting ability to understand speech in noisy workspaces, and as such has great interest for the military.

If we assume that the test is a reliable and valid job sample, the question arises whether with pure-tone and speech audiometry information already at hand one can predict which persons can or cannot communicate acceptably in noisy environments.

The purpose of this paper is to determine what audiometric defects, if any, contribute to decreased performance on the PCTSD.

METHOD

Test and Apparatus. The tapes as furnished, Forms B, D, E, and F were played individually to Ss with an Ampex 302 playback, an attenuator in 1-dB steps, a vacuum tube voltmeter (VTVM), and Otocup earmuffs fitted with monaural TDH-39 earphone. With the use of 1-kHz calibration tone on the tapes, the playback level was set for each subject at 40 dB in relation to his PB-W22 speech reception threshold (PB SRT) as determined with a Grason-Stadler speech audiometer.

Subjects. Forty-eight men, aged 17-29, were selected with a variety of hypacusic audiometric configurations. Only one ear per man was tested. Of these, 21 showed a further loss of 20 - 60 dB at 3 as compared with 2 kHz; the remainder had losses averaging from 17 to 39 dB over the speech range (0.5 - 3 kHz) (see Table I). A variety of diagnoses was present. PB SRT ranged from 2 to 38 dB; all Ss could well understand unmasked speech at 40 dB re SRT (Discrimination Scores of five men were 90%, all others were 100%).

RESULTS AND DISCUSSION

Mean per cents words correct for the two easier tests (B, E) were 89.8 and 87.4, respectively; for the more difficult (D, F) they were 64.3 and 68.7, respectively. These compare with published figures for the normal ear from Kreul of 95.8, 98.2, 75.0, and 81.0,

Table I. Audiometric Thresholds, SRT, PB-Max, and MRT Scores

No.	Frequencies								PB SRT	Max Disc.	MRT			
	500	1000	1500	2000	3000	4000	6000	8000			B	D	E	F
1	30	35	25	25	40	50	60	60	16	100	66	24	60	30
2	5	0	0	5	30	70	80	60	7	100	88	58	84	58
3	25	30	40	40	50	40	55	25	15	100	86	72	92	74
4	5	10	20	20	35	35	40	60	8	100	88	62	96	80
5	5	25	35	25	10	10	50	25	14	100	94	66	94	72
6	15	15	20	35	50	40	40	10	12	90	90	74	90	74
7	20	25	25	25	35	50	50	50	8	100	96	76	94	86
8	15	5	0	5	40	40	30	45	9	100	96	74	96	84
9	5	5	5	5	25	45	60	50	2	100	94	74	92	76
10	20	15	25	25	85	95	NR	NR	22	100	78	54	70	58
11	25	25	..	15	30	10	25	20	6	100	84	34	56	40
12	40	45	40	20	25	35	55	30	33	100	96	64	98	80
13	0	0	0	0	55	70	70	25	11	100	94	64	86	62
14	10	15	15	20	30	35	35	10	12	100	88	70	94	72
15	5	10	15	10	30	40	40	40	12	100	98	78	98	70
16	25	10	10	20	75	75	70	50	13	100	94	68	94	64
17	10	20	20	20	80	90	85	70	6	100	96	66	94	76
18	40	40	35	15	15	10	10	10	36	100	94	60	96	64
19	20	25	35	70	75	60	60	45	30	100	92	70	92	84
20	0	5	5	15	45	80	60	25	11	100	92	68	92	72
21	10	10	10	15	65	60	75	15	4	100	90	70	90	74
22	20	25	20	20	35	35	30	20	12	100	92	66	98	80
23	0	0	0	0	25	70	75	60	4	100	98	66	92	74
24	0	0	15	0	55	75	80	55	28	100	68	48	66	48
25	10	15	10	15	50	50	55	40	4	100	88	62	88	70
26	15	35	40	40	35	20	10	5	14	90	90	70	90	78
27	20	20	20	25	35	45	45	35	12	90	88	58	64	58
28	5	5	5	5	55	60	55	15	6	100	94	64	96	76
29	5	0	10	15	45	40	15	0	6	100	96	64	92	74
30	45	45	45	30	35	40	70	70	38	100	90	62	88	62
31	10	10	20	15	15	45	50	55	8	100	92	60	94	70
32	15	15	40	50	35	20	10	15	12	100	90	64	88	62
33	15	15	15	25	70	75	85	75	6	90	72	72	80	50
34	15	20	25	40	45	40	70	70	8	100	92	44	90	68
35	30	20	30	25	30	30	40	40	24	100	96	64	96	68
36	0	5	5	5	25	50	65	20	10	100	94	62	92	74
37	0	5	0	0	50	65	100	70	4	100	92	72	94	84

