NSAM-930

THE DIAL TEST: A STANDARDIZED PROCEDURE FOR THE EXPERIMENTAL PRODUCTION OF CANAL SICKNESS SYMPTOMATOLOGY IN A ROTATING ENVIRONMENT

Robert S. Kennedy and Ashton Graybiel

JOINT REPORT

UNITED STATES NAVAL SCHOOL OF AVIATION MEDICINE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

June 1965

Distribution of this document is unlimited.

THE DIAL TEST: A STANDARDIZED PROCEDURE FOR THE EXPERIMENTAL PRODUCTION OF CANAL SICKNESS SYMPTOMATOLOGY IN A ROTATING ENVIRONMENT*

Robert S. Kennedy and Ashton Graybiel

Bureau of Medicine and Surgery
Project MR005.13-6001
Subtask 1 Report No. 113

NASA Order No. R-93

Released by

Captain H. C. Hunley, MC USN
Commanding Officer

10 June 1965

*This research was conducted under the sponsorship of the Office of Advanced Research and Technology, National Aeronautics and Space Administration.

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

SUMMARY PAGE

THE PROBLEM

Exposure to angular velocities in the Slow Rotation Room with accompanying head movements gives rise to a constellation of symptoms collectively termed canal sickness. In previous investigations head and body movements were largely uncontrolled. Thus the need arose for a method of forcing specific head and body movements and for normative data on such a standardized procedure. A secondary problem dealt with the interrelationships of performance on this then standardized canal sickness procedure (the Dial Test) and two indices of the positive function of the semicircular canals (Modified Romberg and Coriolis Illusion). The third part of the study related subjects' responses to a motion sickness questionnaire (MSQ) with their susceptibility to canal sickness.

FINDINGS

This report is in three parts: Part 1 describes the standardization study which suggested that the Dial Test should be performed during rotation at 7.5 RPM for twenty sequences of five dial settings with a six-second interval between each setting and a six-second interval between sequences. Incoming flight students, proficiency billet aviators, and test pilots, respectively, were then exposed to this experimental condition. Statistical differences were found between mean performances of each group, with the test pilots least and the flight students most susceptible. These findings are ascribed to differences in habituation and to natural selection.

Parts 2 and 3 report the correlations between Dial Test scores and the Modified Romberg and the Coriolis Illusion, and with scores from a Motion Sickness Questionnaire. Modified Romberg scores (postural equilibrium) had a small but significant (5% level) relationship with Dial Test scores for the "incoming flight student" group, and this relationship was almost significant for the "proficiency billet aviator" group. Coriolis Illusion scores were not significantly related to Dial Test scores but were in the predicted direction. A more sensitive and reliable test of postural equilibrium may augment the relationships observed here; and to a lesser extent a better test of the Coriolis Illusion might also produce significant relationships with Dial Test scores, but the data from these experiments provide less support for this latter thesis. Statistically significant relationships were obtained between Dial Test score (canal sickness susceptibility) and scores from two keys to the Motion Sickness Questionnaire; these need cross-validation, however.

INTRODUCTION

Symptoms of motion sickness have been reported under many conditions: on ships (3,4,26), aircraft (7,14), carnival devices (5), and include the discomfort experienced by astronauts adrift at sea in their space capsules (24) and the experience of naive camel riders (25). In addition, the experimental production of motion sickness has a long history, numerous devices having been used to produce sickness. These range from elaborate rotating devices (18) and vertical accelerators (1,2) to inverted prism spectacles used with rocking chairs (23).

Within these environments the significance of head movements in imparting stimuli to the vestibular apparatus has been emphasized by Johnson et al. (19). That the genesis for the reaction known as motion sickness is in the vestibular apparatus appears to have been well demonstrated by the complete absence of these symptoms in persons with bilateral labyrinthine defects (10,20), and there is evidence that even partially depressed vestibular function affords some protection (13). The terms vestibular sickness (8) and canal sickness (12) have been suggested for this malady.

The present study is concerned with setting forth the procedures used in a new test--the Dial Test--for motion sickness and for reporting the comparative performances on this test of different groups of individuals. A secondary purpose was to discover the relationships between semicircular canal function as measured by performance on the Dial Test, by a modified Romberg test, by the Coriolis illusion, and by response to a motion sickness questionnaire.

These studies were conducted on the Pensacola Slow Rotation Room (SRR), a circular, windowless room 15 feet in diameter. A more detailed description of this device appears in separate reports (6,12). The major feature of this device, with respect to motion sickness studies, is that a subject within the room is aware of the motion of the room only through the vestibular apparatus and his proprioceptors. These modalities provide information when the subject moves his head and body incidental to the room's rotation. There are no visual, auditory, or other sense cues to the rotation of the room. Further, head movements within the room cause gyroscopic torques to impinge in an unusual fashion upon the vestibular apparatus and specifically to the semicircular canal system (16). Canal sickness in this environment has been shown to be related to other forms of motion sickness (21).

PART 1. STANDARDIZATION OF THE DIAL TEST

This part describes a developmental study to identify an optimum Dial Test procedure, and the results of using the procedure on three groups with differing aviation experience.

