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Contents

Summary

Finding an effective treatment for the motion sickness-like symptoms that occur in space has become a high priority for NASA. This paper reviews the background research and presents the experimental design of a formal life sciences shuttle flight experiment designed to prevent space motion sickness in shuttle crewmembers. This experiment utilizes a behavioral medicine approach to solving this problem. This method, Autogenic-Feedback Training (AFT), involves training subjects to voluntarily control several of their own physiological responses to environmental stressors. AFT has been used reliably to increase tolerance to motion sickness during ground-based tests in over 200 men and women under a variety of conditions that induce motion sickness, and preliminary evidence from space suggests that AFT may be an effective treatment for space motion sickness as well. Proposed changes to this experiment for future manifests are included.

The Problem of Space Motion Sickness

Space motion sickness, a disorder which produces symptoms similar to those of motion sickness on Earth, has affected approximately 50% of all astronauts and cosmonauts exposed to microgravity in space. It differs from what is commonly known as motion sickness in a number of critical ways, and there is currently no ground-based method for predicting susceptibility to motion sickness in space. Antimotion sickness drugs have had limited success in preventing or counteracting symptoms in space, and frequently caused debilitating side effects.

Data from past space missions indicate that some individuals who have had wide exposure to motion devices and acceleratory forces on Earth or in aircraft, and who have never previously shown any tendency to develop motion sickness symptoms, were severely debilitated in the microgravity environment (ref. 1). Conversely, some individuals who had a history of susceptibility to motion sickness on Earth were unaffected by symptoms in space. Symptom episodes vary from mild discomfort to repeated vomiting, which sometimes occurs suddenly and with little or no warning. The earliest reported episode began within only 7 minutes of orbital insertion, and malaise has been reported to last from 1 to 5 days. Finding a solution to this biomedical problem has become a high priority goal of NASA because of its potential impact on crew safety, comfort and operational efficiency during Shuttle missions.

Most research in this field has been devoted to the study of vestibular physiology, perceptual phenomena, or pharmacological intervention in man and in animals (ref. 2). In contrast, the primary objective of our own research group has been to develop a method of training people to control their own motion sickness symptoms (refs. 3–12). Our method of treatment is Autogenic-Feedback Training (AFT), a combination of biofeedback and Autogenic Therapy (ref. 13), which involves training physiological self-regulation as an alternative to pharmacological management. The rationale for using AFT to treat motion sickness was based on the observation that there were profound autonomic nervous system (ANS) changes associated with this disorder (ref. 8) and, although these responses are highly idiosyncratic, they are repeatable over time (ref. 10). By studying physiological and behavioral indicators of human adaptation to the microgravity environment, we hoped to use this behavioral medicine training technique to facilitate adaptation.

Objectives

1. To evaluate the effectiveness of Autogenic-Feedback Training as a countermeasure for space motion sickness.

2. To compare physiological data and inflight symptom reports to ground-based motion sickness data.

3. To predict susceptibility to space motion sickness based on preflight data of each treatment group crewmember.

Ground Studies

Physiological Responses to Motion Sickness Stimuli

The relative importance of ANS responses in understanding and treating motion sickness has been a matter of some controversy. Money (ref. 14), in his review of motion sickness research, discussed many possible ANS changes during motion sickness, but correctly noted that there was little consistency in either procedures used or results of the available research.

In a recent paper (ref. 8), we examined the data of 127 people, all given the same motion sickness test in order to describe the general trend of ANS responses in all subjects. Our own laboratory work suggested that differences in initial susceptibility may account for at least one major source of variability in ANS responding reported by others. We, therefore, also investigated whether high-, moderate-, and low-susceptible individuals differed in their ANS responding to motion stimulation. Finally, we examined autonomic responses as predictors of motion sickness susceptibility. We used the ANS variables of heart rate, respiration rate, finger pulse

volume, and skin resistance because they were easily measured, represent different aspects of the ANS, and have been used in previous studies on motion sickness.

Our results clearly showed sympathetic-like activation of all four ANS responses during motion sickness stimulation. These included significant changes in heart rate acceleration, peripheral vasoconstriction, and increases in skin conductance (the latter response being enervated exclusively by the sympathetic nervous system). Physiological response levels changed rapidly and dramatically at the onset of stimulation and when the test concluded. We also found differences in ANS responding among motion sickness susceptibility groups, with highly susceptible subjects producing, in general, larger magnitude changes than the moderate or low susceptible subjects.

