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The prediction of seasickness and performance at sea by a nauseogenic laboratory test.

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Abstract

This paper describes our efforts to develop a personnel selection procedure based on a nauseogenic laboratory test (NT). The first study employed concurrent validation as the basic methodology. Fifty-five sailors with at least 3 months experience at sea rated their seasickness susceptibility using a self rating Likert type scale. They were then exposed to the 6 min NT. This test was conducted on a rotating chair and consisted of cross-coupled angular accelerations and sudden stops. The severity of motion sickness provoked by the NT was measured using a motion sickness symptom questionnaire. Significant positive correlations were found between seasickness susceptibility and the severity of motion sickness provoked by the NT. The second study assessed the test's predictive validity. Subjects were 67 males about to commence their naval service, who were tested with the NT before their actual exposure to sea conditions. 48 hours after the test, they were exposed to rough seas and were asked to perform the daily activities of a crewman. Trained observers monitored their seasickness and its effect on performance, and rated these parameters on a 5 point scale. A year later, these parameters were again evaluated by the vessels' commanders. Significant positive correlations were found between NT and both seasickness susceptibility and decrement in performance at sea as evaluated on both occasions. Prediction by the NT of short- and long-term seasickness susceptibility and level of performance suggests that this method might be useful as part of a naval selection procedure.

Introduction

Seasickness continues to be a major concern for sea-going personnel. It is both a medical and an operational problem, which affects the sailors' behavior, well-being and performance. Many modern Navies are now using small fast missile frigates fo various missions at sea. Due to the relatively small size of these boats, we are faced with a very high rate of seasickness incidence. Another feature of the contemporary Navy is that quality of performance is of vital importance. Efficient and skilled operation of the weaponry employed in modern electronic warfare is sometimes the key to a mission's success.

There is a broad spectrum of individual differences in seasickness susceptibility. There are also pronounced individual differences in the degree to which performance is disturbed under seasickness conditions: some individuals may vomit but will be able to continue functioning, while others might develop helpless behavior and will not perform efficiently. Most modern Navies have the advantage of being able to choose or select sailors from a relatively large pool of candidates. If we could predict a priori which subject will be extremely seasick and therefore may not be able to perform his duties in heavy seas, we could reduce the salience of this problem.

In a review of selection and prediction tests for motion sickness, Guedry (5) concluded that "measures of vestibular thresholds or vestibular 'sensitivity' , either semi-circular canals or otolith, have not proven to be effective predictors of motion sickness susceptibility." In addition, it is Navy policy that seasickness susceptibility per se is not grounds for rejecting candidates for the Navy, but rather for rejecting those candidates who will be unable to cope with their sickness and therefore be unable to perform their duties. In accordance with the preceding we tried in the past to identify the personality variables which differentiate between those individuals who are able to cope with seasickness and those who are not. Various biographical and personality questionnaires have been found to correlate with performance under seasickness conditions: Self report of past motion sickness susceptibility (6); Active coping (3); Self control (9); Repression - Sensitization (6); Beck hopelessness scale (10); Perceived environmental control (10). Though these findings have important theoretical implications, their practical value is limited for the following reasons: a) The correlations found were rather low. b) The dissimulation or the social desirability problem: Most of the items in the inventories tested had one answer which was recognizable as socially more acceptable. In our case in Israel subjects are highly motivated to serve in the Navy, and therefore tended to present themselves in a favorable light. The field of personnel selection has for some times been moving from pen and pencil tests to situational tests (2). It seems, therefore, that a procedure simulating the stress at sea might be a more useful predictor of behavior in real sea conditions.

Researchers in Pensacola used the Coriolis technique (cross coupled angular accelerations) to produce motion sickness in a 6 minute test. This method involves tilting the subject's head, while his body is rotated about the vertical axis (1). This method produces an otolith - canals conflict leading to motion sickness. Graybiel and Lackner (4) reported another procedure producing motion sickness in a laboratory device. This procedure involves rotation and sudden stops. The sudden stops cause the semi-circular canals to signal rotation in the opposite direction while the other receptors, and especially the eyes, signal that the body is stationary. In the experiments described below, we combined these two methods in order to produce a highly provocative test which includes various types of sensory conflict. We shall describe the results of two studies designed to evaluate the validity of the combined provocative test as a predictor of seasickness susceptibility. In the first study, concurrent validation was employed as a basic methodology. The purpose of the second study was to assess the predictive validity of this method.