THE DIAL TEST

The basic procedure required that the subject execute a prescribed number of head and body movements by setting, upon command, five dials mounted in various positions around him. The subject was always seated 3.5 feet from the center of rotation of the room, in a comfortable chair. As shown in Figure 1, the dials were located: 1) above and to the left; 2) above, forward and to the right; 3) down and far left; 4) overhead and behind; 5) down, back and to the left. Their distances as measured from the center of the subject's head while he was seated upright were 28,36,48,18, and 37 inches, respectively. The setting of each of these five dials in turn is referred to here as "one sequence." The subjects were ordered to the task and paced by numbers announced by a tape recording.

The problem was to determine that combination of rotational velocity of the room, time between dial settings, and number of sequences to be performed which would yield the best measure of susceptibility to motion sickness.

Four healthy young men were exposed to 15 experimental conditions each, in which rotational velocities of 1.0, 3.2, 5.4, 7.5, and 10.0 RPM were combined with times between settings of 4, 6, or 8 seconds. The order of their exposure was random. They were told to complete as many sequences as possible to a maximum of fifty, unless they felt that, "by continuing you will vomit."

The two lower RPM's were not sufficiently stressing, in that all four men completed all fifty sequences at all three intervals. At the other extreme 10.0 RPM was too stressful, in that at least one subject failed to complete the first sequence at all three time intervals. At between 5.4 RPM and 7.5 RPM, fifty sequences appeared necessary to provoke sickness in all subjects at the lower RPM, while twenty seemed an adequate standard at the higher.

As to the intervals between settings, it was found that the six-second interval produced motion sickness more rapidly than did either the four or eight second. The lower incidence at the eight-second interval was expected, since the longer interval permitted slower head movements, but the lower incidence at four seconds deserves comment. It was the impression of the on-board observer that at the four-second interval, the subjects had to exert maximum concentration to even come close to the correct dial settings before the next signal, and that they were perhaps too busy to reflect on their symptoms. A somewhat analogous observation was made by Guedry (15) when he suggested that the difference in sickness rate between groups exposed with and without vision is a result of higher levels of mental activity. Anecdotally, sailors claim they are less prone to seasickness when "there is green water over the bow," and aviators express similar feelings about being busy during turbulence or acrobatics. But these relationships of mental activity to motion sickness need additional study.

