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NORMATIVE DATA FOR TWO SHORT TESTS OF MOTION REACTIVITY

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Motion sickness susceptibility

Visual-vestibular interactions

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Naval Medical Research and Development Command
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Commanding Officer

13 December 1977

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SUMMARY PAGE

THE PROBLEM

Reports of airsickness during aviation training are common, but many individuals experience only minor problems on a few flights. Unfortunately, severe airsickness continues in some individuals even after extensive flight training. A similar range of differences in individual reactivity to whole-body motion has been exhibited during brief exposures to motion in laboratory testing. To the extent that these reactions reflect the degree of adjustment that will be required of different individuals in flight, laboratory measures of such reactions may prove useful in training as well as in selection. This report describes normative data for nonpilot flight officer candidates on two laboratory tests of motion reactivity.

FINDINGS

The potential utility of the BVDT and VVIT lies in identifying extremely motion sickness susceptible individuals. These individuals may have such strong reactions to motion stimuli that their success in aviation training is questionable. The highest 1 or 2 percent of rater scores can conservatively be described as representing extreme reactions to these motion stimuli, and may be predictive of difficulty in aviation training. Individuals exhibiting a strong motion reactivity on several screening tests may be more effectively trained if their initial exposures to flight are tailored to avoid sickness.

ACKNOWLEDGMENTS

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Dr. Holtzman is attached to the Naval Aerospace Medical Institute, Pensacola, Florida.

INTRODUCTION

Reports of airsickness during aviation training are common, but many individuals experience only minor problems on a few flights. Unfortunately, severe airsickness continues in some individuals even after extensive flight training. A similar range of differences in individual reactivity to whole-body motion has been exhibited during brief exposures to motion in laboratory testing. To the extent that these reactions reflect the degree of adjustment that will be required of different individuals in flight, laboratory measures of such reactions may prove useful in training as well as in selection. This report describes normative data for nonpilot flight officer candidates on two laboratory tests of motion reactivity.

PROCEDURE

SUBJECTS

The individuals tested were Student Naval Flight Officers (SNFO) who were in preparation for flight training. In 21 consecutive classes there were 573 students, of whom 21 either refused to be tested or were unavailable for testing. Due to scheduling problems, initial classes received only the Brief Vestibular Disorientation Test (BVDT). In total, 552 students were given the BVDT and 304 were given the Visual-Vestibular Interaction Test (VVIT), with 299 participating in both tests. All participants had passed a flight physical and were free from drugs or medication, with the exception of some students who indicated social drinking (alcohol) on the evening preceding testing.

METHOD

Students were typically tested on two consecutive mornings. A pre-experiment interview form, which inquired about the individual's state of health and drug or alcohol consumption, was completed on each testing day. Each student was informed of the confidentiality of the test results and was assured that the outcome would not affect his military career in any way.

On the first day a motion sickness questionnaire (8) was completed by each individual. In almost all instances the VVIT was administered on the first test day and the BVDT on the second, with the exception of the first 248 students who received only the BVDT. Prior to being tested on the second day, each subject completed a follow-up questionnaire relating any aftereffects from the preceding day's test (VVIT). A report of aftereffects from the second day's test (BVDT) was obtained during the succeeding week of training. Each student completed the Spielberger et al. (9) State-Trait Anxiety Inventory (STAI) immediately following the BVDT.

The aftereffect questionnaire (Appendix A) for the BVDT and VVIT consisted of six items: sickness feeling, tiredness or drowsiness, unsteadiness, headache, other,

and how long the disturbance lasted. All items were scored on a 0 to 6 basis, with 0 indicating no reaction and 6 indicating a strong or long reaction. The sum of the first five items was multiplied by the sixth item for a total aftereffect score.

In the VVIT (7) the student was enclosed within the encapsulated chamber (Figure 1) which remained completely dark until presentation of the visual display. The visual display (17.5 cm x 17.5 cm), presented in Figure 2, was mounted 86 cm directly in front of the individual. The student was instructed to use the coordinate system to find the corresponding digit embedded within the matrix. Once the digit was located, the student's task was to verbally report it and the next two digits below it. Coordinates were issued via a taped cassette recording every 7 seconds, with a total of 43 taped commands. The VVIT matrix coordinates were changed from the typical orderly progression of letters or numbers (7) to a randomized format (Figure 2). Previous experience had suggested that with the normal sequence, a few subjects developed methods of finding coordinates without looking back and forth at margins; e.g., position C4 can be located by finding C and counting down four places. During the static portion (approximately 5 minutes) of the VVIT, the student and chamber remained stationary. During the dynamic portion (approximately 5 minutes) the erectly seated student was passively and sinusoidally oscillated at 0.02 Hz (50-sec period) with a peak angular velocity of ±155 deg/sec (±25.8 rpm).

Following the VVIT each student completed a brief questionnaire concerning his reaction to the test. The self-rate questionnaire included five specific areas of reaction: like/dislike, no stomach effects/strong stomach effects, no dizziness/strong dizziness, no sickness feelings/strong sickness feelings, steady/very unsteady. A mark of 1 indicated favorable or no reaction, whereas a mark of 7 indicated extreme reaction. After the dynamic portion was completed, each student was rated by two observers for pallor, sweating, facial expression, unsteadiness, slow recovery, and over-all reaction. These factors were rated on a 10-point scale, with 1 indicating little or no effect and 10 a very strong effect.

