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RESEARCH MEMORANDUM

NUMBER 54-1 January 1954

COMPARISON OF THE AMERICAN OPTICAL VISION TESTER AND THE ARMED FORCES FAR VISUAL ACUITY TEST

B-6-133-13

3 February 1954

PERSONNEL RESEARCH BRANCH

PERSONNEL RESEARCH AND PROCEDURES DIVISION, TAGO

ABSTRACT

Research Memorandum 54-1 B-6-133-13 January 1954

COMPARISON OF THE AMERICAN OPTICAL VISION TESTER AND THE ARMED FORCES FAR VISUAL ACUITY TEST

Comparisons were made of the visual acuity scores of 100 enlisted men on the American Optical Vision Tester (with Sloan plates) and on the Armed Forces Far Visual Acuity test. Order of presentation was: AO-left eye, AO-right eye, AFFVAT-left, AFFVAT-right. Correlation coefficients between AO and AFFVAT were around .89. Dispersion of acuity scores was about the same on the 2 tests. Assuming the absence of practice effect, AO was found to be more difficult (indicated by lower AO average acuity score and displacement of AO score distributions).

2 Feb 54

Research Memorandum released: 3 February 1954.

COMPARISON OF THE AMERICAN OPTICAL VISION TESTER AND THE ARMED FORCES FAR VISUAL ACUITY TEST

BACKGROUND

In compliance with a directive from the Chief of Naval Research, concurred in by the Surgeon General, the Personnel Research Branch cooperated with other agencies in a project to evaluate a new multi-test optical device developed by the American Optical Company.

In a meeting, 7 May 1953, of the Armed Forces - NRC Vision Committee Working Group for the Evaluation of Screening Devices, PRB was assigned the objective of determining the correlation between scores on the American Optical Instrument (AO) and the Armed Forces Far Visual Acuity Test chart (AFFVAT).

A report of the study intended for transmission to the Working Group is attached as TAB A.

PERSONNEL

Program Coordinator: Dr. Melvin R. Marks

Project Director: Dr. Donald A. Gordon

Acting Statistical Advisor: Mr. Leon G. Goldstein

Research Associate: Mr. Thomas J. Houston

TAB A

COMPARISON OF THE AMERICAN OPTICAL VISION TESTER AND THE ARMED FORCES FAR VISUAL ACUITY TEST

I. INTRODUCTION

This study of visual acuity scores compared the American Optical Vision Tester using Sloan Plates (AO) with a wall chart, the Armed Forces Far Visual Acuity Test (AFFVAT).

A. SAMPLE

The examinees were 100 enlisted men from Fort Meade, Maryland. The mean age was 22.8 years with approximately two thirds of the group between 19.2 years and 26.2 years.

B. METHOD

Each examinee was tested with each eye (uncorrected) on both AO and AFFVAT. The order of presentation was: AO-left eye, AO-right eye, AFFVAT-left eye, AFFVAT-right eye.

Correlation coefficients were computed between scores on AO and on AFFVAT. The score used for each man was the total number of letters read correctly (including letters on the line in which four or more errors were made--the failure line).

For purposes of comparing distributions of acuity ratings, scoring was by interpolation on the basis of the proportion of letters read correctly on the failure line. All Snellen fraction scores so obtained were then converted to decimal equivalents by computing the reciprocal of the Snellen fraction. The mean group score for each eye on each instrument was obtained by averaging the decimal equivalents and then reconverting to Snellen fractions.

II. RESULTS

Correlation coefficients between AO and AFFVAT are shown in Table 1.

TABLE 1

CORRELATIONS BETWEEN AO AND AFFVAT BASED ON TOTAL NUMBER OF LETTERS READ CORRECTLY

(N = 100)

Type of Observation	Coefficient
Left Eye	.89
Right Eye	.90
Left and Right Eye (N = 200 eyes)	.89

Average performance on AO and on AFFVAT is compared in Table 2.