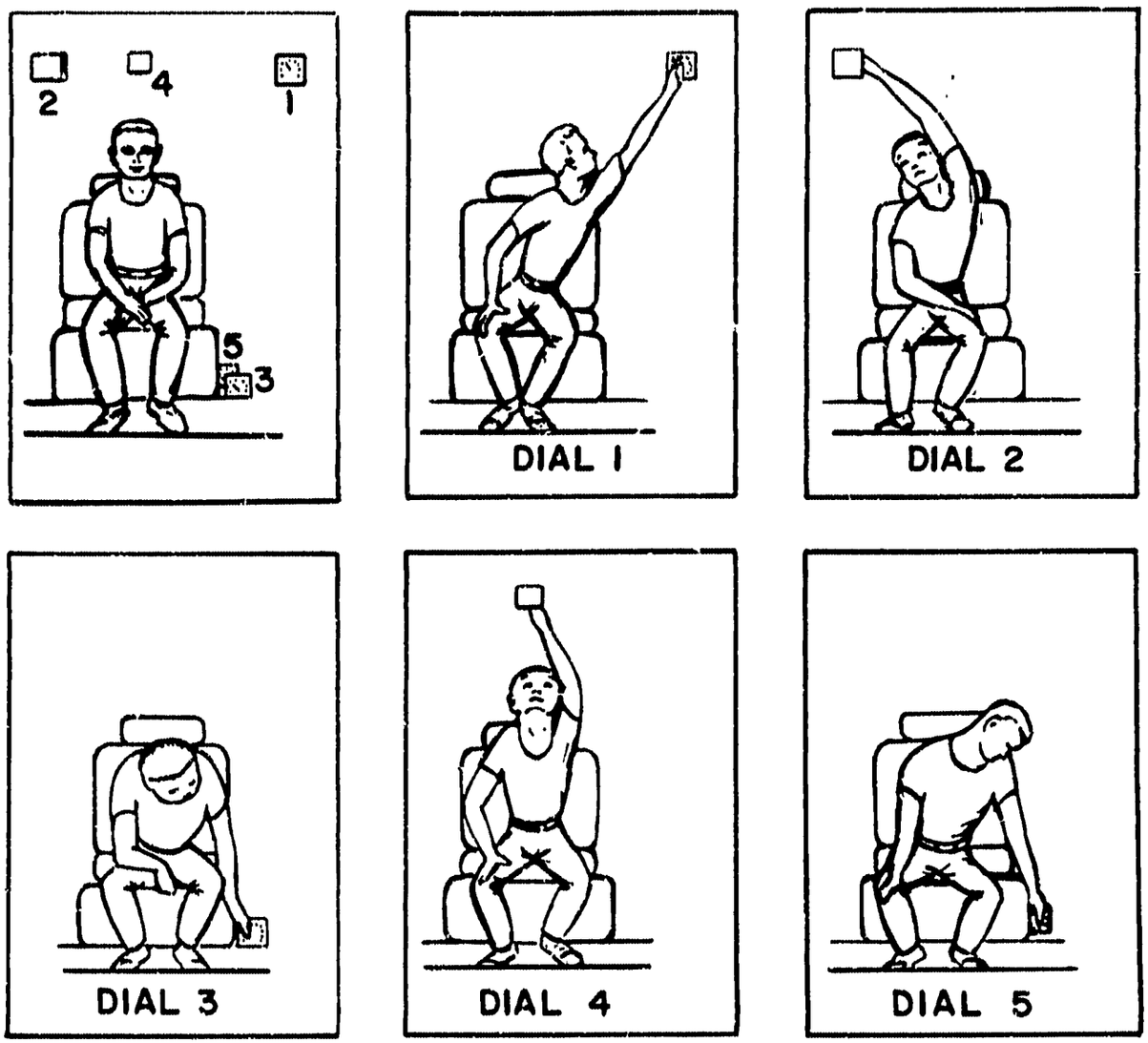

Figure 1

Dial Test -- Dial Setting Sequence

The Dial Test was then administered to three groups of subjects of varying amounts of aviation experience. Group 1 were 100 incoming flight students. Group 2 were 40 experienced aviators assigned to the U. S. Naval School, Pre-Flight as academic instructors. While experienced, they were currently flying little more than the four hours per month required to maintain their proficiency rating. The third group were 25 aviators who were recent graduates of Test Pilot school and whose present duties required them to fly almost daily in high performance, highly maneuverable aircraft.

The members of each group were required to set twenty sequences with six-second intervals between settings and the SRR running at 7.5 RPM.

Results

Table 1 shows the results. The mean numbers of sequences completed and the percentages that became motion sick are in accord with the experience levels of the groups. The Dial Test performance of the test pilots exceeds that of the academic instructors by an amount that is statistically significant at the .02 level, and exceeds that of the students by an amount significant at the .001 level.

Table 1

Means, Standard Deviations, Percentage Sick, and Percentage Vomiting in Three Groups of Naval Aviation Personnel

	Group 1	Group 2	Group 3
Mean Dial Test Score	12.48	15.63	19.44
Standard Deviation	7.04	7.13	2.74
Percentage Sick	70	30	5
Percentage Vomiting	10	0	0
N	100	40	25

It is the authors' opinion that the differences among these three groups may be accounted for both by natural selection and by habituation. First, one might expect that among trainees, those who are most susceptible will tend to leave aviation, and of those who continue, the most susceptible will not apply for test pilot training. These group differences should then be accentuated by the groups' current experiences, since it is known that tolerance increases with exposure.

PART 2. RELATIONSHIPS OF A MODIFIED ROMBERG AND CORIOLIS ILLUSION PERCEPTION TO THE DIAL TEST

This part of the experiment was concerned with relating performances on the Dial Test to two tests of the positive function of the vestibular apparatus: 1) modified Romberg and 2) Coriolis illusion.

MODIFIED ROMBERG TEST

In this test the subject was requested to stand on his preferred foot as steadily as he could with eyes closed for thirty seconds. After a rest he was asked to perform the same task on the other foot. The subject was scored on the following basis: The number of seconds he stood without falling (or putting his foot down) to a maximum of thirty seconds except that if he fell within thirty seconds, he was given three trials, and his best trial was his score, according to the following scale:

1. Slight body sway, no foot movement.
2. Definite sway of small amount, no foot movement.
3. Substantial sway but no foot movement.
4. Substantial body sway and foot is moved.
5. Substantial body sway and other foot put down to prevent fall.

CORIOLIS ILLUSION

The Coriolis illusion is a specialized type of the oculogyral illusion (9) which occurs when an unadapted person with functional semicircular canals tilts his head in one plane while he is passively rotated in another. For the Coriolis illusion test the subject was seated in a chair 3 feet from the center column of the SRR. In front of the subject was a bite board on a swivel which in turn was mounted on a brace. When the subject fixed his head by biting on the board, he was able to turn his head through 150° of arc laterally, 75° either way. A peg could be set in at 15° intervals so as to restrict the excursion to narrower settings.

In an attempt to maximize the perception of the illusion preliminary tests were performed using four subjects. Two target lights were boxes with perforations along each visible edge, lighted from within. Each was mounted so as to produce a three-dimensional figure when viewed in a darkened room. (Three-dimensional figures were

used to eliminate the possible influence of autokinesis.) Rheostats were connected to the light inside the box. One box was 6 inches square and the other a rectangle (7' x 7½ x 9"). Both were mounted at eye level 8 feet from the subject. The variables under consideration were: 1)speed of rotation (5 to 10 RPM); 2) speed of head movement (0.5 – 4 seconds); 3) degree of head movement (15° – 75°); 4) size of target; 5) intensity of target light (very dim through very bright). The subjects were asked to estimate the number of inches the target appeared to be displaced, as well as the direction of the movement. Each testing session consisted of four head movements (right, return, left, return). The subject's score was the average of these four estimations.

The results of these preliminary tests appeared to suggest that when the head was moved: a) 45° in b) 1.5 seconds while the c) square box was d) dimly lit and e) the rotational velocity of the SRR was 6.5 RPM,* the perceived illusion was maximal. This procedure was then followed when the subjects in groups 1, 2, and 3 were tested for the illusion.

Results

Table II contains the results of the modified Romberg for groups 1 and 2 and the Coriolis illusion for groups 1, 2, and 3. (A time stress prevented group 3 from taking the Romberg Test.)

Table II

Means and Standard Deviations for the Modified Romberg and the Coriolis Illusion Groups of Naval Aviation Personnel

	Group 1		Group 2		Group 3
	Rom	CI	Rom	CI	CI
Mean	2.86	10.60	2.46	19.71	18.71
Standard Deviation	0.88	12.31	1.22	13.41	11.41
N	100		40		25

---

* Higher velocities (viz., 10 RPM) did in fact produce a greater magnitude of the illusion but also produced vestibular sickness prior to completion of the test.

