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A PROGRESS REPORT ON THE NAVAL AVIATORS' SPEECH DISCRIMINATION TEST

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SUMMARY PAGE

THE PROBLEM

In 1964 the Naval Aviators' Speech Discrimination Test (NASDT) was constructed for use in providing an objective basis for granting waivers to senior aviators whose hearing did not meet the pure-tone hearing standards, but who reported no hearing difficulties in their operational environment. It seems appropriate at this time to present a progress report on the data that have been obtained thus far.

FINDINGS

Although the NASDT has been administered to over 150 senior Navy and Marine Corps aviators, complete data, including pure-tone thresholds and NASDT scores, are available for only 103 men. Correlations calculated between NASDT scores and hearing threshold levels reflect the inability of the pure-tone audiogram to provide a valid evaluation of the ability to hear speech in the presence of aircraft noise. From an analysis of the data that have been obtained to date, including those obtained from groups of student aviators and participants in the Pensacola "Thousand Aviator" Study, it appears that the NASDT has fulfilled its original purpose and has led to a more realistic and practical evaluation of the hearing of senior naval aviators.

INTRODUCTION

For several years prior to 1964, the Navy was faced with the problem of evaluating a number of senior aviators who, by the nature of their duties, had sustained a hearing loss, resulting in their no longer being able to meet the required hearing standards. Since the men indicated they had not experienced any hearing problems in their operational environment, the aircraft, a question arose as to the relevancy of the pure-tone threshold audiogram for evaluating the hearing of this highly qualified group. More specifically, were their careers and experience being sacrificed on the basis of an incorrect criterion of physical fitness for aviation activities?

This problem was first studied in 1946 by Dickson et al, for the British Royal Air Force (1). They devised a test procedure and instrumentation for administering speech tests in a simulated aircraft noise environment. In 1953, McFarland pointed out the failure of the pure-tone audiogram to provide a valid evaluation of the ability of an individual to hear speech in the presence of aircraft noise (2). He indicated that recruitment, which usually accompanies noise-induced hearing loss, enables a pilot with a hearing loss to hear speech in noise as well as a pilot whose hearing is normal.

In 1964, Bragg and Greene constructed a test, the Naval Aviators' Speech Discrimination Test (NASDT), for use in providing an objective basis for granting waivers to those aviators who failed to meet the pure-tone hearing standards (3). Essentially, the test consists of tape-recorded lists of 100 phonetically balanced (PB) words mixed with C-45 aircraft noise (4). The recording is reproduced via earphones and is calibrated so that the sound pressure level of the noise is 100 dB and that of the speech peaks, 115 dB.* Based on data obtained during the development of the test, the pass-fail score was set at 70 percent.

Because of limited use of the NASDT, data obtained from the test have accumulated rather slowly since its adoption for Navy use. In order to obtain additional information about the NASDT the test was administered to several other groups of individuals with different degrees of flight experience. It seems appropriate at this time to report on the data that have been obtained thus far.

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*While a +6 to +8 dB speech-to-noise ratio would have been more realistic, a +15 dB speech-to-noise ratio was employed to compensate for an unfavorable consonant-to-vowel ratio noted in the speech recording.

SUBJECTS AND DATA

SENIOR AVIATORS

Although the NASDT has been administered to over 150 senior Navy and Marine Corps aviators, complete data, including pure-tone thresholds and NASDT scores, are available for only 103 men. This group has been subdivided into three groups according to hearing requirements as given in the Manual of the Medical Department (5). Figure 1 shows the mean hearing thresholds and mean NASDT scores for three groups of aviators: 1) those whose hearing was within the limits for Service Group I (SG I) standards (N = 22 ears); 2) those who failed Service Group I but passed Service Group III (SG III) standards (N = 106 ears); and 3) those whose hearing failed to meet Service Group III standards (N = [illegible] ears). All three curves in this figure show the familiar high-frequency hearing loss resulting from exposure to high-intensity aircraft noise. In some individuals, however, some of the loss may be attributed to exposure to gunfire noise. The average NASDT scores for the three groups were 79.9 percent, 78.0 percent, and 77.0 percent, respectively, with an overall grand mean of 77.8 percent. A frequency distribution of the NASDT scores approximates a normal curve. The percentage of individuals whose scores fell below 70 percent was 11.6. It is apparent that although the hearing threshold levels for the speech frequencies (500 to 3000 Hertz) vary among the three groups, the mean NASDT scores are similar.