In another study, comparisons were made of two separate motion sickness tests on each of 58 subjects (ref. 10). Again, the same four physiological responses (heart rate, finger pulse volume, respiration rate, and skin resistance) were measured during both motion tests. The goal of this study was to examine individual differences in physiological responding (i.e., response *patterns*) to motion stimuli and determine how these data were related to self-reports of motion sickness malaise experienced. The phenomenon of *individual ANS stereotypy*, that propensity of individuals to respond maximally in the same ANS variable to a variety of different stimuli, is well known in the psychophysiological literature (refs. 15–18). In the presence of any stimulus (for example, a loud noise), all subjects might show a rise in heart rate, but some individuals will make a much larger response than others. Data transformation such as z-scoring, or covariance analyses, allow comparisons of response magnitude across different physiological variables. Hence, for any given individual, the heart rate response may be of greater magnitude than his or her skin resistance level or other measured responses.

The results revealed 11 separate patterns (i.e., response magnitude hierarchies), of physiological responding in which all or some combination of the four physiological measures clearly reflected motion sickness malaise levels of each of the 58 subjects. Individual response patterns produced on the first tests were not significantly different than those of the second test. Analyses showed that of the 58 subjects, 27 showed the same response patterns on both tests for all four physiological measures, 14 were stable for three variables, 6 were stable for two variables, and 11 were stable responders for at least one variable.

General Procedures of Training

Because certain ANS responses were correlated with, and indeed predictors of (i.e., consistently preceded), reports of motion sickness distress, it was hypothesized that training subjects to control these responses might prevent or reduce symptoms. The observed individual differences in responding suggested that, to be effective, such training would have to be directed at the different responses for different people. In other words, training would have to be "tailored" for each individual. The training procedure we used, AFT, was based on the principles of operant conditioning.

Operant conditioning may be succinctly described as a trial-and-error process in which the response learned and performed must be followed by either a reward or a punishment (i.e., contingent reinforcement). When a novice is learning better voluntary control over where the basketball goes in shooting fouls, seeing the ball go through the hoop (success) serves as a reward and seeing it miss (failure) serves as a punishment. If the novice were blindfolded so that he did not have any knowledge of the results of his shots, he would not learn (i.e., improve his accuracy). It was Miller's contention (ref. 19), that visceral and CNS events may be modified by contingent reinforcement in the same way overt behaviors or skeletal responses may be conditioned. Hence, the "same rules" apply for describing the process by which athletic skills are acquired, as in the situation where an individual learns voluntary control of his own heart rate or the vasomotor activity of his hands. To learn control of a physiological response, the subject must be given a means of perceiving that response. The "blindfold" is removed by showing a subject (for example) an amplified display of his own heart rate on a digital panel meter. This process is called biofeedback.

AFT is actually a combined application of several physiological and perceptual training techniques, principal among these are Autogenic Therapy (ref. 13) and biofeedback. This combined-therapies approach produces a methodology which is appreciably more effective than either of these two techniques when used alone (refs. 3 and 6). Autogenic exercises provide the subject with a specific set of instructions and method of concentration which are likely to produce the desired response. For example, self-suggestions of warmth in the hands and feet are associated with measurable increases in peripheral vasodilatation (ref. 20). Consequently, the time normally spent by the subject using a trial-and-error strategy is shortened, and the initial probability of making a correct response is substantially increased. Biofeedback complements Autogenic Therapy by providing immediate sensory information to the subject about the magnitude

and direction of a response. Operant conditioning procedures allow for more precise control of a response, as the "reward" (or feedback) can be presented only as the subject makes gradually larger response changes in the desired direction. As a result, the ultimate effectiveness of training is significantly increased (refs. 3–9).

During a typical training session, subjects are instructed to control a pattern of physiological responses and are given many different feedback displays (visual and auditory) simultaneously. Multiparameter feedback requires additional training in attending to a complex set of feedback signals. Verbal instructions by the experimenter are often required to direct the subject's attention to specific feedback signals and to advise him of alternative strategies when an inappropriate response has occurred. Included in these alternative strategies are elements of systematic desensitization and progressive relaxation of muscle tension monitored at several sites.