Mean Coriolis illusion score was higher in the aviator groups than in the student group, and mean differences were significant between groups 1 and 2 and groups 1 and 3 ($\alpha = < .001$) but not between groups 2 and 3 ($\alpha = .5$). Romberg performance scores differed significantly ($\alpha = < .05$) between groups 1 and 2.

The correlations of these two measures to Dial Test score for groups 1 and 2 appear in Table III. Correlations were not performed for group 3 since 24 of 25 subjects completed the 20 sequences, and thus no range of scores was available.

Table III

Correlations Between Dial Test Score and Modified Romberg and Coriolis Illusion Performance for Two Groups of Naval Aviation Personnel

	Modified Romberg		Dial Test Score	
	Group 1	Group 2	Group 1	Group 2
Modified Romberg			.21*	.17
Coriolis Illusion	-.06	-.18	-.11	-.04

*.05 Level of significance.

The correlation between Dial Test score and modified Romberg is significant at the .05 level for group 1 (and insignificant but in the predicted direction for group 2). This appears to demonstrate at least some tendency for canal sickness susceptibility to be related to postural equilibrium: the better the equilibrium, the more tendency toward susceptibility. There were no other significant correlations.

COMMENT

It is not known whether the group differences in magnitude of Coriolis illusion perception are the result of age or of increased sophistication in making these types of estimations. It is true that aviators frequently make similar types of estimations in night flying, and these data may reflect this ability. The main purpose of this part of the study was to determine the relationships, if any, of two tests which may be indices of the positive function of the semicircular canal system. If performance on a modified Romberg and the Coriolis illusion could be shown to be related to susceptibility to canal sickness, these tests might prove valuable assets in the prediction and understanding of this malady. Additionally, it seemed reasonable to investigate whether a low semicircular canal sensitivity as measured by these tests afforded some protection from

canal sickness. The difficulties associated with the perception and report of the Coriolis illusion have been commented on elsewhere (22). It was hoped that with a more valid and reliable method of scoring this phenomenon, significant relationships could be obtained; however, the data from the present experiment show no statistically significant relationship. That only a moderate relationship between Coriolis nystagmus and susceptibility to canal sickness has been found (17) lends support to the findings of the present experiment and indicates a need for further research. The results of the modified Romberg test, however, suggest that a more precise and discriminating test of postural equilibrium may also increase the ability to predict motion sickness susceptibility from postural equilibrium performance. The recently reported Graybiel-Fregly ataxia test (11) appears promising in this regard.

PART 3. RELATIONSHIP OF A MOTION SICKNESS QUESTIONNAIRE TO DIAL TEST PERFORMANCE

In this part of the study a Motion Sickness Questionnaire (MSQ)* was administered to the subjects of groups 1, 2, and 3 with the intention of relating a past history of motion sickness to susceptibility to canal sickness as demonstrated by Dial Test performance.

The questionnaire employed was one which inquired about the subjects' 1) experience with different devices known to have produced motion sickness (e.g., cars, boats, planes, carnival devices, etc.), and 2) his own incidence of motion sickness.

An item analysis was conducted on the responses of group 1, and twelve scorable responses were obtained.

RESULTS AND COMMENT

A separate item analysis was run on the responses of group 2. Here ten scorable responses were found, but these differed sufficiently from the ones identified for group 1 as to make it obvious that the same key could not be applied to both groups. Examination of the responses showed that the aviators in group 2 reported greater frequencies of motion sickness than the students in group 1; but their exposure to conditions that might produce motion sickness, such as rough weather at sea and aircraft during turbulence, was also far greater.

Taken independently, the MSQ scores for group 1 correlated .41 with Dial Test performance, while those of group 2 correlated .59. Both of these correlation coefficients could be expected to shrink substantially on a cross-validation in which the MSQ questionnaire responses of another group of students and another comparable group of aviators are scored with the appropriate keys developed here. The best guess at this point is that relationship with Dial Test performance exists, but that its magnitude is uncertain.

---

* This questionnaire (NAVSCOLAVNMED 6500/24) was developed by the authors and appears as Appendix A.

REFERENCES

1. Alexander, S. J., Cotzin, M., Hill, C. J., Jr., Ricciuti, W. A., and Wendt, G. R., Wesleyan University studies of motion sickness. I. The effects of variations of time intervals between accelerations upon sickness rates. J. Psychol., 19:49-62, 1945.

2. Alexander, S. J., Cotzin, M., Hill, C. J., Jr., Ricciuti, W. A., and Wendt, G. R., Wesleyan University studies of motion sickness. III. The effects of various accelerations upon sickness rates. J. Psychol., 20:3-8, 1945.

3. Birren, J. E., and Morales, M. F., Observations on men highly susceptible to seasickness with remarks on periodic motions of ships. Project No. X-278, Report No. 5. Bethesda, Md.: Naval Medical Research Institute, 1945.

4. Bruner, J. M. R., Seasickness in a destroyer escort squadron. U. S. forces med. J., 6:469-490, 1955.

5. Chinn, H. I., and Smith, P. K., Motion sickness. Pharmacol. Rev., 7:33-82, 1955.

6. Clark, B., and Graybiel, A., Human performance during adaptation to stress in the Pensacola Slow Rotation Room. Aerospace Med., 32:93-106, 1961.