STUDENT AVIATORS AND "THOUSAND AVIATORS"

The NASDT was also administered to a group of 210 preflight student aviators and to participants in the Pensacola "Thousand Aviator" studies. The data for these groups are shown in Figure 2. The upper curve in this graph represents the mean hearing thresholds for the group of student aviators (N = 420 ears) which were within normal limits; their mean NASDT score was 77.6 percent. The other three curves represent mean hearing thresholds for individuals selected at random from the "Thousand Aviator" study group, who were categorized into three subgroups: 1) men having less than two years' flight experience (N = 60 ears); 2) men having from two to ten years' flight experience (N = 180 ears); and 3) men having more than ten years' flight experience (N = 326 ears). The mean hearing threshold levels of the three "Thousand Aviator" groups were not so elevated as those obtained for the three senior aviator subgroups; mean NASDT scores were 76.7 percent, 76.6 percent, and 78.5 percent, respectively.

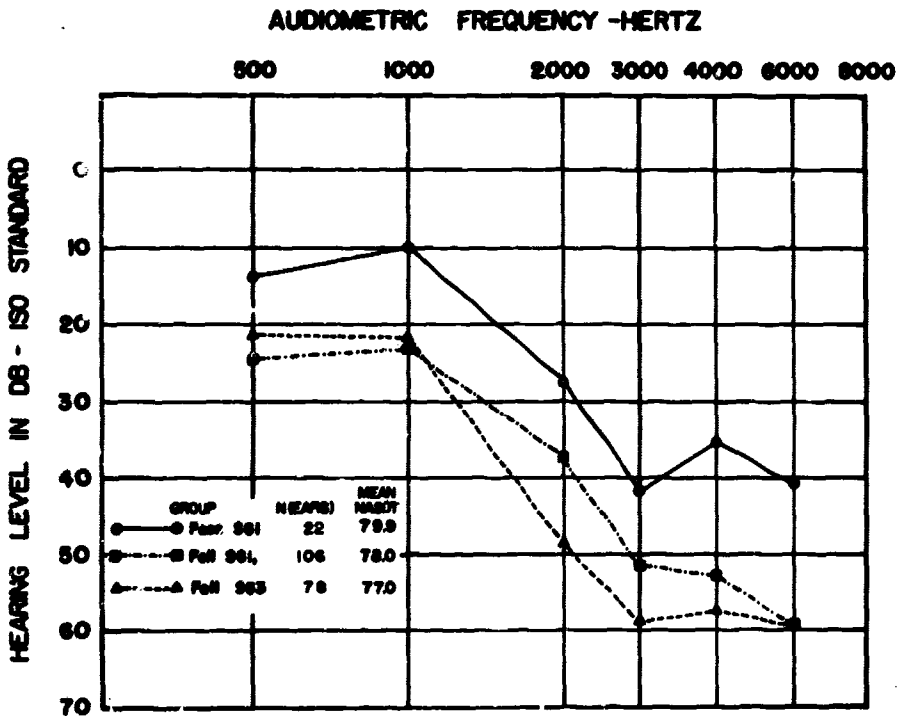

Figure 1

Mean Hearing Threshold Levels and NASDT Scores
for Three Groups of Senior Aviators

