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THE RELATIONSHIP BETWEEN PAST HISTORY OF MOTION SICKNESS AND ATTRITION FROM FLIGHT TRAINING

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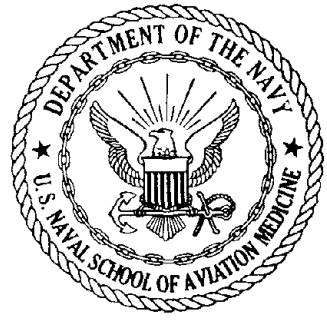

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U. S. NAVAL SCHOOL OF AVIATION MEDICINE
U. S. NAVAL AVIATION MEDICAL CENTER
PENSACOLA, FLORIDA

Research Report

THE RELATIONSHIP BETWEEN PAST HISTORY OF MOTION SICKNESS AND ATTRITION FROM FLIGHT TRAINING

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SUMMARY PAGE

THE PROBLEM

The purpose of the study was to determine if student scores on the Pensacola Motion Sickness Questionnaire (MSQ) would supplement current multiple prediction formulae in predicting completion of flight training and/or voluntary withdrawal from this training.

FINDINGS

The MSQ score was found to be significantly related to both completion of flight training and voluntary withdrawal from training. With respect to this latter criterion, the MSQ was the single most valid predictor available. When included in the multiple prediction formulae, the MSQ significantly increased the multiple validity for predicting both criteria.

INTRODUCTION

The high incidence of motion sickness experienced by student aviators in their first phases of flight training suggests that susceptibility to motion sickness might be responsible for a significant proportion of student attrition from flight training. Other investigators (1-3) have predicted susceptibility to motion sickness through the use of questionnaires dealing with a personal history of reactions to various kinds of motion. Scores on the Pensacola Motion Sickness Questionnaire (MSQ) have been shown (8) to be related to susceptibility to motion sickness in the Pensacola Slow Rotation Room (SRR) (5). Since it has also been demonstrated (7) that susceptibility to motion sickness in the SRR is positively related to susceptibility to airsickness, it was hypothesized that the MSQ might be of value as a predictor of successful completion of flight training and as such might make a significant contribution to the multiple prediction formulae currently used to predict this criterion.

In a preliminary study conducted to test this hypothesis, the MSQ scores of 802 flight students were correlated with the student's eventual outcome in the flight training program (Complete vs. Attrite). The MSQ score used in this investigation was derived from a previous item analysis of the questionnaire (8) in which susceptibility to motion sickness in the SRR had been used as the criterion for item selection. A point biserial correlation coefficient of .084 ($P < .01$) between MSQ score and completion of flight training was obtained. While this was not of sufficient magnitude to justify the inclusion of the questionnaire scores, as such, in the multiple prediction formulae currently in use, it did supply partial verification of the hypothesis. It was, therefore, reasoned that if the MSQ was scored according to an item analysis which used eventual success in training as the criterion for item selection, its validity as a predictor of completion of flight training might be substantially increased.

PROCEDURE

The questionnaires of 660 incoming flight students who completed their MSQ forms in 1960 and 1961 were subjected to an item analysis. The proportions of successful and unsuccessful students choosing each alternative were computed. An eta coefficient was then calculated on each item. Those items found to have a significant relationship (.05 level) with completion of flight training were weighted according to the percentage of successful students choosing each alternative, using the method suggested by Guilford (6). After all the significant items were determined, French's (4) method for optimizing the total score was used to arrive at the most valid MSQ score. This score was then correlated with two dichotomous criterion variables: Completion versus Attrition (the criterion used for the item selection) and Voluntary Withdrawal versus Other.* (The latter dichotomy separated those students who voluntarily left the program from all other students regardless of their success or failure.)

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* This criterion was included to check the hypothesis that susceptibility to motion sickness would increase the chances of a student voluntarily quitting even though his academic and flight performances were satisfactory.