STUDY 1 - CONCURRENT VALIDATION

Methods

Subjects: Subjects were 55 sailors who volunteered to participate in the experiment. All had sailing experience and had been exposed to seasickness conditions in the past. It was explained to them that the results of the experiment would not affect their future career in the Navy.

Apparatus: We used a rotating platform with an earth vertical axis of rotation. Two chairs were mounted on the device, and were eccentrically positioned. The center of each chair was situated 50 cm from the axis of rotation. The angle formed by the radius and the line passing the saggital plane of each chair was 45 degrees. The bearing and drive system consisted of a DC motor and a gear speed reducer.

Procedure: A short description of the test was given to subjects before the experiment. Subjects were rotated for 6 minutes, and were instructed to perform head movements every 15 seconds according to recorded instructions. The motion profile consisted of 4 periods of rotation followed by sudden stops. Each period of rotation consisted of 15 seconds of 11 RPM rotation clockwise or counter-clockwise. After the sudden stops, rotation began in the opposite direction. Subjects were asked to keep their eyes open and fixed on the perspex partition which rotated with the chair.

Measurements:
A) Seasickness susceptibility : Subjects were asked to evaluate their seasickness using a five point Likert type scale , where 1 was not susceptible and 5 was very susceptible. This evaluation was carried out before the beginning of the test.

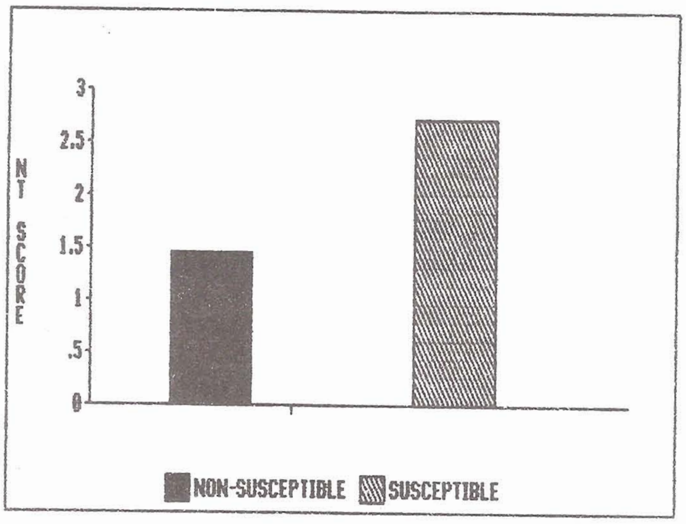
B) Motion sickness questionnaire: In order to measure the effects of rotation, subjects were given a questionnaire which consisted of the following items: nausea, need to vomit, cold sweat, dizziness, fatigue, headache.

C) Well-being rating: The method employed by Reason and Graybiel (6) was adopted in order to evaluate each subject's well-being (a Likert type self-rating scale: 1= I feel fine, 5= I feel awful).

Results and discussion

Following Ambler and Guedry (1) the mean of the ratings obtained for the list of symptoms was taken as the motion sickness score (NT score). Spearman correlation between seasickness susceptibility and the NT score was .64 ($p<.001$). The correlation between seasickness susceptibility and the well being score was .699, ($p<.001$). In an additional analysis subjects were divided into non-susceptible (score 1-2, n=32) and susceptible (score 3-5, n=23). Fig 1 presents the NT score in the test as a function of susceptibility. The difference between the groups is significant ($F=48.6$, $df=1$, $p<.0001$).

FIG 1: NT SCORE
AS A FUNCTION OF SUSCEPTIBILITY



These results show that the laboratory test produces symptoms correlated with seasickness susceptibility, and that the score in susceptible subjects is significantly higher than in the non-susceptible. However, there are some limitations to the conclusions which can be drawn from this study. One limitation is, of course, that both measurements (seasickness and the laboratory motion sickness test) were taken simultaneously.
Another drawback is that the evaluation of seasickness susceptibility is based only on a self-report questionnaire.
The following experiment was designed to overcome these problems.

STUDY 2 - PREDICTIVE VALIDITY

The former study used sea sickness susceptibility as the validation criteria. As was mentioned earlier, the ultimate criterion should be the level of performance under seasickness conditions. The purpose of this study was to evaluate the predictive validity of the test while using officer's evaluation as the criterion for evaluating performance under motion sickness conditions.

Methods

Subjects: Subjects were 67 healthy sailors who had volunteered for naval service.

The experiment consisted of three different stages: a) Exposure to the NT test. b) Short term validation at sea. c) long term follow up.

A) Test phase: The same motion profile was employed as in the previous experiment. Motion sickness symptoms were evaluated using the same self-report scale.