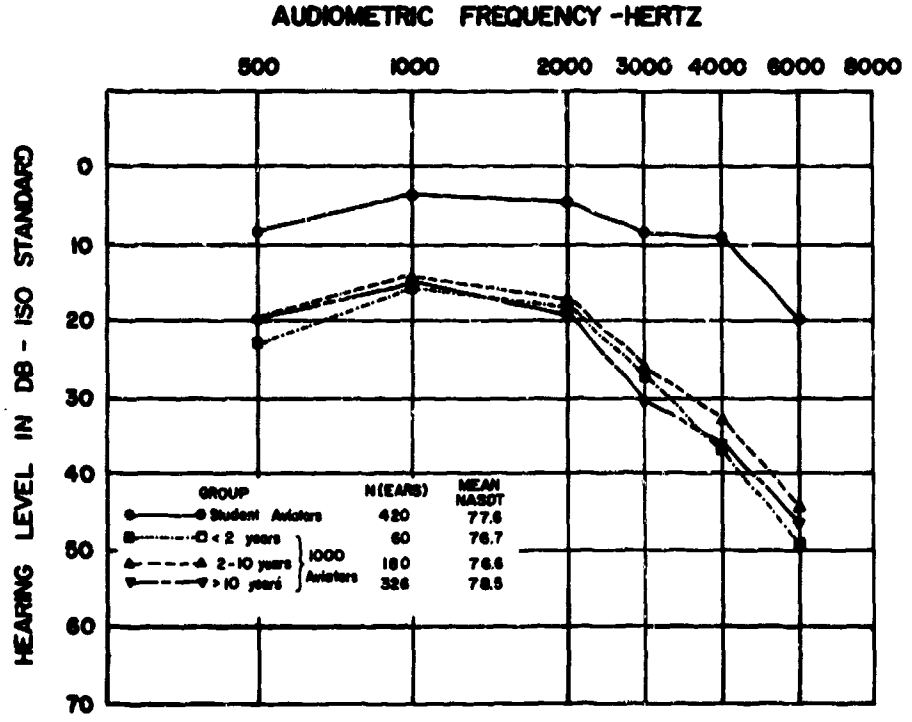

Figure 2

Mean Hearing Threshold Levels and NASDT Scores for a Group of
Student Aviators and Three Groups of Aviators from
the Pensacola "1000 Aviator" Study

ANALYSIS AND DISCUSSION

Additional statistical information for all of the just-mentioned groups is summarized in Table I. Inspection of these data reveals that, despite wide variations in age and flight experience among the groups, the mean NASDT scores were remarkably similar.

Table I

Statistical Description and NASDT Scores
for Various Aviator Groups

	N	Average Age-Years	Average Flight Time-Hours	NASDT Mean	NASDT S. D.	Percent Failure
Senior Aviators Pass SG I	11	41.2	4578	79.9	7.2	9.1
Senior Aviators Fail SG I	53	42.9	4500	78.0	6.3	9.4
Senior Aviators Fail SG III	39	44.7	5465	77.0	8.2	15.4
Preflight Student Aviators	210	22.2	0	77.6	5.9	10.0
"1000 Aviators" <2 years flying	30	47.0	117	76.7	6.2	13.3
"1000 Aviators" 2-10 years flying	90	46.3	3515	76.7	6.8	13.3
"1000 Aviators" >10 years flying	163	46.9	6299	78.5	5.7	6.7

Pearson product-moment correlations were calculated between the NASDT scores and hearing threshold levels for the 103 senior aviators. As was expected, the correlations were low, reflecting the inability of the pure-tone audiogram to provide a valid evaluation of the ability to hear speech in the presence of aircraft noise. This lends support to conclusions reached in 1968 based on data obtained from 61 senior naval aviators (6).

CURRENT STUDIES

In addition to the types of data already presented, some in-flight and laboratory tests are presently being conducted for the purpose of validating the NASDT and making it a more efficient test. Questions for which answers are being sought are: 1) Does an aviator's performance on the NASDT actually reflect how well he can hear voice communications in his aircraft? 2) Should the speech materials employed reflect the type of communication the aviator hears in flying his aircraft (i.e., words commonly used in aviation voice communications)? 3) Can the test be streamlined to make test administration and scoring more efficient?