After conclusion of the item analysis, an additional 550 questionnaires, completed by incoming flight students in 1962, were scored according to the weights determined above, in order to cross-validate this scoring procedure. The MSQ scores of this group were then subjected to a correlation analysis with those predictor variables (Table I) currently used in the multiple prediction formulae to predict success in the flight program.

Table I

Correlation of MSQ scores with Predictor Variables from the Multiple Prediction Formulae

Predictor Variables#	Correlation with MSQ
Selection Variables	
1. Age	-.005
2. Education	.087*
3. Aviation Qualification Test (AQT)	.044
4. Mechanical Comprehension Test (MCT)	.019
5. Spatial Apperception Test (SAT)	.000
6. Biographical Inventory (BI)	.318**
Pre-Flight Course Grades	
7. Leadership	-.006
8. Officer-Like Quality	-.063
9. Peer Rating	-.045
10. Physiology	.031
11. Mathematics	.027
12. Physics	.007
13. Aviation Science	.016
14. Engines	.044
15. Naval Orientation	.008
16. Navigation	.024
17. Principles of Flight	.093*
18. Study Skills	.054
19. Physical Training	.096*

* Significant at .05 level. ** Significant at .01 level.

\# For a description of these variables, see Wherry and Hutchins (9).

This analysis was conducted separately with those predictor variables available during the first week of pre-flight (incoming students), and with those available after sixteen weeks of pre-flight school (during the actual flight phases of training). From the correlation coefficients obtained in this analysis, multiple prediction formulae were computed

for both stages in training, using the Wherry-Doolittle method of test selection. This procedure selects those variables which in combination yield the highest multiple correlation with a particular criterion. In order to determine the unique contribution of the MSQ to the validity of these formulae, the Wherry-Doolittle analysis was conducted with and without the MSQ score included. The significance of the increase in multiple validity due to the inclusion of the MSQ was determined by means of an F-test* between the criterion variances accounted for with and without the MSQ included in the analysis.

RESULTS

Twelve items were found to significantly discriminate between students who eventually completed flight training and those who did not. When best total score was considered, however, only those nine items shown in Table II were included in the scoring of the questionnaire.

Table II

Point Biserial Correlation Coefficients Between Selected MSQ Items and the Complete/Attrite Criterion for Original and Cross-Validation Samples

Selected Items	1960-1961 Sample	1962 Cross-Validation Sample
Perceived susceptibility to motion sickness	.153	.083
Single-engine aircraft experience	.138	.105
Multi-engine aircraft experience	.079	.027
Perceived chances of getting sick where 50% of others get sick	.102	.070
Willingness to volunteer in experiment where 25% others get sick	.022	.063
Preference for and experience in dancing	.086	.064
Preference for and experience in skiing	.122	.020
Time in recovering from motion sickness	.060	.071
Procurement source	.128	.053
Total questionnaire score	.256	.174

The point biserial correlation coefficients between MSQ and the criteria for the sample used in the item analysis were .256 for Complete/Attrite and .155 for Voluntary Withdrawal/Other. When cross-validated on the 1962 sample, these coefficients shrank to .174 and .135 for training stage 1, and to .163 and .157 for training stage 2.

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* $$F = \frac{R_1^2 - R_2^2 / DF_1 - DF_2}{(1 - R_1^2)/N - DF - 1}$$ where the subscripts 1 and 2 refer to MSQ included and MSQ excluded, respectively.

(All four cross-validated coefficients are significant at the .001 level.) The proportions of students completing flight training for succeeding intervals of MSQ scores are shown in Table III. As can be seen, the chances of a student completing training increase as scores become larger.

Table III

Proportions of Students Completing Flight Training for Various MSQ Scores

MSQ Score	Number in Interval	Per Cent of Sample	Per Cent Completing
675 or above	29	5.28	86.2
665 - 674	74	13.47	77.0
655 - 664	133	24.21	71.0
645 - 654	150	27.30	63.0
635 - 644	84	15.29	60.0
625 - 634	45	8.19	62.4
624 or below	35	6.37	42.8

The results of the evaluation of the MSQ as a supplement to the currently used multiple prediction formulae are shown in Table IV. The inclusion of the MSQ into the multiple prediction formulae significantly increased the multiple validity for predicting both criteria at both stages in training.