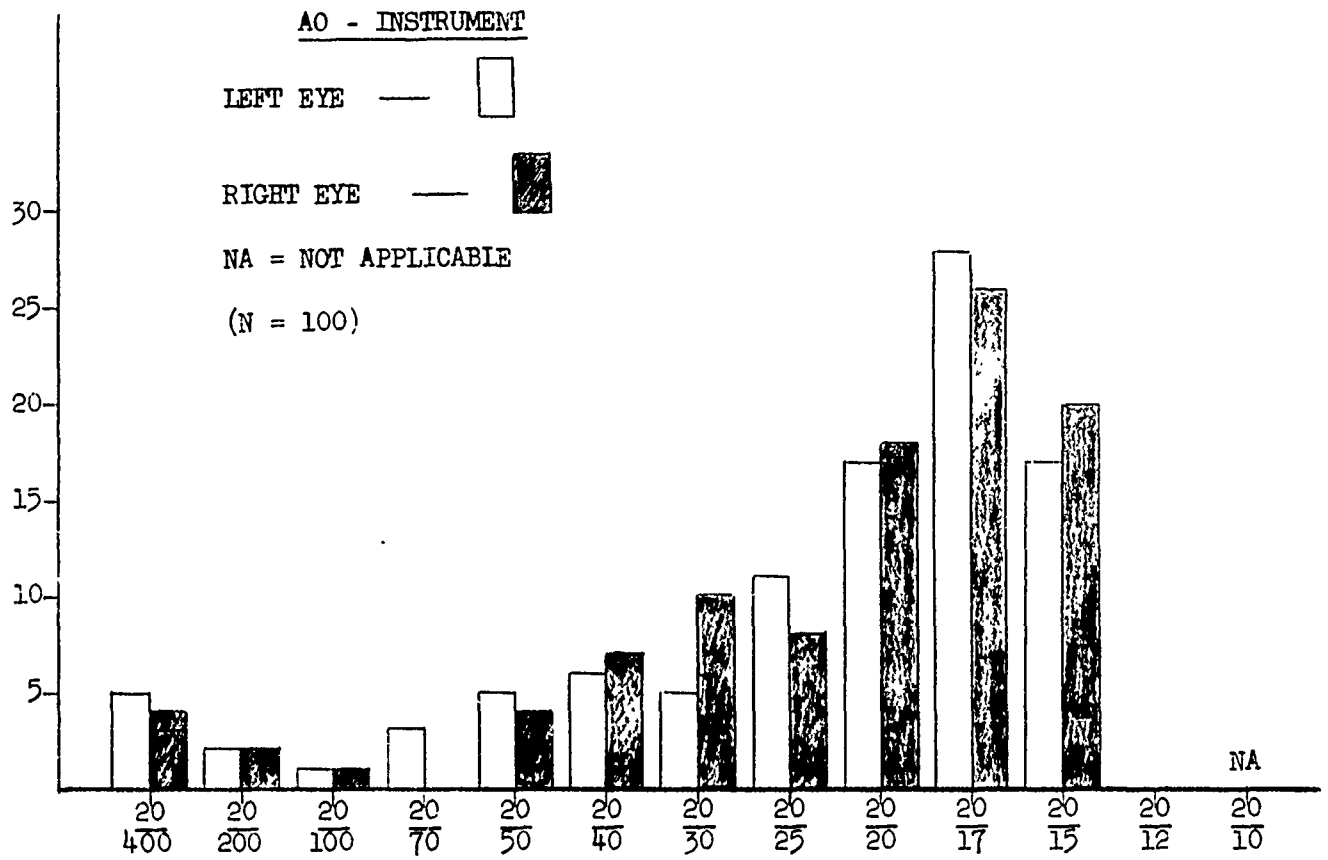
TABLE 2

MEAN SNELLEN FRACTION AND DECIMAL ACUITY SCORES FOR AO AND AFFVAT

(N = 100)

Type of Observation	Mean Snellen Rating	Mean Decimal Score
AO-Left Eye	20/30.6	1.53
AO-Right Eye	20/28.2	1.41
AFFVAT-Left Eye	20/21.6	1.08
AFFVAT-Right Eye	20/22.8	1.14

The distributions of acuity ratings by Snellen fractions are given in Table 3 and in Figure 1. The frequency distributions in Figure 1, rather than standard deviations, are presented to show dispersion since the deviation statistic appears to be less easily interpreted because of the skewness of the distributions. Approximately 5% of the group in each case failed to read the largest line with either eye on either target.