7. Flaherty, T. T., Airsickness during acrobatics. Nav. med. Bull, Wash., 40: 902-906, 1942.

8. Graybiel, A., Vestibular sickness and some of its implications for space flight. In: Fields, W. S., and Alford, B. R. (Eds.), Neurological Aspects of Auditory and Vestibular Disorders. Springfield, Ill.: Charles C Thomas, 1964.

9. Graybiel, A., and Hupp, D., The oculo-gyral illusion: A form of apparent motion which may be observed following stimulation of the semicircular canals. J. aviat. Med., 17:3-27, 1946.

10. Graybiel, A., and Johnson, W. H., A comparison of the symptomatology experienced by healthy persons and subjects with loss of labyrinthine function when exposed to unusual patterns of centripetal force in a counter-rotating room. Ann. Otol., 72:885-893, 1963.

11. Graybiel, A., and Fregly, A. R., A new quantitative ataxia test battery. NSAM-919. NASA Order No. R-93. Pensacola, Fla.: U. S. Naval School of Aviation Medicine, 1965.

12. 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.

13. Graybiel, A., Schuknecht, H. F., Fregly, A. R., Miller, E. F., II, and McLeod, M. E., Practical and theoretical implications based on long-term follow-up of Ménière's patients treated with streptomycin sulfate. NAMI-948. NASA Order No. R-93. Pensacola, Fla.: Naval Aerospace Medical Institute, 1965.

14. Green, D. M., Airsickness in bomber crews. J. aviat. Med., 14:366-372, 1943.

15. Guedry, F. E., Jr., Visual control of habituation to complex vestibular stimulation in man. Acta otolaryng., Stockh., 58:377-389, 1964.

16. Guedry, F. E., Jr., Psychophysiological studies of vestibular function. In: Neff, W. D. (Ed.), Contributions to Sensory Physiology. Vol. I. New York: Academic Press, 1965. Pp 63-135.

17. Guedry, F. E., Habituation to complex vestibular stimulation in man: Transfer and retention of effects from 12-days of rotation at 10 RPM. Perceptual mot. Skills, in press, 1965.

18. Guedry, F. E., and Graybiel, A., Rotation devices, other than centrifuges and motion simulators: The rationale for their special characteristics and use. Publication 902. Washington, D. C.: National Academy of Sciences-National Research Council, 1961.

19. Johnson, W. H., Stubbs, R. A., Kelk, G. F., and Franks, W. R., Stimulus required to produce motion sickness. I. Preliminary report dealing with importance of head movements. J. aviat. Med., 22:365-374, 1951.

20. Kellogg, R. S., Kennedy, R. S., and Graybiel, A., Motion sickness symptomatology of labyrinthine defective and normal subjects during zero gravity maneuvers. Aerospace Med., 36:315-318, 1965.

21. Kennedy, R. S., and Graybiel, A., The validity of tests of canal sickness in predicting susceptibility to airsickness and seasickness. Aerospace Med., 33:935-938, 1962.

22. Kennedy, R. S., Tolhurst, G. C., and Graybiel, A., The effects of visual deprivation on adaptation to a rotating environment. NSAM-918. NASA Order No. R-93. Pensacola, Fla.: U. S. Naval School of Aviation Medicine, 1965.

23. Kottenhoff, H., and Lindahl, L. E. H., Visual and emotional factors in motion sickness: Preliminary communication. Percept. mot. Skills, 8:173-174, 1958.

24. Minners, H. A., Douglas, W. K., Knoblock, E. C., Graybiel, A., and Hawkins, W. R., Aeromedical preparation and results of postflight medical examinations. In: Results of the First United States Manned Orbital Space Flight, February 20, 1962. National Aeronautics and Space Administration, Manned Spacecraft Center.

25. Tyler, D. B., and Bard, P., Motion sickness. Physiol. Rev., 29:311-369, 1949.

26. deWit, G., Seasickness (motion sickness). A labyrinthological study. Acta otolaryng., Stockh., Suppl. 108, 1-56, 1953.

NAVSCOLAVNMED 6500/24

PENSACOLA MOTION SICKNESS QUESTIONNAIRE

Enclosures:

1. Subjects Pre-experimentation Interview
2. Experimenter's Evaluation Sheet
3. Subject's Evaluation Sheet

Form A

Name_____ Rank_____ Age____ Weight_____ Height_____

Serial No._____ Class (if any)_____ Today's Date_____

Have you ever taken this test before? YES____ NO____ When?_____

Check one of the following:

Aviator	_____
Cadet (MarCad)	_____
Aviation Officer Candidate	_____
Officer under instruction	_____
LDO	_____
Enlisted	_____
Flight Surgeon	_____
Staff Corps Officer	_____
Civilian	_____
Other (Specify)	_____ _____

Check one of the following:

Navy	_____
Marine	_____
Coast Guard	_____
Other (Specify)	_____ _____

Number of hours in multi-engine aircraft:
(Draw a circle around one or more of the following: (Passenger, Crew, Military or Commercial.)

None	_____
Less than 10	_____
10-50	_____
50-200	_____
200-1000	_____
More than 1000	_____

Number of hours in single-engine aircraft: (Passenger, Crew, Military, Commerical)

None	_____
Less than 10	_____
10-50	_____
50-200	_____
200-1000	_____
More than 1000	_____

NAVSCOLAVNMED 6500/24

Study of "Motion Sickness"

Under one condition or another just about all normal individuals get "motion sick." The number of times and the conditions under which this occurs vary with the individuals. It has not yet been determined just which "individual differences" are involved. It is believed the results of this study will give us some indications.