The protocol for all of our ground-based studies was essentially the same. First, a rotating chair test was used to induce the initial symptoms of motion sickness. In this way, we could document the pattern of physiological responses to motion stimulation for each individual. The rotating chair tests were conducted by initiating rotation at 6 rpm (0.628 rad/s) and incrementing by 2 rpm (0.209 rad/s) every 5 minutes, with a maximum velocity of 30 rpm (3.142 rad/s). During each 5-minute period of rotation, subjects made head movements (front, back, left, and right) in random order at 2-second intervals until motion sickness symptoms were induced.

A second type of motion sickness test combined the rotating chair with optokinetic stimulation (a rotating drum surrounding the chair). The drum was painted with alternating black and white vertical stripes which were 7 inches (17.8 cm) wide, subtended to a visual angle of 7°. The rotation of the drum was controlled independently of the chair. These tests were conducted by initiating chair rotation at 1 rpm and rotation of the drum at 2 rpm in the same direction (counterclockwise). At 5-minute intervals, if the subject indicated he could continue (following a symptom report), the speed of the chair was increased by 1-rpm increments while the speed of the drum was increased by 2-rpm increments. The speed of the drum was always twice that of the rotating chair. The subject's perception of the combined stimulus was rotation in a clockwise direction (the opposite of actual chair rotation). As in the rotating chair tests, subjects made head movements in four quadrants at 2-second intervals. The maximum duration of this test was 25 minutes.

Vertical acceleration tests were yet another method for inducing the initial symptoms of motion sickness in test participants. These tests were conducted on the VARD (Vertical Acceleration and Roll Device) located at Ames Research Center. The VARD is a light-proof enclosed cab which can achieve a maximum vertical displacement of ±6 feet (±1.829 meters). The frequency and g-load are programmable. VARD tests were conducted by initiating vertical motions at 0.33 Hz, 0.35 g. Again, subjects were instructed to make head movements in four quadrants at 2-second intervals and diagnostic scores were obtained from subjects at 5-minute intervals. VARD tests were terminated after 75 minutes or when the subjects reached their malaise endpoints.

Every 5 minutes during the test, subjects were asked to report symptoms that they were experiencing using a standardized diagnostic scoring procedure (refs. 8 and 21) so that we could accurately assess the relationship between perceived distress and physiological responses at any given time. Table 1 is a outline of the diagnostic scale used. An array of possible symptoms are represented, including epigastric awareness (EA), headache (HAC), and sweating (SWT). The presence or absence and/or strength of most symptoms are assessed subjectively by the subject (mild "I," moderate "II," or severe "III"). Nausea is evaluated on five levels; epigastric awareness, epigastric discomfort, and nausea which is reported as either mild (I), moderate (II), or severe (III). And of course, frank vomiting (VMT) is indicated as either present (I) or absent (no entry).

Initial exposure to the rotating chair was followed by two (or four) resting baseline sessions and a second rotating chair test. This procedure enabled us to clearly identify which ANS responses changed from the subject's own resting baseline as a function of motion sickness stimulation. During subsequent AFT sessions, emphasis was placed on training control of those ANS variables that were most responsive in the individual's motion sickness tests. AFT was administered in three sets of four 30-minute sessions (maximum 6 hours) under nonrotating conditions. Each AFT set was followed by a rotating chair test in which the subject attempted to apply AFT to control symptoms. The primary criterion for evaluating treatment success was increased tolerance (i.e., ride for longer duration at higher speeds) to this motion sickness stimulus.

Table 1. Motion sickness diagnostic scale

Malaise level	Points	VMT	TMP	DIZ	HAC	DRZ	SWT	PAL	SAL	NSA	ED	EA
Pathognomic	16	I										
Major	8					III	III	III	III	II,III		
Minor	4					II	II	II	II	I		
Minimal	2					I	I	I	I		I	
AQS	1		I,II	I,II	I							I

VMT = vomiting, TMP = increased warmth, DIZ = dizziness, HAC = headache, DRZ = drowsiness, SWT = sweating, PAL = pallor, NSA = nausea, ED = epigastric discomfort, EA = epigastric awareness, AQS = Also qualifying symp.