The BVDT, described in detail by Ambler and Guedry (1-4), involved passive rotation of an individual (eyes closed) at a constant speed of 90 deg/sec (15 rpm). After 30 seconds at constant velocity, the individual being tested made head movements of 45 degrees (Figure 3) every 30 seconds, starting from upright and then assuming each of the following positions: head right, upright, head left, upright, head right, upright, head left, upright, head forward, upright. On completion of this sequence, the rotating chair was stopped, but the individual's eyes remained closed until his sensation of movement subsided. In this test, reactions during and immediately after rotation were rated by three observers, and each student completed a brief self-rate form.

RESULTS

Mean rater, self-rate, and follow-up scores are presented in Table 1. Both total and individual item scores indicate that the VVIT is, in general, more provocative than the BVDT. The percentage of individuals aborting the VVIT (11.5 percent) was greater

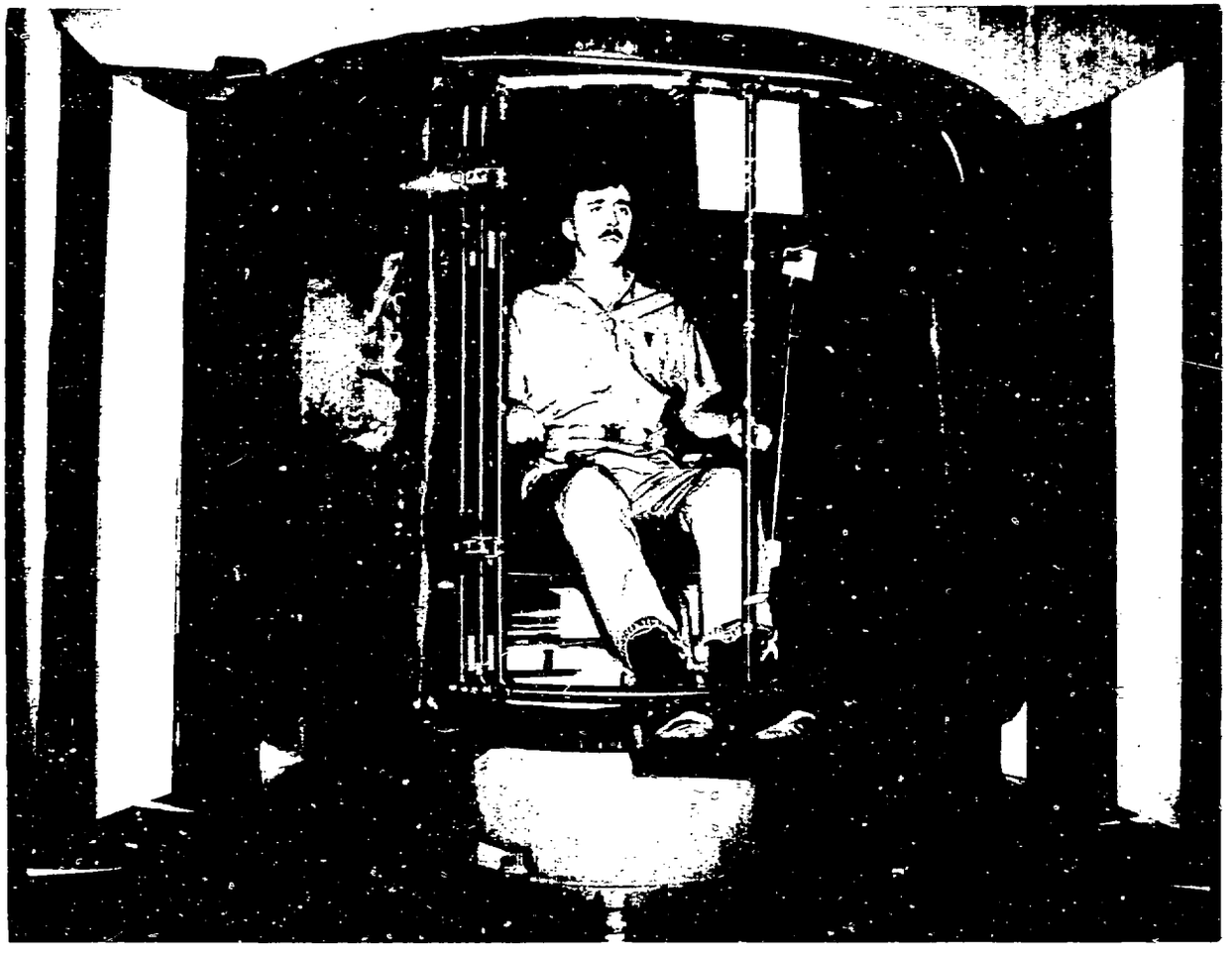


Figure 1

Visual-Vestibular Interaction Test Device
During testing, the black shroud completely occluded the subject's external visual reference.