A radio system installed in the laboratory is used to obtain in-flight measures of speech discrimination as subjects are flown in an A1-E research aircraft. Aviators with different degrees of hearing loss are used as subjects. The normal procedure is to first administer a pure-tone audiometric test and the NASDT in the laboratory. Then the subjects are briefed and dispatched to the aircraft. During the in-flight portion of the experiment each subject receives the following via radio: 1) the same PB word recording used in the NASDT (without noise); 2) a list of aviation jargon (words commonly used in aviation voice communications); and 3) a list of Modified Rhyme Test words (7). The last, a multiple-choice test having a closed-response format, is being evaluated by CHABA Working Group 52 as a proposed speech reception test for aviators.

Table II shows data which have been obtained thus far from nine subjects. It can be seen from these limited data that the mean scores for the NASDT and the in-flight PB words were similar, while those for the other two word lists tended to be somewhat higher. These differences may be in part due to the use of a different microphone and recording system for the latter two word lists. It can also be seen that, whereas the in-flight tests appear to differentiate between normal-hearing subjects and subjects having hearing losses, the NASDT does not. Additional data are required to determine whether this differentiation can be attributed to the particular speech recordings used in the tests or to the in-flight test conditions. Subject FMJ scored significantly lower than the rest of the subjects for the in-flight tests.* His low performance was found to be due to a poorly fitted flight helmet. This incident demonstrated the need to ensure proper helmet fit prior to obtaining in-flight speech discrimination data. A helmet fitting test has since been incorporated into our experimental procedures.

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*Data for subject FMJ were not included in calculation of mean scores.

Table II

Comparison of NASDT Scores and Results Obtained from Nine Subjects for Three In-flight Tests

Subject	Hearing	NASDT	PB	Aviation Jargon	Modified Rhyme Test
CHM	Normal	85	92	96	100
WWM	Normal	85	89	98	98
*FMJ	Normal	79	48	76	76
ABH	High Freq. Loss	85	77	96	92
NRR	High Freq. Loss	84	86	96	94
WJJ	High Freq. Loss	83	82	94	94
WF	High Freq. Loss	89	80	92	80
WHG	Mixed Loss	81	83	94	88
RRG	Severe High Freq. Loss	87	85	92	86
	Mean Scores	84.9	84.2	94.8	91.5

*Subject FMJ omitted.

CONCLUSIONS

From an analysis of the data that have been obtained to date with the NASDT, it appears that the test has fulfilled its original purpose and has led to a more realistic and practical evaluation of the hearing of senior naval aviators. In-flight and laboratory test data currently being obtained will, hopefully, lead to a more efficient functional test of an aviator's hearing capabilities in his operational environment. Such a test could be used not only for senior aviators, but for all aviators and aircrew personnel. This is not to suggest that the ultimate test would replace the pure-tone threshold audiogram which provides valuable clinical information.

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13. ABSTRACT

Six years have elapsed since the Naval Aviators' Speech Discrimination Test (NASDT) was first used to provide an objective basis for granting waivers to senior aviators who fail to meet the pure-tone hearing standards but who experience no hearing difficulties in their working environment. While the NASDT is normally administered only to aviators whose hearing falls below current standards, the test is also being administered to groups of student aviators and participants in the Pensacola "Thousand Aviator" Study.

From an analysis of the data that have been obtained to date, it appears that the NASDT has fulfilled its original purpose and has led to a more realistic and practical evaluation of the hearing of senior naval aviators. Pearson product-moment correlations calculated between NASDT scores and hearing threshold levels reflect the inability of the pure-tone audiogram to provide a valid evaluation of the ability to hear speech in the presence of aircraft noise. In-flight and laboratory test data currently being obtained will, hopefully, lead to a more efficient functional test of an aviator's hearing capabilities in his operational environment.

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Aviator's Hearing Standards						
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