Results of Ground-Based Research

In preparation for tests of AFT in space, we conducted investigations on over 200 people. Each study was designed to test the effectiveness of AFT as a countermeasure for motion sickness and the feasibility of using AFT to prevent or reduce the severity of space motion sickness symptoms in aerospace crews. Another important objective was to determine if the reduction in symptoms observed could be attributed to some experimental factor other than AFT.

In one study, differences in motion sickness tolerance were compared in subjects given AFT, an alternative cognitive task, or no treatment (ref. 12). Two hours of AFT were administered to treatment group subjects before the third, fourth, and fifth motion sickness tests (6 hours total). Figure 1 shows the performance of all three groups in the motion sickness tests. Results showed that subjects who received AFT had significantly greater motion sickness tolerance than subjects performing an alternative cognitive task ($p \leq 0.025$) or those performing no task ($p \leq 0.025$). Although the cognitive task group had slightly greater mean tolerance than the no-task control group, the differences were not statistically significant.

Another experiment was designed to determine if an individual's initial susceptibility to motion sickness was related to his ability to learn to control his own symptoms (ref. 7). Following an initial exposure to a rotating chair test, subjects were assigned to groups based on their motion sickness tolerance. Two AFT treatment groups (highly and moderately susceptible to motion sickness) were compared to two control groups who were matched to the AFT groups for initial susceptibility, but were given no treatment. Figure 2 shows the performance of these groups across six motion sickness tests. Statistical analyses showed that both AFT treatment groups significantly improved their motion sickness tolerance while neither control group improved significantly. During the last two tests, after 6 hours of AFT, the high and moderate susceptible treatment groups were no longer significantly different in their motion sickness tolerance, while the high and moderate control groups remained significantly different across all tests.

The results of other studies showed (1) the ability to apply AFT to control symptoms was statistically the same for men and women (ref. 4), (2) the ability to control symptoms could be retained for as long as 3 years after training (ref. 4), and (3) after extensive examination of potential intervening variables under controlled experimental conditions, it was concluded that the primary component of the treatment effect in each of these studies could most probably be attributed to learned control of physiological responses (ref. 4). This conclusion was further substantiated by the observation that subjects who increased their tolerance to motion sickness inducing tests consistently showed a statistically significant reduction in the magnitude of changes in autonomic responses after training than before (ref. 11).