	D	H	G	B	K	C	F	L	A	J	I	E
4	7	1	1	8	2	4	3	1	6	6	9	4
8	6	4	4	2	4	3	1	8	9	7	4	1
3	2	2	3	4	7	8	6	5	1	4	8	5
10	9	9	5	4	6	2	7	3	8	3	7	9
7	8	1	4	3	6	5	7	7	1	4	2	6
2	7	4	7	1	8	1	9	6	3	2	8	5
5	1	7	6	7	6	4	9	5	4	8	3	7
1	7	1	3	3	4	8	9	4	2	5	6	8
12	6	2	1	6	7	3	8	9	7	2	6	6
9	1	7	5	9	9	1	5	6	6	3	5	8
6	9	3	6	7	3	2	2	8	4	5	2	5
11	2	7	6	2	9	9	3	4	1	5	1	7

Figure 2

VVIT Visual Display

Figure 3

Brief Vestibular Disorientation Device, Subject's Head in Right Tilted Position

Table I

Rater, Self-rate, and Follow-up Scores for BVDT and VVIT Items (Mean [SD])

	Rater Scores						
	Pallor	Sweating	Facial Expression	Unsteadiness	Slow Recovery	Over-all Reaction	Total
BVDT N = 552	2.4 (1.2)	2.5 (1.6)	2.1 (1.3)	2.3 (1.3)	2.0 (1.3)	2.5 (1.8)	13.9 (6.7)
VVIT N = 304	3.0 (1.4)	3.3 (2.2)	2.4 (1.1)	2.4 (1.3)	2.0 (1.1)	3.4 (2.7)	16.5 (7.7)

	Self-rate Scores					
	Like Dislike	Stomach Effects	Dizziness	Sickness Feelings	Steadiness	Total
BVDT N = 552	3.2 (1.6)	2.4 (1.6)	3.2 (1.6)	2.4 (1.6)	2.8 (1.4)	14.0 (6.5)
VVIT N = 304	3.6 (1.7)	2.8 (1.8)	3.2 (1.8)	2.8 (1.9)	3.0 (1.5)	15.5 (6.8)

	Follow-up Scores						
	Sickness Feeling	Tiredness Drowsiness	Unsteadiness	Headache	Other	Duration	Total
BVDT N = 524	0.7 (1.3)	0.4 (1.0)	0.5 (1.0)	0.4 (1.0)	0.1 (0.6)	0.9 (1.3)	5.5 (13.9)
VVIT N = 300	1.2 (1.6)	0.6 (1.2)	0.9 (1.3)	0.5 (1.1)	0.3 (1.0)	1.4 (1.4)	9.1 (18.4)

than the percentage aborting the BVDT (3.1 percent). Seven of the 299 students taking both tests (2.3 percent) aborted on both the BVDT and VVIT.

A distribution of total rater, self-rate, and follow-up scores for the susceptibility tests is shown in Figures 4 and 5. In each case the distribution is skewed with a high percentage of very low scores. Most individuals reported either minimal or no effects from testing. There were significant correlations among rater, self-rate, and follow-up measures, both within and between the BVDT and VVIT (Table II).

Performance data collected during the VVIT procedure are summarized in Table III. In the static or stationary condition the ease in performing the task was exemplified by near-perfect performance scores (mean 121.4 of a possible 129.0). In the dynamic condition the number of correct answers dramatically decreased and was significantly correlated with rater, self-rate, and follow-up scores on the VVIT and BVDT (Table II).

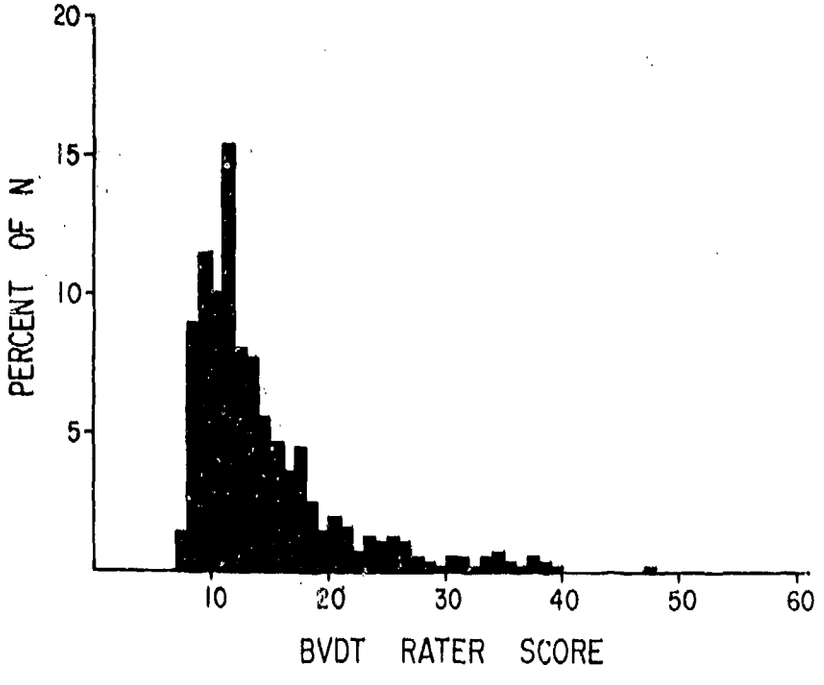
The motion sickness questionnaire (MSQ) was scored by a procedure developed by Reason (8) (Appendix B). The mean total MSQ score was 15.99 (SD = 18.78). The students reported a higher incidence of motion sickness before the age of 12 ($\bar{x}$ = 8.97, SD = 11.20) than after 12 ($\bar{x}$ = 6.75, SD = 9.44). The highest MSQ intercorrelation was with VVIT rater (r = .20, $p < .001$). In general, the correlations between MSQ scores and other measures were very low ($r <= .10$) as shown in Table II.