B) Short term validation at sea: The first seasickness evaluation was conducted 24-48 hours after the NT. Subjects were divided into groups of 10. Each group sailed on a missile boat for several hours. Subjects were asked to perform the daily activities of a crewman (i.e. watching radar, cleaning, serving food etc.) Experienced observers accompanied each group. Their task was to watch each subject in order to monitor signs of seasickness and to estimate how their performance was affected by their sickness. They were asked to estimate susceptibility and decrement in performance using two 5 point Likert type scales

C) Long term follow up: A year after the experiment, we contacted the subjects and their officers, and asked them to evaluate their current seasickness susceptibility and its effect on their level of performance. 30 subjects responded and filled the questionnaires. Each subject was asked to rate his current susceptibility on a five point scale. In addition, two officers from the subject's ship were asked to evaluate the severity of seasickness symptoms in the same subjects, as well as the extent to which their performance was affected. The mean of the two officers' evaluations was calculated.

RESULTS

The Spearman correlations between symptoms in the test phase (NT score) and the estimation of susceptibility in the other two phases are presented in Table 1.

Table 1
Spearman correlations between symptoms during test phase and seasickness at sea

	Criteria	NT score	well being score
Short term measures	susceptibility (observer's evaluation)	.60	.39
	performance decrement (observer's evaluation)	.42	.50
Long term measurers	susceptibility (officer's rating)	.42	.52
	susceptibility (self report)	.57	.50
	performance decrement (officer's rating)	.41	.58

Note: All correlations are significant ($p>.05$)

The Spearman correlation between the first seasickness evaluation (short term measures), and the data obtained a year later was .5449 ($p<.05$). There was no significant correlation between performance evaluation at the two stages (between short term measures and long term measures).

Discussion

The results of these two experiments indicate that significant correlations exist between symptoms produced in the laboratory test and seasickness susceptibility. It seems that the combination of coriolis stimulation and sudden stops is an effective method of predicting susceptibility. The second experiment has demonstrated the predictive validity of the test as well as its correlation with level of performance under seasickness conditions. The fact that this test can predict officers' evaluations of subject performance a year after the test suggests that the test might be of a practical value.

It is known that an adaptation process takes place after repeated exposures to sea. Some authors have suggested that the susceptibility and adaptability factors are independent (1). The results of this study suggest that if a subject is highly susceptible, he might also be a "slow adapter".

It is interesting to note that the correlation between the short laboratory test and seasickness susceptibility as evaluated a year later was similar to the correlation between actual exposure at sea and the same evaluation a year later. These results indicate that the rotating chair test is as a good predictor as actual exposure, yet it has a clear advantage that it is more standardized and controlled then a field (sea) test, and it is much less expensive.

The results of this test indicate that the nauseogenic laboratory test might be a valuable tool in naval selection procedure. Future studies might focus on the development of additional indices to evaluate the ability to cope with seasickness.

References

1. Ambler, R. K. and F. E. Guedry. A Manual for the brief vestibular disorientation test. Pensacola, Fl. Naval Aerospace Medical Research Laboratory, 1978.

2. Anastasi, A. Psychological Testing, New York, Collier McMillan, 1976.

3. Gal, R. Assessment of seasickness and its consequences by a method of peer evaluation. Aviation Space and Environmental Medicine, 46: 836-839, 1975.

4. Graybiel A. and J. R. Lackner. A sudden stop vestibulovisual test for rapid assessment of motion sickness manifestations. Aviation Space and Environmental Medicine, 51: 21-23, 1980.

5. Guedry, F. E. Selection and prediction tests. Paper presented at the NASA Symposium for Space Motion Sickness. Houston, TX. National Aeronautics and Space Administration, 1978.

6. Keinan, G., N. Friedland, J. Yitzhaky, and A. Moran. Biographical, physiological and personality variables as predictors of performance under sickness-inducing motion. Journal of Applied Psychology, 66: 233-241, 1981

7. Reason J. T. and J. J. Brand. Motion Sickness. New York, Academic Press, 1975.

8. Reason, J. T. and A. Graybiel 1970. Changes in the subjective estimates of well-being during the onset and remission of motion sickness symptomatology in the slow rotating room. Aerospace Medicine, 41: 166-171, 1970.

9. Rosenbaum. M, and A. Rolnick. Self control behavior and coping with seasickness. Cognitive Therapy and Research, 1: 93-98, 1983.

10. Rolnick, A. Uncontrollability and Helplessness in Motion Sickness. Ph.D. Dissertation, Department of Psychology, Tel Aviv University, 1984.