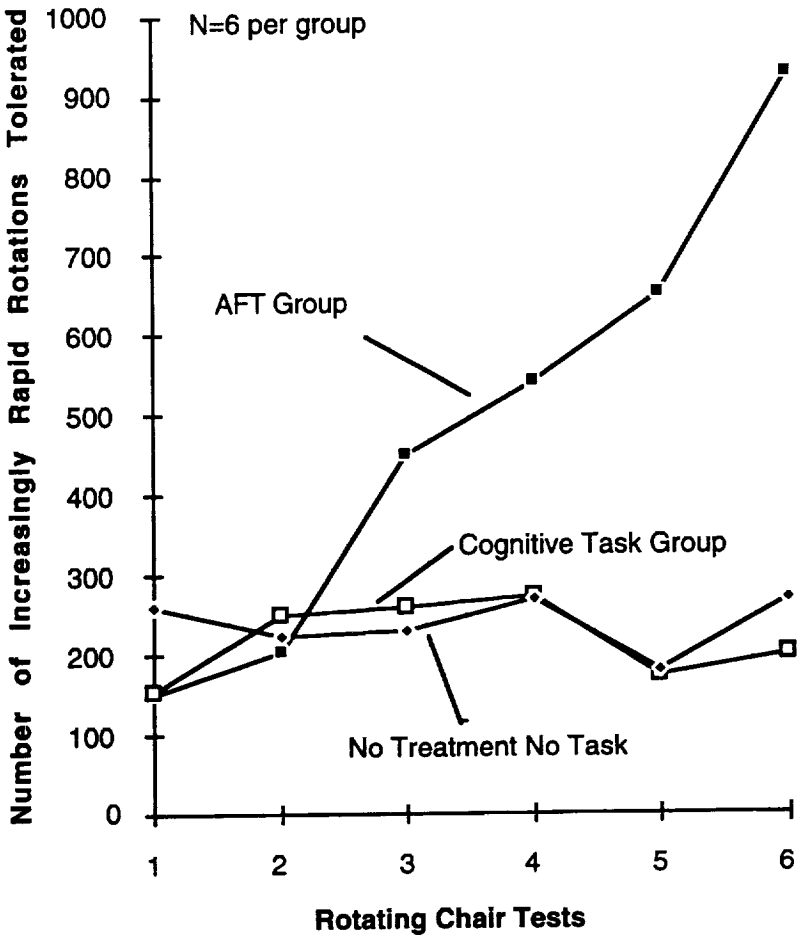


Figure 1. Effects of AFT treatment compared with those of a distracting