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THE VALIDITY OF A BRIEF VESTIBULAR DISORIENTATION TEST IN SCREENING PILOT TRAINEES*

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SUMMARY PAGE

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THE PROBLEM

This study investigated the validity of a Brief Vestibular Disorientation Test (BVDT) for predicting various pilot training criteria.

FINDINGS

Test scores were evaluated for their relation to three criteria: 1) students separated from flight training for all causes versus completions; 2) tension and/or airsick separations versus all others; and 3) airsick separations versus all others. Results showed significant relationships between high sensitivity scores on the BVDT and membership in the various separation groups. The airsick separation group had the highest mean BVDT sensitivity score. Statistical evidence indicates that the BVDT ratings tap a significant portion of the flight criterion variance not reached by the present prediction methods.

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INTRODUCTION

The Coriolis vestibular reaction, which can be elicited by tilting the head during simple whole-body rotation, has been of interest to the aviation examiner since the time of World War I. Early attention centered mainly around identifying and describing the phenomenon. More recently, efforts have been made to assess the subject's total behavior associated with the Coriolis vestibular reaction and to base predictions on these assessments (1-7, 9, 10). Evaluations of individuals experiencing this Coriolis vestibular reaction have been compared with their subsequent performance in flight training in the Netherlands (4,6,7) and Canadian (9) Air Training Commands. Results were encouraging, in that the evaluations appeared to predict success and also occurrence of motion sickness in flight training. Performance in a rotating environment also has been found to be predictive of susceptibility to airsickness and seasickness (3).

At Pensacola a Brief Vestibular Disorientation Test (BVDT) has been developed that involves an assessment of subjects' reactions produced by head movements in a rotating chair. A structured rating procedure was introduced to permit brief and objective administration of the test by personnel who have only a modicum of training for the task. Reliability of measurement has been demonstrated by substantial agreement among several types of observers using the BVDT technique for the same subjects and by substantial agreement between observers' BVDT ratings and the subjects' self-ratings of sensitivity. These data have been reported previously (2). The present study investigated the validity of the test for predicting various pilot training criteria.

PROCEDURE

SUBJECTS

Subjects were 226 naval aviation trainees who were within approximately one week of completing the sixteen-week pre-flight syllabus. They were chosen from eighteen consecutive classes. About thirteen subjects were randomly selected from each class of approximately thirty-five men. None of the subjects had started training in actual flight, but all had passed a rigorous battery of selection tests and, of course, were successfully completing pre-flight training.

BVDT PROCEDURE

Subjects were taken singly into the experimental room and seated in a rotary chair (Stille-Werner) where practice head movements were made, with the chair stationary, until instructions were clearly understood. The subject was asked to make head movements of 45 degrees in about three seconds with his eyes closed and without mechanical aids. After instructions the procedure was as follows: Chair was accelerated at 15 deg/sec^2 to a constant velocity of 90 deg/sec (15 RPM). After one minute the following positions were assumed by the subject: head right, upright,

head left, upright, head right, upright, head left, upright, head forward, upright. Each position was maintained for thirty seconds. Upon completion of this sequence, the chair was stopped with a 15 deg/sec^2 deceleration. The subject was instructed to open his eyes immediately after the sensation of movement stopped.

Four raters, all of whom were inexperienced in this type of task, made independent ratings of each of the subjects. Forms were used to record rater estimates of pallor, sweating, facial expression, unsteadiness, speed of recovery, and over-all performance. Included in over-all performance were estimates of the speed and accuracy of head movements, spontaneous comments, intensity of nystagmus observed following deceleration, and behavior upon leaving the chair. Ratings were made for each factor on a ten-point scale, with the lowest point indicating little or no effect and the topmost, strong effect. Raters were told not to make relative judgments of subjects but to judge each man separately. For example, a rating of 10 on sweating would mean that the man was sweating profusely. This procedure was adopted to avoid, if possible, the necessity of giving raters a wealth of experience in comparing subjects before they could qualify to administer the test and to avoid having the individual's rating reflect his standing within his subgroup rather than his standing within the pilot population. After rotation each subject was asked to complete a brief questionnaire involving a seven-point scale of rating his own reactions to the experience. The questionnaire included five specific areas of reaction. These were: like/dislike, no stomach effects/ strong stomach effects, no dizziness/strong dizziness, no sickness feelings/strong sickness feelings, and steady on feet/very unsteady on feet. A mark of 1 on the scale indicated favorable or no reaction, and a mark of 7 indicated extreme reaction.

ANALYSIS AND RESULTS

Although the BVDT was designed to give the subject a relatively mild stimulus, most subjects reported some reaction to the experience. Table I shows the distribution of responses to the questionnaire that each subject completed after his run. It is interesting to note that about half of them admitted at least some feelings of sickness. This finding is a by-product of the investigation. Little emphasis was placed on the relevance of the self-ratings for prediction because it was felt that in an actual operational setting, a potential pilot trainee would not express any "undesirable" reactions to the experience. The raters' judgments were therefore the main concern.

Rater judgments on the six elements (pallor, sweating, facial expression, unsteadiness, speed of recovery, and over-all performance) were summed for each subject. Since a ten-point scale was used, the range of possible scores was from six to sixty. Means of the four raters' scores were determined for each subject for use in validating against flight criteria. This mean score was termed the BVDT score.