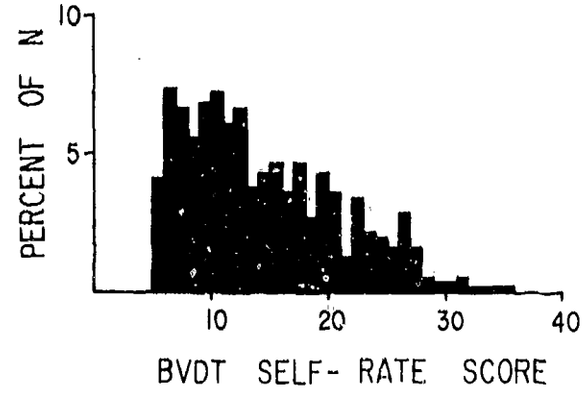
The STAI, which was completed immediately following BVDT administration, was scored as suggested by the STAI manual (9). The state anxiety mean of 31.45 (SD = 9.08) and trait anxiety mean of 29.51 (SD = 6.77) were somewhat lower than respective scores from a male college undergraduate population (state, $\bar{x}$ = 36.35, SD = 9.67; trait, $\bar{x}$ = 37.68, SD = 9.69). State anxiety scores correlated significantly with BVDT and VVIT rater, self-rate, and follow-up scores (Table II). Correlations between trait anxiety scores and other measures were generally very low with a few achieving statistical significance from zero correlation but of questionable practical significance.

DISCUSSION

The potential utility of the BVDT and VVIT lies in identifying extremely motion sickness susceptible individuals. These individuals may have such strong reactions to motion stimuli that their success in aviation training is questionable. The highest 1 or 2 percent of rater scores (Table IV) can conservatively be described as representing extreme reactions to these motion stimuli, and may be predictive of difficulty in aviation training.

On the other hand, past experience has shown that any single test of motion sickness susceptibility can be deceiving. Individuals with a strong susceptibility to one set of conflicting motion stimuli do not necessarily display an equal susceptibility to a different ser of motion stimuli (6). If a single laboratory test of motion sickness susceptibility is to be used as a selection device, the specific set of conflicting motion stimuli should closely approximate stimuli encountered in the operational environment. In this study the BVDT and VVIT may be identifying slightly different forms of motion sickness susceptibility since the conflicting sensory stimuli in each test are different.





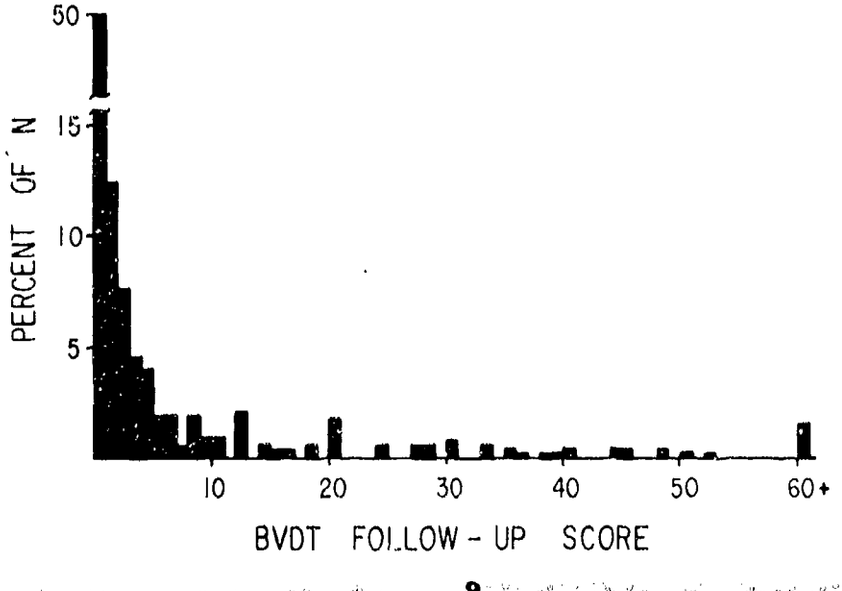
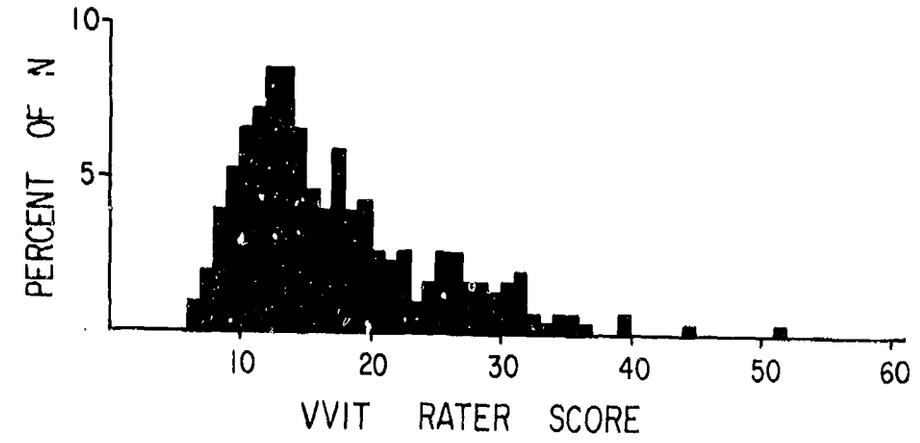
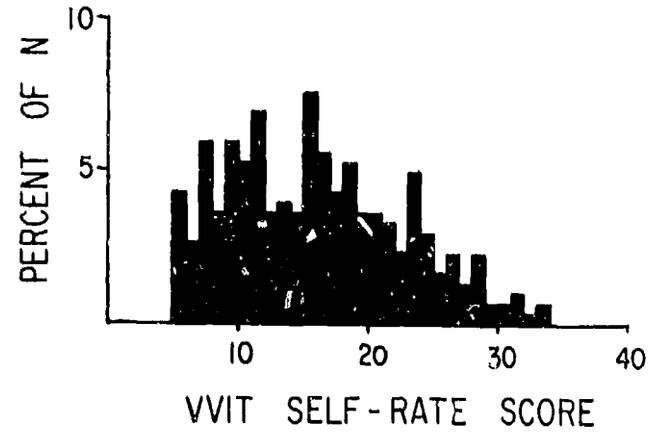