cognitive task and no treatment.

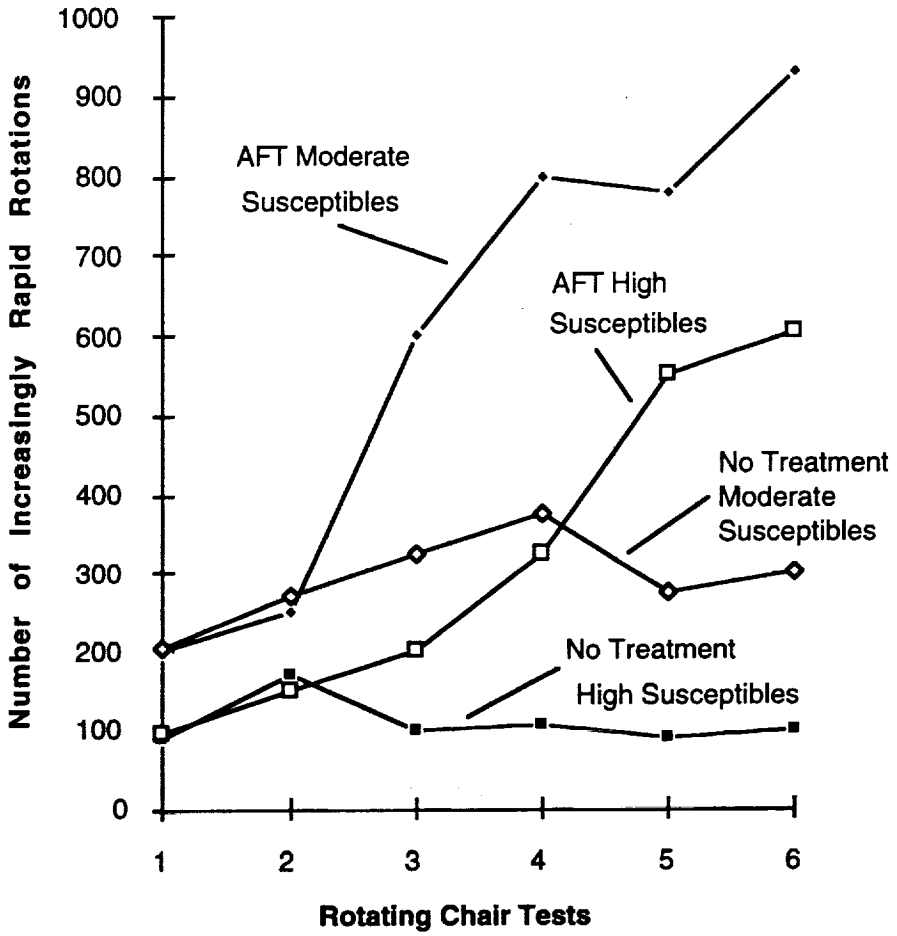
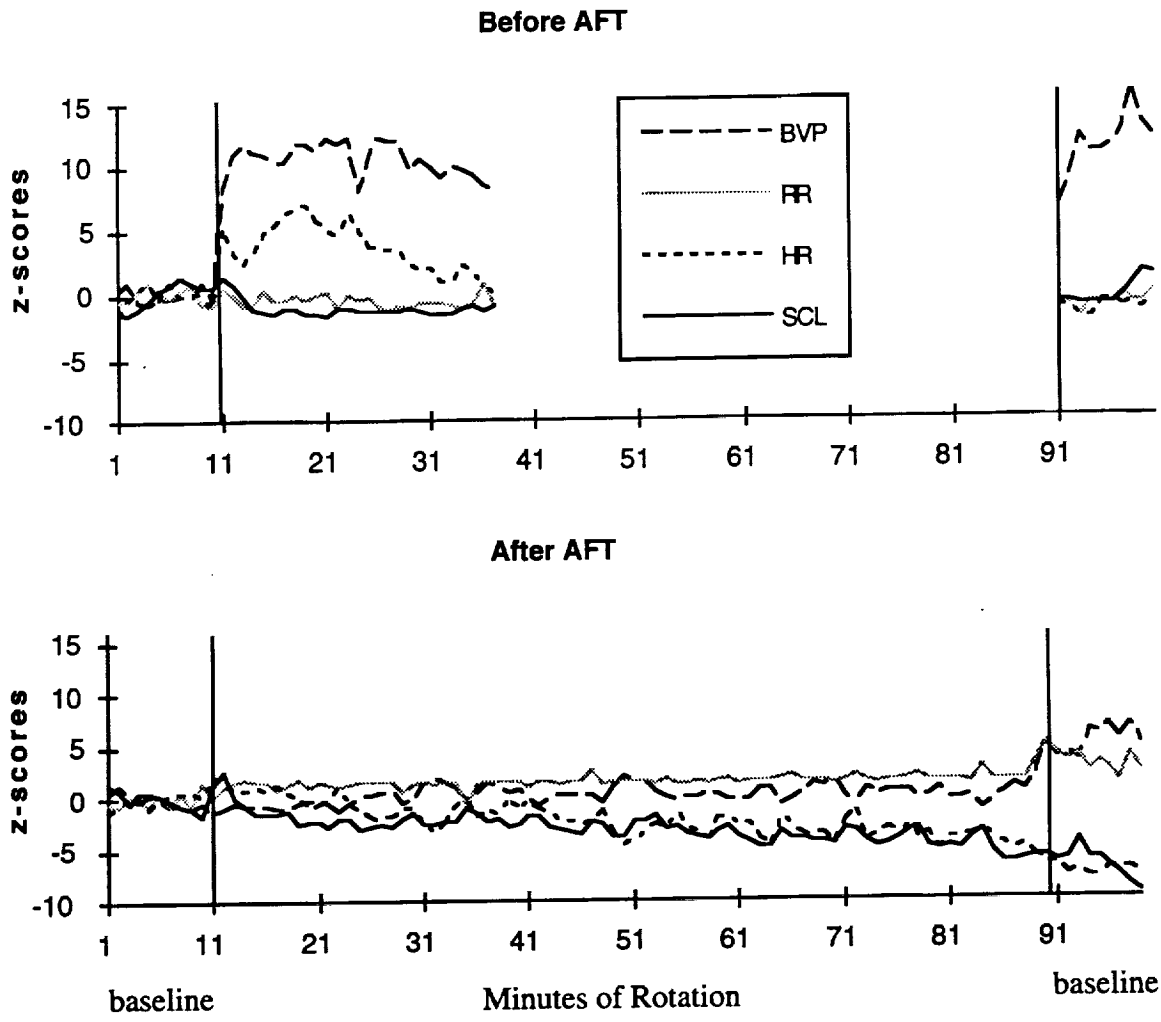