The term "motion sickness" covers a wide variety of subjective symptoms and objective signs and may be experienced over a wide range of severity. Common symptoms are discomfort, lack of appetite, nausea, dizziness and drowsiness; common signs are pallor, sweating, increased salivation and vomiting. Most persons recall accurately severe symptoms but not mild symptoms which, even when experienced, may not have been attributed to motion. The diagnosis or identification of motion sickness depends almost entirely on the close relation of the onset of symptoms to the onset of motion.

1a. In the following, indicate the amount or number of experiences you have had with each activity.

How many experiences with:	No.
Swings	
Hammocks	
Gymnastic apparatus	
Roller skating	
Spinning on foot	
Roller coaster	
Squirrel cage	
Cartwheels	
Merry-Go-Round	
Other carnival devices	

How many experiences with:	No.
Long train trips	
Buses	
Motor cars	
Motorcycles	
Elevators	
Cinerama at movies with wide screen	
In a plane in slight turbulence	
In a plane in severe turbulence	
In a plane in acrobatics	
In a plane in Zero "g"	

1b. Disregarding the number of experiences you have had, how many times were you sick? In addition, check the symptoms you experienced. (You may check more than one.)

	No.	Vomited	Nausea	Stomach awareness	Increased salivation	Dizziness	Drowsiness	Sweating	Pallor	Vertigo	Awareness of breathing	Headache	Other symptoms
Swings													
Hammocks													
Gymnastic apparatus													
Roller skating													
Spinning on foot													
Roller coaster													
Squirrel cage													
Cartwheels													
Merry-Go-Round													
Other carnival devices													
Long train trips													
Buses													
Motor cars													
Motorcycles													
Elevators													
Cinerama at movies with wide screen													
In a plane in slight turbulence													
In a plane in severe turbulence													
In a plane in acrobatics													
In a plane in zero "g"													

If you had any other symptoms as a result of motion sickness, what were they:

2. a. How many experiences have you had at sea aboard ships or boats?

Many_____ Numerous_____ Some_____ Too few to mention_____ None_____

b. Have you ever been seasick? YES____NO____If YES, would you describe the experience. Please describe weather conditions, length of voyage, type of vessel, whether you recovered while at sea, (and if you became sick again), and any other factors you consider pertinent.

c. From your experience at sea would you say that you: Always get sick_____

Frequently get sick_____ Sometimes_____ Rarely_____ Never_____

3. Have you ever been motion sick under any conditions other than the ones listed so far?

YES_____NO_____If so, under what conditions?

4. If you vomited while experiencing motion sickness, did you;

Feel better and remain so? _____
Feel better temporarily, then vomit again? _____
Feel no better, but not vomit again? _____

5. In general, how susceptible to motion sickness are you? Extremely_____

Very_____ Moderately_____ Minimally_____ Not at all_____

6. In the past 8 weeks have you been nauseated FOR ANY REASON. YES____NO____
(If YES, Explain)

a. In the past when you were nauseated for any reason, did you: 1) vomit easily____
2) only with difficulty____3) retch and finally vomited with great difficulty____
4) could never vomit when nauseated_____ 5) never nauseated in life_____

b. Have you ever vomited in your sleep after heavy partying the night previous?
YES_____ NO_____

NAVSCOLAVMED 6500/24

7. The following contains a list of recreational activities. Please indicate by a check your past experiences with each, as well as your preference. Please be sure to check one in each section for "amount of experience", and "preference."

	More than 10 times	5 to 10 times	Less than 5 times	Never	Like	Neutral	Dislike
Airplanes							
Shipboard cruises							
Sailing							
Salt water fishing							
Roller skating							
Diving from a board							
Trampoline							
Water polo							
Figure skating							
Dancing							
Riding a motorcycle							
Playing ice hockey							
Underwater spear fishing							
Ice skating							
Roller coaster							
Squirrel cage							
Dive bomber							
Carnival devices							
Skiing (water or snow)							

8. What do you think your chances of getting sick would be in an experiment where 50% of the subjects get sick?

I almost certainly would _____
I probably would _____
I probably would not _____
I almost certainly would not _____

9. Would you volunteer for an experiment where you knew that:

85% of the subjects did get motion sick? YES_____ NO_____
75% of the subjects did get motion sick? YES_____ NO_____
25% of the subjects did get motion sick? YES_____ NO_____

NAVSCOLAVIMED 6500/24

10. a. Have you ever taken part in any activities which involved unusual body rotation, (dance, game, etc.,)? YES___NO_____

b. If yes, what were they? _____

c. If yes, how severe was the motion? _____

d. If yes, did you get motion sick? YES___NO_____

e. What were the specific symptoms? _____

11. What influence do you think the food you ate, before your experience with motion, had on whether or not you got sick?

12. At the time you were motion sick, what type of remedy did you use? (whether medical or otherwise)

13. It is thought that there are two kinds of motion sickness. One starts in the brain, (dizziness, sleepiness), and the other one starts in the stomach or intestines, (vomiting, nausea). Which would you say was most like yours?