Table I. Audiometric Thresholds, SRT, PB-Max, and MRT Scores (cont)

No.	Frequencies								PB SRT	Max Disc.	MRT			
	500	1000	1500	2000	3000	4000	6000	8000			B	D	E	F
38	10	10	. .	15	20	35	35	25	6	100	96	68	94	74
39	30	35	. .	45	45	60	55	65	38	100	74	46	82	64
40	15	20	50	40	55	60	55	30	16	100	88	80	82	80
41	0	0	5	25	60	65	65	50	6	100	88	72	94	72
42	0	10	0	5	15	75	NR	NR	12	100	96	78	90	68
43	20	25	25	25	25	25	40	50	14	100	88	58	86	60
44	0	0	0	5	60	60	80	55	12	100	88	66	86	68
45	5	0	0	0	60	60	75	65	3	100	96	72	98	62
46	10	15	. .	15	20	70	75	60	0	100	92	68	82	50
47	10	5	10	5	25	45	65	40	2	100	88	64	90	62
48	35	20	5	15	35	30	10	5	14	90	90	72	44	90

	B	D	E	F
Mn:	89.8	64.3	87.4	68.7
S.D.:	7.24	10.75	11.75	11.86

respectively, and for 19 normal ears from this laboratory[4] of 94.1, 95.2, 72.1, and 74.3, respectively. It is seen that these subjects perform on the easier tests by an average of 7.2 percentage points worse than normal-hearing Ss, on the more difficult tests by an average of 9.1 percentage points worse.

Figure 1 shows the typical relation between performance in quiet vs in noise; with a couple of exceptions, those who do poorly in quiet are not those who do poorly in noise (List D); and the converse. The same is true (see Fig. 2) for pure-tone audiometry averaged over 0.5 - 2 kHz vs PCTSD (List D), and even for loss at 2 kHz vs PCTSD (List

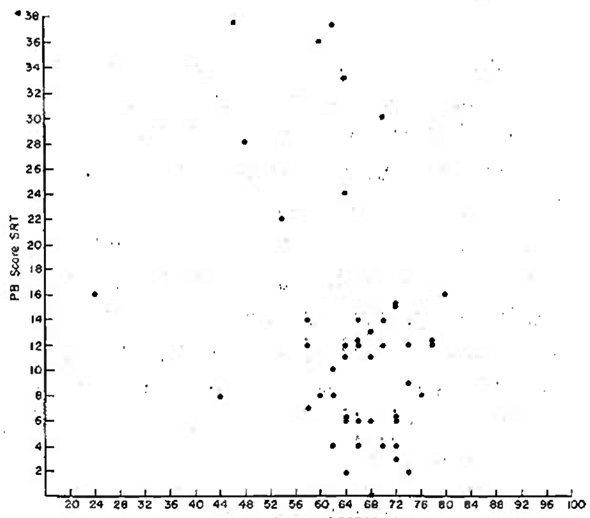

Fig. 1. Relation Between Speech in Quiet (SRT) Vs Speech in Noise (PCTSD)

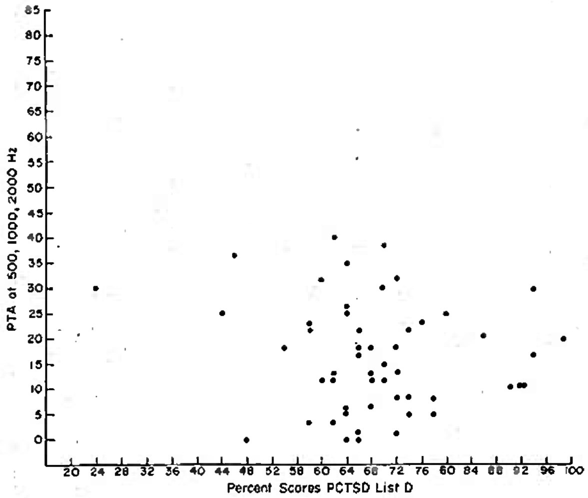

Fig. 2. Relation Between Pure-Tone Average at 0.5-2 kHz Vs Speech in Noise (PCTSD)

D) (see Fig. 3), a frequency which might have been supposed from Kryter et al[5] to be most strongly related to speech intelligibility in noise.