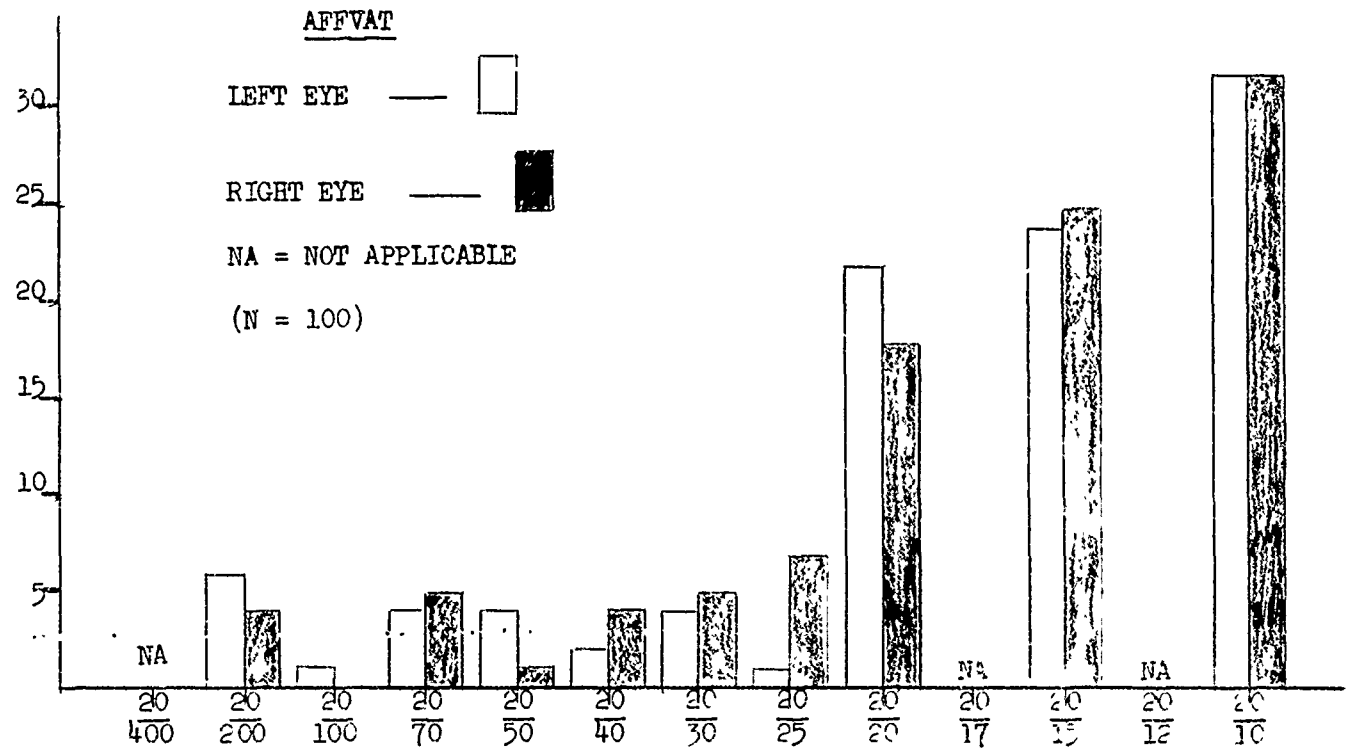


FIGURE 1. Distributions of acuity ratings on American Optical Instrument (AO) and on Armed Forces Far Visual Acuity Test (AFFVAT)

TABLE 3

DISTRIBUTIONS OF ACUITY RATINGS BY SNELLEN FRACTION

Snellen Fraction	AO Left	AO Right	AFFVAT Left	AFFVAT Right
20/400	5	4	NA*	NA
20/200	2	2	6	4
20/100	1	1	1	0
20/70	3	0	4	5
20/50	5	4	4	1
20/40	6	7	2	4
20/30	5	10	4	5
20/25	11	8	1	7
20/20	17	18	22	18
20/17	28	26	NA	NA
20/15	17	20	24	25
20/12	0	0	NA	NA
20/10	NA	NA	32	32
	100	100	100	100

*Not Applicable

III. DISCUSSION

The primary objective of this study was to determine the correlation between AO and AFFVAT; to determine the equivalence of the targets was a secondary objective. The order of presentation used (The AO and the left eye always first rather than a counter-balancing of the two targets and of the two eyes) was deliberately chosen to meet the needs of the primary objective. The objection to counter-balancing for correlational analysis is that practice effects (if present) would differentially affect the scale of measurement in counter-balanced orders of presentation. This scale distortion would, in turn, spuriously influence the correlation between the targets.

On the other hand, counter-balancing is a necessity when the determination of equivalence is the primary concern. Otherwise, practice effect (if present) would produce a difference in scores even though the targets were

in fact equivalent in difficulty. In this study, changes in acuity scores which might have involved practice effect, at least from left to right eye, appeared to be negligible or nonexistent; as shown in Table 2, average acuity scores from left to right eye improved on AO but lessened on AFFVAT. Because of the slight magnitude and variation in direction of these changes, it is assumed that practice effect from test to test was also negligible in this study.

With these considerations in mind, Table 2, Table 3, and Figure 1 indicate that the AO is more difficult than the AFFVAT. For example, none of the men successfully read the 20/12 line on AO; in contrast, about 1/3 achieved 20/10 on AFFVAT. A lack of equivalence presents interchangeable use of AO and AFFVAT under operating conditions, unless norms are adjusted empirically. For example, if 20/20 Snellen were set as a cutting score for a particular selection purpose, AO could not be used unless the cutting score was changed to approximately 20/30 Snellen.

Table 1 may be interpreted to show that AO and AFFVAT appear to be measuring much the same ability. Indeed, when the correlations were corrected statistically for the attenuating effects of unreliability of measurement, they approached unity.