Figure 4

BVDT Rater, Self-rate, and Follow-up Score Distributions





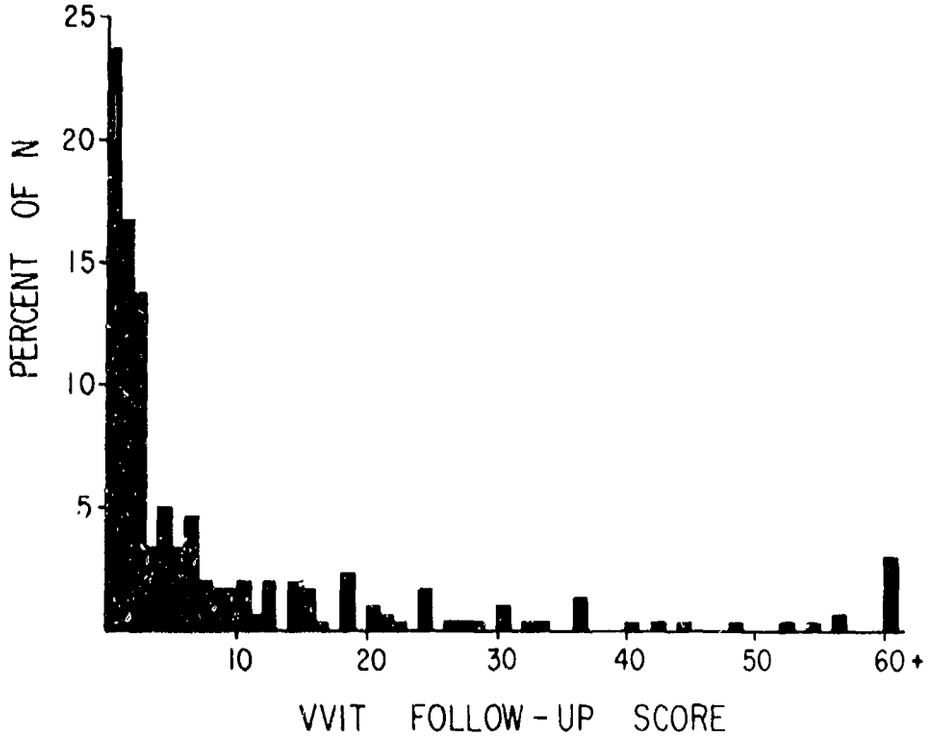


Figure 5

VVIT Rater, Self-rate, and Follow-up Score Distributions

Table II

Intercorrelation Measures (Pearson Product-Moment)

	BVDT Rater	BVDT Self-rate	BVDT Follow-up	VVIT Rater	VVIT Self-rate	VVIT Follow-up	STAI State	STAI Trait	MSQ	VVIT Dynamic No. Right
BVDT Rater	--									
BVDT Self-rate	.59 (554) ***	--								
BVDT Follow-up	.41 (524) ***	.47 (522) ***	--							
VVIT Rater	.48 (299) ***	.36 (299) ***	.32 (276) ***	--						
VVIT Self-rate	.38 (299) ***	.49 (299) ***	.34 (276) ***	.68 (304) ***	--					
VVIT Follow-up	.22 (298) ***	.27 (298) ***	.40 (276) ***	.37 (300) ***	.45 (300) ***	--				
STAI State	.56 (282) ***	.57 (282) ***	.49 (262) ***	.32 (282) ***	.36 (282) ***	.23 (281) ***	--			
STAI Trait	.17 (281) **	.20 (281) ***	.08 (261)	.08 (281)	.19 (281) **	.14 (280) *	.49 (281) ***	--		
MSQ	.02 (556)	.09 (554) *	.10 (524) *	.20 (204) ***	.04 (304)	.02 (300)	.09 (282)	.04 (281)	--	
VVIT Dynamic No. Right	-.30 (299) ***	-.21 (299) ***	-.15 (276) *	-.49 (304) ***	-.38 (304) ***	-.12 (300) *	-.20 (282) ***	-.11 (281)	-.12 (304) *	--

*p < .05
**p < .01
*** p < .001

Number of Pairs (N)

Table III

Mean (SD) VVIT Performance Measures*

	Mean (SD)		
	Right	Wrong	Omit
Static	121.4 (7.5)	5.4 (5.3)	2.2 (4.0)
Dynamic	73.6 (31.2)	10.0 (7.4)	39.4 (28.4)

*Scores from subjects who aborted the dynamic portion of testing are included, with the exception of items to which the subject was not exposed.