Figures 4 and 5 further show that the relation is negligible between hearing loss at 3 kHz vs PCTSD (Lists D, F).

Thus, by no audiometric index is it possible to understand the variance among listeners to the PCTSD. The search will have to broaden into other areas altogether. In the meantime, it is not justified to select individuals for communicating in noisy workspaces on the basis of any audiometric data. The best solution at the moment is to regard the PCTSD as a selection item itself, and not as a valid job sample, and to seek to set cut-off criteria by relating

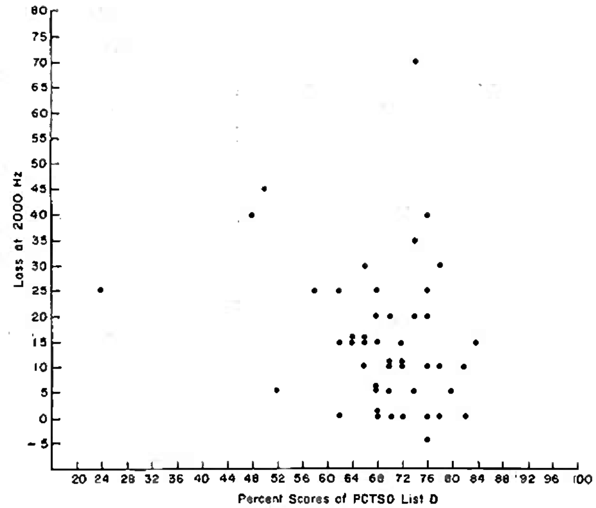

Fig. 3. Relation Between Audiometric Loss at 2 kHz Vs Speech in Noise (PCTSD)

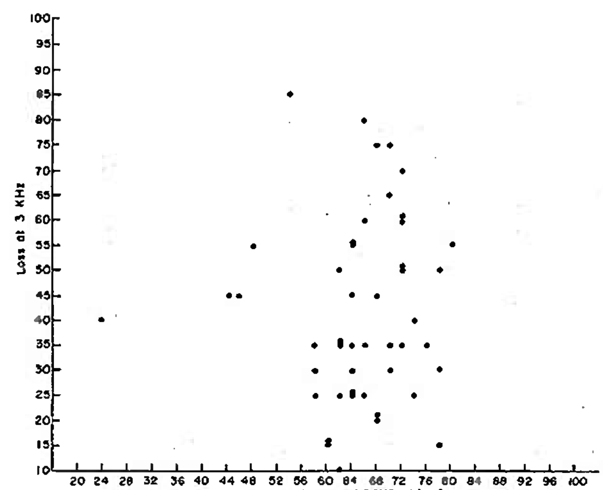

Fig. 4. Relation Between Audiometric Loss at 3 kHz Vs Speech in Noise (PCTSD, List D)

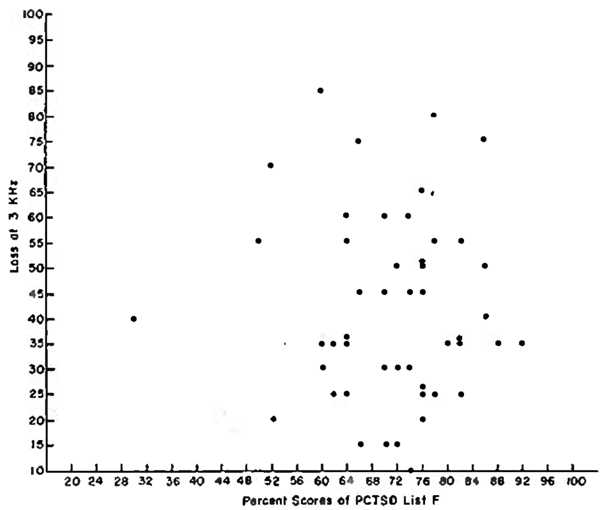

Fig. 5. Relation Between Audiometric Loss at 3 kHz Vs Speech in Noise (PCTSD, List F)

PCTSD scores to samples of actual communications ability on the job.

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