14. Were you a passenger or controller of a vehicle when you got sick?

15. Most people experience slight dizziness (not a result of motion) 3 to 5 times a year. The past year you have been dizzy:

more than this _____
the same as _____
less than _____
never dizzy _____

16. Have you ever had a broken bone? If yes, when and which bone? (arm, leg, nose, etc.)

When	Bone
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____

NAVSCOLAVNMED 6500/24

17. Most people experience faintness (not a result of motion) 2 or 3 times a year. During the past year you have felt faint:

more than this _____
the some as this _____
less than this _____
never faint _____

18. How well do you understand your motives and reasons for doing things?

Very well _____
Better than most _____
About average _____
Less than average _____
Not well at all _____

19. If volunteers from your class were requested for a very important flying mission, would you:

a. Not volunteer at all _____
b. Volunteer to lead the mission _____
c. Volunteer and wish to elect a leader _____
d. Volunteer and have the CO designate a flight leader _____

20. Have you ever had an ear illness or injury which was accompanied by dizziness and/or nausea?

21. What can you add that might be beneficial to this study or that would improve this questionnaire?

22. a. Have you ever experienced zero "g"? YES____ NO_____
    b. How many times? _____
    c. Were you restrained? YES____NO_____
    d. Have you ever free floated? YES____ NO_____
    e. Have you ever been motion sick at zero "g"? YES____NO_____
    f. If yes, describe the experience:

23. Almost all pilots have had one or more experiences with vertigo and/or disorientation.

Have you had:		Were they: (you may check more than one)	
Less than five	_____	Mainly in training	_____
Five to ten	_____	In operational jets	_____
More than ten	_____	In operational props	_____
None	_____	Other (Specify)	_____

24. Would you describe one particular incident when you experienced vertigo, which you consider interesting?

NAVSCOLAVNMED 6500/24

SUBJECT'S PRE-EXPERIMENTATION INTERVIEW

Experiment _____
Experimenter _____
Subject _____
Date _____

1. Have you been ill in the past week? Yes____ No____. If yes, specify:
   a) severity, b) time course, c) where localized, etc.

2. I am_____ am not____ in my usual state of fitness.

3. Drugs:

   a. How much alcohol have you consumed during the past 24 hours?
      drinks _____

   b. How many cigarettes in past 3 hours?_____ cigars_____ pipefuls_____

   c. Have you taken any drugs or medications of any kind in the past 24 hours?
      Yes____ No_____ If yes, were they

      1) Sedative or tranquilizer _____
      2) Analgesic (aspirin) _____
      3) Anti-motion sickness remedy (anti-histamine) _____
      4) Other, (Specify) _____

4. How many hours sleep did you have last night?_____ Was this sufficient?_____
   Insufficient? _____

5. How concerned are you regarding your performance on this test?
   None____ Minimal____ Moderate____ Great____ Very great_____

6. Do you expect to perform better_____ less well____ same_____, as average person?

7. Food:

   a. How many hours since your last meal? _____

   b. Approximately how many cups of fluid have you had in the past
      2 hours? _____

ENCLOSURE (1)

NAVSCOLAVNMED 6500/24 A

Examiner's Estimate of Subject's Fitness for Test:

1. Fit: Will use results in study. _____
2. Fit: Will use results only for pilot study. _____
3. Unfit: _____
4. Other (Specify): _____

Purpose of Exposure of Subject:

1. Designated experiment. _____
2. Pilot run. _____
3. Clinical evaluation. _____
4. Other (Specify): _____

EXPERIMENTER'S EVALUATION

Experimenter: _____ _____

Subject: _____

Experiment: _____

Date: _____ Hour: _____

☐ Maximum symptomatology during (entire)_____period of exposure to force environment.

☐ Maximum symptomatology_____after exposure to force environment.

☐ Other_____

_____

A. Does subject appear:

1.	Anxious	No Change_____	_____	_____	_____
2.	Apathetic	No Change_____	_____	_____	_____
3.	Drowsy	No Change_____	_____	_____	_____
4.	Sick	No Change_____	_____	_____	_____

B. Does subject exhibit

1.	Frequent yawning	No_____ Yes_____			
2.	Over-ventilation (Overt)?	No_____ Yes_____			
3.	Respiratory sighing	No_____ Yes_____			
4.	Other respiratory irregularities				
5.	Pallor	None_____	_____	_____	_____
6.	Facial sweating	None_____	_____	_____	_____
7.	Axillary sweating	None_____	_____	_____	_____
*8.	Trunk sweating	None_____	_____	_____	_____
9.	Aerophagia	None_____	_____	_____	_____
10.	Restricted head movements	No_____ Yes_____			
11.	Retching	No_____ Yes_____ No. of times_____			
12.	Vomiting	No_____ Yes_____ No. of times_____			

*Observed with or without clothes.