The provocativeness of the BVDT is based on the cross-coupled Coriolis stimulus which generates semicircular canal responses at right angles to concurrent otolith responses. The provocative aspect of the VVIT seems to be the conflict between voluntary saccadic excursions to fixation points necessary to perform the task and the involuntary nystagmic eye movements generated by rotation.

Several aspects of the VVIT are similar to conditions encountered by the SNFO in training (i.e., reading and interpreting charts, maps, and instruments in a motion environment with limited external visual references in many cases). The BVDT conditions, which in some ways simulate provocative maneuvers, can also be related to SNFO training. A prudent approach to selection might be to consider either for special training or for elimination only those individuals with extreme reactions on several tests. For example, 2.3 percent of the individuals tested in the current group (n = 299) were unable to complete either the BVDT or the VVIT. In certain circumstances, it may also be important to identify individuals who are exceptionally insensitive to a set of tests and use this information as a pipeline determinant or selection procedure.

Individuals exhibiting a strong motion reactivity on several screening tests may be more effectively trained if their initial exposures to flight are tailored to avoid sickness. For some "sensitive" candidates who are very highly motivated and determined to succeed, problems with airsickness may be perceived as threatening; the resulting anxiety may predispose the individual to further sickness, and a vicious circle develops. This may be avoidable in some cases, if training were tailored to avoid sickness; and then, with adaptive mechanisms in control, training could be accelerated.

In a screening or selection situation, the self-rate and follow-up indices may be of limited value due to the potential for fraudulent reporting. In this regard, the high rater/self-rate and rater/follow-up correlations are significant in that they indicate

Table IV

Cumulative Percentage Table for BVDT and VVIT Scores

Score	BVDT			VVIT		
	Rater	Self-rate	Follow-up	Rater	Self-rate	Follow-up
0	0.0	0.0	50.0	0.0	0.0	23.7
1	0.0	0.0	62.4	0.0	0.0	40.3
2	0.0	0.0	70.0	0.0	0.0	54.0
3	0.0	0.0	74.6	0.0	0.0	57.3
4	0.0	0.0	78.6	0.0	0.0	62.3
5	0.0	4.2	80.5	0.0	4.3	65.7
6	0.0	11.6	82.4	1.0	6.9	70.3
7	1.4	18.2	83.0	3.0	12.8	72.3
8	10.4	23.8	84.9	6.9	16.4	74.0
9	21.9	30.7	85.9	12.2	22.4	75.7
10	32.0	37.9	86.8	18.8	27.6	77.7
11	47.5	44.0	86.8	26.0	34.5	78.3
12	55.6	50.7	88.9	34.5	38.2	80.3
13	63.3	54.5	88.9	43.1	42.1	80.3
14	68.9	58.8	89.5	49.7	45.7	82.3
15	73.6	63.5	89.9	54.3	53.3	84.0
16	77.2	67.1	90.3	58.2	58.9	84.3
17	81.7	71.8	90.3	64.1	63.2	84.3
18	84.2	74.5	90.8	68.1	68.4	86.7
19	85.6	78.9	90.8	72.4	72.0	86.7
20	87.6	82.5	92.6	75.0	75.7	87.7
21	89.2	83.8	92.6	77.3	78.9	88.3
22	89.9	87.2	92.6	79.9	81.3	88.7
23	91.2	89.4	92.6	80.9	86.2	88.7
24	92.3	91.3	93.1	82.6	89.1	90.3
25	93.5	93.0	93.1	85.2	90.8	90.3
26	94.6	95.8	93.1	87.8	93.1	90.7
27	95.1	97.5	93.7	89.5	94.4	91.0
28	95.5	98.0	94.3	91.1	96.7	91.3
29	95.7	98.4	94.3	92.4	97.4	91.3
30	96.2	98.7	95.0	94.1	98.0	92.3
31	96.8	99.3	95.0	96.1	99.0	92.3
32	96.9	99.5	95.0	96.7	99.3	92.7
33	97.5	99.6	95.6	97.0	100.0	93.0
34	98.2	99.8	95.6	97.7	100.0	93.0
35	98.6	100.0	96.0	98.4	100.0	93.0
36	98.7	100.0	96.2	98.7	100.0	94.3
37	99.3	100.0	96.2	98.7	100.0	94.3
38	99.6	100.0	96.4	98.7	100.0	94.3
39	99.8	100.0	96.6	99.3	100.0	94.3
40	99.8	100.0	96.9	99.3	100.0	94.7
41	99.8	100.0	96.9	99.3	100.0	94.7
42	99.8	100.0	96.9	99.3	100.0	95.0
43	99.8	100.0	96.9	99.3	100.0	95.0
44	99.8	100.0	97.3	99.7	100.0	95.3
45	99.8	100.0	97.7	99.7	100.0	95.3
46	99.8	100.0	97.7	99.7	100.0	95.3
47	100.0	100.0	97.7	99.7	100.0	95.3
48	100.0	100.0	98.1	99.7	100.0	95.7
49	100.0	100.0	98.1	99.7	100.0	95.7
50	100.0	100.0	98.3	99.7	100.0	95.7
51	100.0	100.0	98.3	100.0	100.0	95.7
52	100.0	100.0	98.5	100.0	100.0	96.0
53	100.0	100.0	98.5	100.0	100.0	96.0
54	100.0	100.0	98.5	100.0	100.0	96.3
55	100.0	100.0	98.5	100.0	100.0	96.3
56	100.0	100.0	98.5	100.0	100.0	97.0
57	100.0	100.0	98.5	100.0	100.0	97.0
58	100.0	100.0	98.5	100.0	100.0	97.0
59	100.0	100.0	98.5	100.0	100.0	97.0
60+	100.0	100.0	100.0	100.0	100.0	100.0