Table I

Percentage of Subjects' Responses for Each Point of Seven Point Scale Expressing Subjects' Own Reactions to BVDT Procedure

Favorable	1	2	3	4	5	6	7	Unfavorable
Like	32.2	21.5	15.5	16.7	10.0	2.0	2.0	Dislike
No stomach effects	54.6	21.1	7.7	5.7	6.9	2.8	1.2	Strong stomach effects
No dizziness	26.7	28.7	20.3	8.4	13.1	2.4	0.4	Strong dizziness
No sickness feelings	51.8	23.7	6.5	7.8	8.2	1.2	0.8	Strong sickness feelings
Steady on feet	66.1	20.2	6.9	4.0	2.0	0.8	0.0	Very unsteady on feet

Three dichotomous criteria were used for validation. These were as follows:

1) Students separated from flight training for any reason versus completing students.
2) Students separated from flight training because of tension and/or airsickness versus all other students.
3) Students separated from flight training because of airsickness versus all other students.

The BVDT score correlated significantly with all three criteria. The point biserial correlation with the first criterion was .165, with the second .272, and with the third .413. (For a sample of 226 a correlation of .155 is required for .02 significance level.) Table II contains these coefficients and additional data showing the separate correlations of the six elements of the BVDT with the criteria. Rater reliability for the six elements is included also. The six elements all correlated significantly with the criteria, but the reliability for any single element was not so good as the rater reliability for the total BVDT score. For this reason the total BVDT score was used in the subsequent analysis.

Although these significant coefficients suggest that the BVDT is a useful selection instrument, it was necessary to determine whether it augmented existing selection procedures. Research at the Naval Aerospace Medical Institute has developed multiple regression equations for predicting subsequent separation from flight training. Separate equations are available for various critical points in training (11). Table III shows for these 226 subjects the multiple correlation values for the variables that are currently in the prediction equation used at the end of pre-flight training. These variables are the Spatial Apperception Test and the Biographical Inventory from the Aviation Selection Test Battery, the Peer Rating on military leadership taken at the eighth week of pre-flight, the pre-flight Engines grade, and the pre-flight Navigation grade. The BVDT score was added to this array of variables, and the resulting multiple correlation values for the three criteria also are shown in Table III. For the first criterion the increase in multiple correlation was significant at better than the .001 level. The F test was used to test the significance of these increases (8). Table IV presents some descriptive data for the various criteria categories. Here the large difference between the completions and airsick separations is clearly illustrated.

DISCUSSION AND CONCLUSIONS

The statistical evidence indicated that the BVDT is a valid predictor of later separation from flight training because of airsickness, and to a somewhat lesser degree a valid predictor of separation for all causes. Furthermore, it appears that existing prediction procedures available at the end of pre-flight training could be augmented by addition of the BVDT score to the prediction equation now in use. Cross-validation on an independent sample utilizing different individuals as raters is recommended before implementation. Although the correlations obtained were impressive, the BVDT

Table II

Rater Reliability and Validity Coefficients for Six Elements of BVDT

	Rater Reliability*	Criterion #1	Criterion #2	Criterion #3
Pallor	.403	.184	.321	.482
Sweating	.588	.116	.245	.338
Facial expression	.591	.186	.305	.454
Unsteadiness	.639	.132	.291	.480
Speed of recovery	.699	.126	.296	.515
Over-all performance	.686	.178	.351	.512
Total BVDT Score	.763	.165	.272	.413

*Correlation between two raters

Table III

Multiple Correlation Coefficients Based on Existing Prediction Equation for End of Pre-Flight Compared with Same Equation Augmented by the BVD Test (N = 226)

Criterion Dichotomy	Existing Equation R_1	$\bar{R}_1$*	Augmented by BVDT R_2	$\bar{R}_2$*	Significance of Difference
Student separations (all causes) versus completions (N's = 58 vs. 168)	.229	.199	.293	.263	< .01
Tense and/or airsick separations versus all others (N's = 27 vs. 199)	.131	.090	.314	.293	< .001
Airsick separations versus all others (N's = 10 vs. 216)	.090	.000	.430	.417	< .001

* Values reported are shrunken multiple correlations.

Table IV

Means and Standard Deviations of BVDT Scores for Various Criteria Categories

Criterion Group	$\bar{X}$	σ	N
Completions	12.09	4.67	168
Separations (all causes)	14.09	7.92	58
Tense and/or airsick separations	16.81	10.14	27
Airsick separations	23.11	13.68	10
Total	12.64	5.76	226

did not detect all potential airsick individuals, and in one instance there was an individual with a very high BVDT score who apparently did not experience later airsickness and, in fact, completed the training program successfully. However, if the BVDT were added to the present prediction equations, the latter type probably would not be penalized by a high score. The prediction equations are used only if a student encounters difficulties in training and an administrative decision must be made about his retention. Continued exploration of variables in order to improve the BVDT is in progress, and fleet performance criteria will be checked when data become available.

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A Brief Vestibular Disorientation Test (BVDT) has been developed that involves an assessment of reactions produced by head movements in a rotating chair. Reliability of measurement has been demonstrated. This study investigated the validity of the test for predicting pilot training criteria.

The BVDT was administered to 226 naval aviation trainees during the latter part of their pre-flight training. After the subjects had either completed training or separated therefrom, the test results were evaluated for their relation to the following criteria: 1) students separated from flight training for all causes vs. completions; 2) tension and/or airsick separations vs. all others; and 3) airsick separations vs. all others. Relationships existed between high sensitivity scores on the BVDT and membership in the various separation groups. The airsick separation group had the highest mean score. Evidence indicates that the BVDT ratings tap a significant portion of the flight criterion variance not reached by the present prediction methods.

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