ENCLOSURE (2)
NAVSCOLAVHMED 6500/24B

C. Does subject report:

1. General discomfort	None_____ Slight_____ Moderate_____ Severe_____
2. Fatigue	None_____ Slight_____ Moderate_____ Severe_____
3. Boredom	None_____ Slight_____ Moderate_____ Severe_____
4. Mental depression	No_____ Yes_____
5. Drowsiness	None_____ Slight_____ Moderate_____ Severe_____
6. Headache	None_____ Slight_____ Moderate_____ Severe_____
7. "Fullness of the Head"	No_____ Yes_____
8. Blurred vision	No_____ Yes_____
9. a. Dizziness with eyes open	No_____ Yes_____
b. Dizziness with eyes closed	No_____ Yes_____ Not tried_____
10. Vertigo	No_____ Yes_____
11. a. Salivation increased	None_____ Slight_____ Moderate_____ Severe_____
b. Salivation usual	Yes_____ No_____
c. Salivation decreased	None_____ Slight_____ Moderate_____ Severe_____
12. Sweating	None_____ Slight_____ Moderate_____ Severe_____
13. Faintness	No_____ Yes_____
14. Aware of breathing	No_____ Yes_____
*15. Stomach awareness	No_____ Yes_____
16. Nausea	None_____ Slight_____ Moderate_____ Severe_____
17. Burping	No_____ Yes_____ No. of times_____
18. Confusion	No_____ Yes_____
19. Loss of appetite	No_____ Yes_____
20. Increased appetite	No_____ Yes_____
21. Desire to move bowels	No_____ Yes_____
22. Other_____	

*Stomach awareness is usually used to indicate a feeling of discomfort which is just short of nausea.

D. Subject did_____ did not_____ complete experimental procedure.

E. Even in L-D subjects the experimental conditions were likely to cause:

anxiety_____, boredom_____, thermal sweating_____,

general discomfort_____, fatigue_____, other_____

ENCLOSURE (2)
NAVSCOLAVNMED 6500/24B

SUBJECT'S EVALUATION

Name _____

Hours _____

Date _____

The experimenter has indicated in the box below the precise period to keep in mind when filling out the questionnaire.

NOT TO BE FILLED BY SUBJECT

☐ Maximum symptoms experienced during (entire)(_____) period of exposure to the force environment.

☐ Maximum symptoms experienced_____ after exposure to the force environment.

☐ Other_____

Experiment _____

1. General discomfort	None____ Slight____ Moderate____ Severe____
2. Fatigue	None____ Slight____ Moderate____ Severe____
3. Boredom	None____ Slight____ Moderate____ Severe____
4. Mental depression	No____ Yes____
5. Drowsiness	None____ Slight____ Moderate____ Severe____
6. Headache	None____ Slight____ Moderate____ Severe____
7. "Fullness of the Head"	No____ Yes____
8. Blurred vision	No____ Yes____
9.a. Dizziness with eyes open	No____ Yes____
b. Dizziness with eyes closed	No____ Yes____ Not tried_____
10. Vertigo	No____ Yes____
11. a. Salivation increased	None____ Slight____ Moderate____ Severe____
b. Salivation usual	Yes____ No____
c. Salivation decreased	None____ Slight____ Moderate____ Severe____
12. Sweating	None____ Slight____ Moderate____ Severe____
13. Faintness	No____ Yes____
14. Aware of breathing	No____ Yes____
*15. Stomach awareness	No____ Yes____
16. Nausea	None____ Slight____ Moderate____ Severe____
17. Burping	No____ Yes____ No. of times_____
18. Loss of appetite	No____ Yes____
19. Increased appetite	No____ Yes____
20. Desire to move bowels	No____ Yes____
21. Vomiting	No____ Yes____ No. of times_____
22. Confusion	No____ Yes____
23. Other	

* Stomach awareness is usually used to indicate a feeling of discomfort which is just short of nausea.

ENCLOSURE (3)

NAVSCOLAVNMED 6500/24C

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)
U. S. Naval School of Aviation Medicine
U. S. Naval Aviation Medical Center
Pensacola, Florida

2a REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

2b GROUP

3 REPORT TITLE
The Dial Test: A Standardized Procedure for the Experimental Production of Canal Sickness Symptomatology in a Rotating Environment.

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

5 AUTHOR(S) (Last name, first name, initial)
Kennedy, Robert S. and Graybiel, Ashton

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b NO OF REFS
10 June 1965	25	26

8a CONTRACT OR GRANT NO.

b. PROJECT NO. MR005.13-6001 Subtask 1

c.

d.

9a ORIGINATOR'S REPORT NUMBER(S)
NSAM - 930

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
113

10 AVAILABILITY/LIMITATION NOTICES Qualified requesters may obtain copies of this report from DDC. Available, for sale to the public, from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia, 22151.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

13. ABSTRACT

Part 1 describes a developmental study to identify an optimum Dial Test procedure and the results of using the procedure on three groups with differing aviation experience. The problem was to determine that combination of rotational velocity of a Slow Rotation Room, time between dial settings, and number of sequences to be performed which would yield the best measure of susceptibility to motion sickness. Parts 2 and 3 report the correlations between Dial Test scores and the Modified Romberg and the Coriolis Illusion, and with scores from a Motion Sickness Questionnaire. Modified Romberg scores had a small but significant relationship with Dial Test scores for the "incoming flight student" group, and this relationship was almost significant for the "proficiency billet aviator" group. Coriolis Illusion scores were not significantly related to Dial Test scores but were in the predicted direction. Statistically significant relationships were obtained between Dial Test score and scores from two keys to the Motion Sickness Questionnaire; these need cross-validation, however.

DD FORM 1 JAN 64 1473

Unclassified

Security Classification

Unclassified
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Test for motion sickness						
Motion Sickness Questionnaire						
Test of postural equilibrium						
Perception of Coriolis illusion						
Semicircular canals						
Aviation personnel						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers *(either by the originator or by the sponsor)*, also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS), (S), (C), or (U)*.

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, roles, and weights is optional.

Unclassified
Security Classification