Table IV

Comparison of the Shrunken Multiple R's* Obtained with the Cross-Validated MSQ Score Excluded and Included

Criterion	Shrunken Multiple R MSQ Excluded	Shrunken Multiple R MSQ Included	Significance of Increase in Multiple
Training Stage I			
Complete/Attrite	.201	.247	$P < .01$
Voluntary Withdrawal/Other	.059	.137	$P < .01$
Training Stage II			
Complete/Attrite	.377	.393	$P < .01$
Voluntary Withdrawal/Other	.186	.225	$P < .01$

* All multiple R's reported in this study are actually shrunken multiple R's.

DISCUSSION

It is apparent that the Pensacola Motion Sickness Questionnaire, as scored in this study, is of significant value as an additional predictor of completion of flight training. It is, of course, quite possible that factors other than motion sickness are partially or totally responsible for the relationship between the MSQ score and completion of training. We may, however, speculate that the principal factor responsible for this validity is susceptibility to motion sickness, since the majority of the items found to be significant discriminators were related to various aspects of motion sickness. The increase in the validity for predicting those students who voluntarily leave the program would seem to provide further support for a motion sickness factor, especially since this validity was greater after the student had completed pre-flight school, i.e., had begun the actual flying phases of his training.

The correlation of .318 (Table I) between the MSQ score and the Biographical Inventory (BI) suggests that these questionnaires measure some common factors. It might be beneficial to incorporate those items found significant in the MSQ into the BI. Further investigation into the feasibility of this suggestion is currently being considered.

Due to the rather encouraging results of this study the MSQ is presently being administered to incoming flight students and after further cross-validation will be routinely included in the Pensacola Student Prediction System.

REFERENCES

1. Alexander, S.J., Cotzin, M., Hill, C.J., Ricciuti, E.A., and Wendt, G.R., Wesleyan University studies of motion sickness: I. Prediction of sickness on a vertical accelerator by means of a motion sickness history questionnaire. J. Psychol., 20:25-30, 1945.

2. Birren, J.E., and Fisher, M.D., Susceptibility to seasickness: A questionnaire approach. J. appl. Psychol., 31:288-297, 1947.

3. Birren, J.E., Fisher, M.B., and Stormant, R.T., Evaluation of a motion sickness questionnaire in predicting susceptibility to seasickness. Nav. Med. Bull., 45:629-634, 1945.

4. French, J.W., A technique for criterion-keying and selecting test items. Psychometrika, 17:101-106, 1952.

5. Graybiel, A., Clark, B., and Zarriello, J.J., Observations on human subjects living in a "slow rotation room" for periods of two days. Arch. Neurol., 3:55-73, 1960.

6. Guilford, J.P., Psychometric Methods. New York: McGraw-Hill, 1954.

7. Kennedy, R.S., and Graybiel, A., Validity of tests of canal sickness in predicting susceptibility to airsickness and seasickness. Aerospace Med., 33:935-938,

8. Kennedy, R.S., and Graybiel, A., The Dial Test: A standardization procedure for the experimental production of vestibular symptomatology. NSAM-930. NASA Order No. R-93. Pensacola, Fla.: Naval School of Aviation Medicine, 1965.

9. Wherry, R.J., Jr., and Hutchins, C.W., Jr., An investigation of unpredicted differences in attrition rates among students from different procurement sources. NSAM-907. Pensacola, Fla.: Naval School of Aviation Medicine, 1964.

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The Pensacola Motion Sickness Questionnaire (MSQ) was subjected to an item analysis using successful completion of the flight training program as the criterion for item selection. The scoring key that resulted was cross-validated on a new sample and a statistically significant correlation obtained. When included in the multiple prediction formulae used at this facility to predict training success, the MSQ made significant increases in the multiple validity of the formulae for predicting both successful completion of flight training and voluntary withdrawal from training.

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