that rater evaluations are reasonable approximations of what an individual is experiencing. It is possible that a follow-up rating could be obtained by observing individuals for several hours after testing. The persistence of symptoms after exposure may be related to an individual's adaptive potential and if so, follow-up ratings could be very beneficial.

The use of historical motion sickness questionnaires as the sole predictor of susceptibility has not met with much success, although in some cases the MSQ score has confirmed the results from laboratory tests of susceptibility. Fraudulent or inaccurate reporting and the lack of uniform exposure to motion sickness questionnaire items are problems that have not been resolved (5).

The visual performance measures from the VVIT were significantly related to some of the signs and symptoms of motion sickness. These measures need further evaluation to determine the extent to which they could be used as part of a predictive test.

The significant correlations between state anxiety scores and BVDT rater, self-rate, and follow-up scores may reflect the fact that the STAI form was completed immediately following the BVDT. Thus an individual with symptoms from the BVDT may reflect these on the STAI form. However, this would not explain the significant correlation between state anxiety scores and VVIT rater, self-rate, and follow-up scores, since they were administered on separate days.

The SNFO's who participated in these tests are currently being followed through training, and a future report will specifically describe the incidence of airsickness, attrition, et cetera, in this group.

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APPENDIX A

Follow-up Questionnaire

NAME_____

SOCIAL SECURITY NUMBER_____

CLASS_____

This is a follow-up to determine whether or not you feel that there were after-effects connected with the spin test (head movements) or matrix reading test you have taken.

After leaving the test room, I experienced:

1. Sickness feeling

None _____ _____ _____ _____ _____ _____ Strong

2. Tiredness or drowsiness

None _____ _____ _____ _____ _____ _____ Extreme

3. Unsteadiness

None _____ _____ _____ _____ _____ _____ Extreme

4. Headache

None _____ _____ _____ _____ _____ _____ Strong

5. Other*

None _____ _____ _____ _____ _____ _____ Strong

6. Disturbance lasted

NA <30 min <1 hr <2 hr <3 hr <4 hr >4 hr

*Explain Other:

Information furnished by you on this form is bound by the same Privacy Act Statement you signed when you took the matrix reading test.

APPENDIX B

Scoring the MSQ

SCORING THE MSQ

Each section is scored separately and yields two subscores, which are summed for a section score. The two section scores are then summed to yield a total score, the MSQ.

Scoring is done with the aid of the following conversion table:

Experience Level	Frequency of Report			
	R	S	F	A
1	2	4	6	8
2	3	5	7	9
3	4	6	8	10

Example: A subject has reported Section A as follows:

Question	Cars	Buses or Coaches	Trains	Airplanes	Small Boats	Ocean Liners	Swings	Merry Go Round	Roller Coasters
A1	3	2	2	3	3	0	3	3	3
A2	S	R	R	R	N	0	N	N	N
A3	R	R	N	R	N	0	N	N	N
Score									
A1&A2		6	3	3	4	0	0	0	0
A1&A3		4	3	0	4	0	0	0	0

Determine the cell score for "nausea in cars" by determining the experience level from A1. This is 3. The frequency is S. Enter the table and read the weight 6 at the intersection of Row 3 and Column S. Repeat for the remaining cells in Lines A1 and A2. Determine the cell score for "vomiting in cars." The experience level is 3. The frequency is R. Read the weighted score 4 at the intersection of Line 3 and Column R. Enter the weight on the "Vomiting" line under "Cars" as indicated. Note that 0 experience level and/or N frequency always lead to a zero cell score.

Sum the nausea weights to obtain the "corrected frequency score" for nausea: $6 + 3 + 3 + 4 = 16$. Sum the vomiting weights to obtain the "corrected frequency score" for vomiting: $4 + 3 + 4 = 11$. Determine the number of types of motion experienced: $9 - 1 = 8$.

The total section score is obtained as follows:

$$\text{Section Score} = \frac{\text{Sum of the corrected frequency scores}}{\text{No. of types of experience}} \times 9$$

$$= \frac{16 + 11}{8} \times 9 = 30.4 \text{ (to the nearest tenth).}$$

The procedure is then repeated for Section B. Let us assume the section score for B is 12. The Motion Sickness Quotient is then obtained by summing the section scores:

$$\text{MSQ} = \text{Section A score} + \text{Section B score}$$
$$= 30.4 + 12 = 42.4$$

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Motion sickness susceptibility; visual-vestibular interactions

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Reports of airsickness during aviation training are common, but many individuals experience only minor problems on a few flights. Unfortunately, severe airsickness continues in some individuals even after extensive flight training. A similar range of differences in individual reactivity to whole-body motion has been exhibited during brief exposures to motion in laboratory testing. To the extent that these reactions reflect the degree of adjustment that will be required of different individuals in flight, laboratory measures of such reactions may prove useful in training as well as in selection. This report describes

normative data for nonpilot flight officer candidates on two laboratory tests of motion reactivity.