Figure 2. Effects of AFT treatment for highly and moderately motion sickness susceptible subjects compared with matched controls given no treatment.

Figure 3 depicts the autonomic response profiles of a typical subject generated before and after AFT (ref. 11). These data were transformed (z-scored) on the subject's own averaged response levels during resting baseline conditions (i.e., prior to stimulation). A mean and standard deviation were calculated for each physiological response during (in this example) the 10 minutes prior to rotation. The z-scores generated represent the number of standard deviations each response varied from his own baseline (mean z-score = 0) during subsequent minutes of rotation. Immediately after the start of rotation in the test administered before AFT, these physiological levels can be seen to diverge from baseline (e.g., heart rate accelerations, increased blood flow to hands), and the subject terminated the test at 40 minutes. After AFT, however, the subject was able to maintain all physiological levels at or near his own baseline and could tolerate rotation at higher velocities for a longer period of time (i.e., subject terminated test after 91 minutes).

Transfer of Training Effects to Different Motion Environments

Experiments in the literature (ref. 2), and clinical experience show that habituation to a specific nauseogenic situation does not transfer to new situations. Repeated exposure apparently affects primarily the sensory side (or "input" side) of the response system. AFT is aimed at controlling the "output" side (i.e., the various symptoms of motion sickness). To the extent that such control can be learned, we would expect it to be much more likely to transfer to different situations that induce nausea. A demonstration of the transfer of training to different types of vestibular stimuli on Earth, would



BVP = finger pulse volume; RR = respiration rate, HR = heart rate, SCL =s kin conductance level.

Figure 3. Z-scores of physiological data during rotating chair tests administered before and after AFT.

indicate an increased likelihood that AFT would also transfer to the unique conditions of microgravity.

An extensive examination of transfer of training was made in another study, which involved several different types of stimuli that induce motion sickness. Twenty-four men and women were assigned to two equal groups, matched for sex and initial susceptibility to motion sickness in a rotating chair. The two groups of subjects, an AFT treatment group and a no-treatment control group, were given three types of motion sickness inducing tests at the start of the study: (1) rotating chair test, (2) the combination of optokinetic stimulation with rotation in a chair, and (3) a vertical acceleration test (VARD). Treatment subjects were then given 6 hours of AFT over 5 days, while the controls received no training. Both groups of subjects were given their second exposure to the battery of different types of motion sickness tests at the end of the experiment. Figure 4 shows the performance of both groups during all three motion sickness tests before and after AFT (pretest vs. post-test). Because these tests had different maximum durations, scores for motion sickness tolerance were based on group averaged percentages of the total test completed.

Results showed that subjects given AFT significantly improved their tolerance to the different types of motion sickness tests, whereas the control subjects (habituation only) did not. Furthermore, the Air Force had adopted a similar form of AFT to treat crewmembers for whom other methods had proved unsuccessful in combating persistent air sickness in high performance military planes

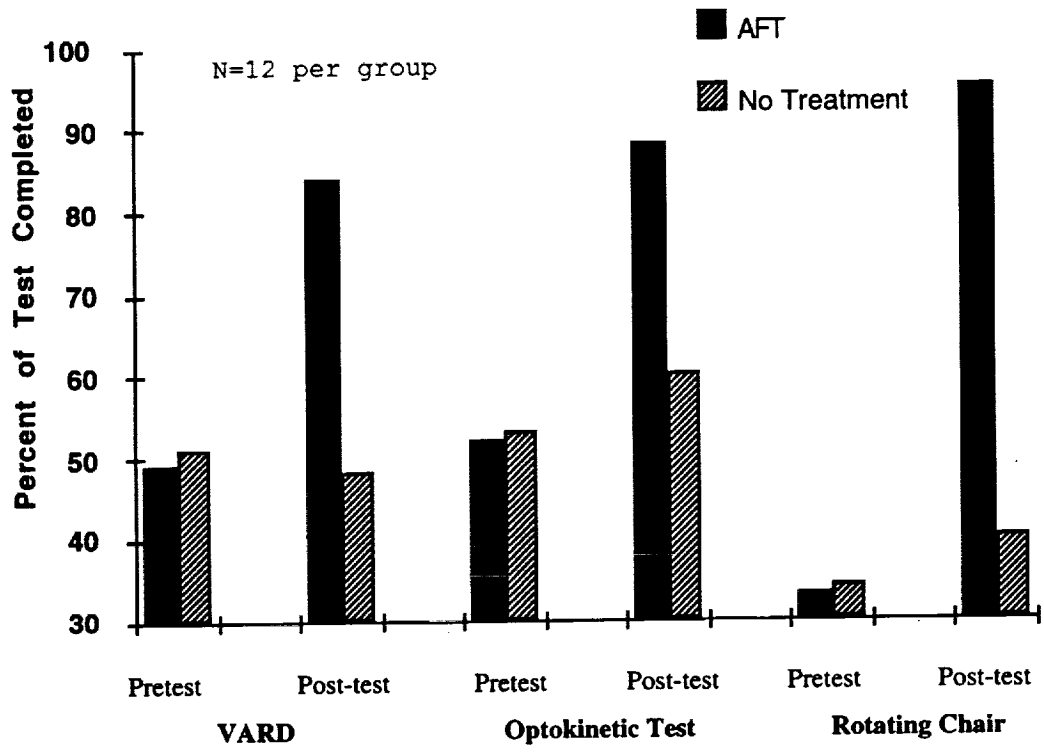


Figure 4. Group comparison of tolerance to three types of motion sickness tests before and after AFT.