The potential utility of the Brief Vestibular Disorientation Test and the Visual-Vestibular Interaction Test lies in identifying extremely motion sickness susceptible individuals. These individuals may have such strong reactions to motion stimuli that their success in aviation training is questionable. The highest 1 or 2 percent of rater scores can conservatively be described as representing extreme reactions to these motion stimuli, and may be predictive of difficulty in aviation training. Individuals exhibiting a strong motion reactivity on several screening tests may be more effectively trained if their initial exposures to flight are tailored to avoid sickness.

SUPPLEMENTARY

INFORMATION

than the percentage aborting the BVDT (3.1 percent). Seven of the 299 students taking both tests (2.3 percent) aborted on both the BVDT and VVIT.

A distribution of total rater, self-rate, and follow-up scores for the susceptibility tests is shown in Figures 4 and 5. In each case the distribution is skewed with a high percentage of very low scores. Most individuals reported either minimal or no effects from testing. There were significant correlations among rater, self-rate, and follow-up measures, both within and between the BVDT and VVIT (Table II).

Performance data collected during the VVIT procedure are summarized in Table III. In the static or stationary condition the ease in performing the task was exemplified by near-perfect performance scores (mean 121.4 of a possible 129.0). In the dynamic condition the number of correct answers dramatically decreased and was significantly correlated with rater, self-rate, and follow-up scores on the VVIT and BVDT (Table II).

The motion sickness questionnaire (MSQ) was scored by a procedure developed by Reason (8) (Appendix B). The mean total MSQ score was 15.99 (SD = 18.78). The students reported a higher incidence of motion sickness before the age of 12 ($\bar{x}$ = 8.97, SD = 11.20) than after 12 ($\bar{x}$ = 6.75, SD = 9.44). The MSQ showed low but statistically significant correlation with all other scores obtained as shown in Table II.

The STAI, which was completed immediately following BVDT administration, was scored as suggested by the STAI manual (9). The state anxiety mean of 31.45 (SD = 9.08) and trait anxiety mean of 29.51 (SD = 6.77) were somewhat lower than respective scores from a male college undergraduate population (state, $\bar{x}$ = 36.35, SD = 9.67; trait, $\bar{x}$ = 37.68, SD = 9.69). State anxiety scores correlated significantly with BVDT and VVIT rater, self-rate, and follow-up scores (Table II). Correlations between trait anxiety scores and other measures were generally very low with a few achieving statistical significance from zero correlation but of questionable practical significance.

DISCUSSION

The potential utility of the BVDT and VVIT lies in identifying extremely motion sickness susceptible individuals. These individuals may have such strong reactions to motion stimuli that their success in aviation training is questionable. The highest 1 or 2 percent of rater scores (Table IV) can conservatively be described as representing extreme reactions to these motion stimuli, and may be predictive of difficulty in aviation training.

On the other hand, past experience has shown that any single test of motion sickness susceptibility can be deceiving. Individuals with a strong susceptibility to one set of conflicting motion stimuli do not necessarily display an equal susceptibility to a different set of motion stimuli (6). If a single laboratory test of motion sickness susceptibility is to be used as a selection device, the specific set of conflicting motion stimuli should closely approximate stimuli encountered in the operational environment. In this study the BVDT and VVIT may be identifying slightly different forms of motion sickness susceptibility since the conflicting sensory stimuli in each test are different.

There was a computer error in one line of Table II of Research Report NAMRL-1243 (Lentz, Holtzman, Hixson, and Guedry), December 19[illegible]. Attached are corrected Pages 7 and 10 to substitute in your copy of this report.

Table II

Intercorrelation Measures (Pearson Product-Moment)

	BVDT Rater	BVDT Self-rate	BVDT Follow-up	VVIT Rater	VVIT Self-rate	VVIT Follow-up	STAI State	STAI Trait	MSQ	VVIT Dynamic No. Right
BVDT Rater	--									
BVDT Self-rate	.59 (554) ***	--								
BVDT Follow-up	.41 (524) ***	.47 (522) ***	--							
VVIT Rater	.48 (299) ***	.36 (299) ***	.32 (276) ***	--						
VVIT Self-rate	.38 (299) ***	.49 (299) ***	.34 (276) ***	.68 (304) ***	--					
VVIT Follow-up	.22 (298) ***	.27 (298) ***	.40 (276) ***	.37 (300) ***	.45 (300) ***	--				
STAI State	.56 (282) ***	.57 (282) ***	.49 (262) ***	.32 (282) ***	.36 (282) ***	.23 (281) ***	--			
STAI Trait	.17 (281) **	.20 (281) ***	.08 (261)	.08 (281)	.19 (281) **	.14 (280) *	.49 (281) ***	--		
MSQ	.17 (555) ***	.24 (553) ***	.29 (523) ***	.19 (301) ***	.25 (301) ***	.16 (298) **	.20 (282) ***	.17 (281) **	--	
VVIT Dynamic No. Right	-.30 (299) ***	-.21 (299) ***	-.15 (276) *	-.49 (304) ***	-.38 (304) ***	-.12 (300) *	-.20 (282) ***	-.11 (281)	-.12 (304) *	--

*p < .05
**p < .01
*** p < .001

Number of Pairs (N)