(refs. 22 and 23). They have found that such training transfers from the rotating chair on the ground to the variety of maneuvers in military flight well enough to return air crew that otherwise would have been permanently grounded to active flying duty. These results on transfer of control over response symptoms to different types of stimuli eliciting nausea led us to be hopeful of transfer to the stimuli eliciting symptoms in space.

Flight Experiment Design

This section reflects the basic experiment design of the AFT investigation as it would be flown, as initially proposed, on multiple missions. Specific references are made here to our most recent flight on the Spacelab-J mission, as it reflects the most current procedures.

Preflight Training

One year prior to the flight, the SL-J crewmembers began their participation in AFTE. One mission specialist received 6 hours of AFT for the control of motion sickness and a second mission specialist served as a control (i.e., received no training). In addition, the alternate crewmembers and the Japanese Payload Specialist were provided with this training.

Baseline data collection– Physiological data were obtained from all subjects during two types of motion sickness tests: a rotating chair and a vertical accelerator. Additionally, data were recorded during two resting baseline (30-minute) sessions and two 12-hour ambulatory sessions during a mission simulation; during zero-g maneuvers in the KC-135 aircraft; and during a 90-minute reclining baseline in the launch position in a shuttle mockup.

Formal AFT sessions– The design of training is much the same as the ground-based studies described above. Twelve 30-minute sessions were administered (at the P.I.'s laboratory) over a 15-day period, with each block (four consecutive days) of training followed by a motion sickness rotating chair test. The principal criterion for evaluating the success of the AFT treatment was the increased time that crewmembers could tolerate these tests as training progressed. For the SL-J mission, launched in September 1992, the actual launch date slipped more than 12 months. As a result, all of the treatment crewmembers received an additional 6 hours (a total of 12 hours) of AFT.

Follow-up AFT sessions– During the period of 6 months to 1 month prior to launch, AFT training continued in the form of followup sessions at Johnson Space Center (JSC)

and Marshall Spaceflight Center (MSFC). Flight hardware (fig. 5) was used to monitor and feedback physiological measures during training for a total of eight (30-minute) sessions.

L-10 day session– This 2-hour session was the last time investigators contacted crewmembers prior to the mission. It allowed us to document the amount of physiological control retained by the treatment subjects and any differences (from previous sessions) in baseline levels of these subjects or the control subjects.

Inflight Procedures and Flight Hardware

Continuous daytime monitoring– During the mission, the physiological responses of both the treatment and control subjects were monitored and recorded for the first three mission days (waking hours only) using the Autogenic-Feedback System-2 (AFS-2). The AFS-2 is a portable belt-worn physiological monitoring system (fig. 5). Developed by NASA in support of spaceflight experiments, this system can continuously record up to eight physiological responses. This system includes a garment, transducers, biomedical amplifiers, a digital wrist-worn feedback display, and a cassette tape recorder. The entire instrument is powered by a self-contained battery pack. The AFS-2 can record and display electrocardiogram/heart rate, respiration waveform/ respiration rate, skin conductance level, finger temperature, finger pulse volume, and triaxial accelerations of the head.

Timelined and symptom-contingent diagnostic– An 11-item symptom log book (fig. 6) was used by crewmembers to note the type and severity of symptoms. This diagnostic scale was identical to that used in preflight motion sickness testing (refs. 8 and 21). Each page of this log book provided space for the crewmembers to write their identification numbers (assigned preflight) and Greenwich Meridian Time (GMT). Crewmembers were instructed to fill out this form at predesignated times during the mission (i.e., Time-Line) immediately after awakening in the morning and before retiring at night. Reports were also to be made anytime during a mission day that the crewmember experienced symptoms (i.e., symptom contingent—SYMP CONT). The appropriate box is checked by crewmembers. The list of abbreviated symptoms shows the level (i.e., I, II, or III) that can be reported in the blank boxes below.Space is also provided for any additional written comments the crewmember

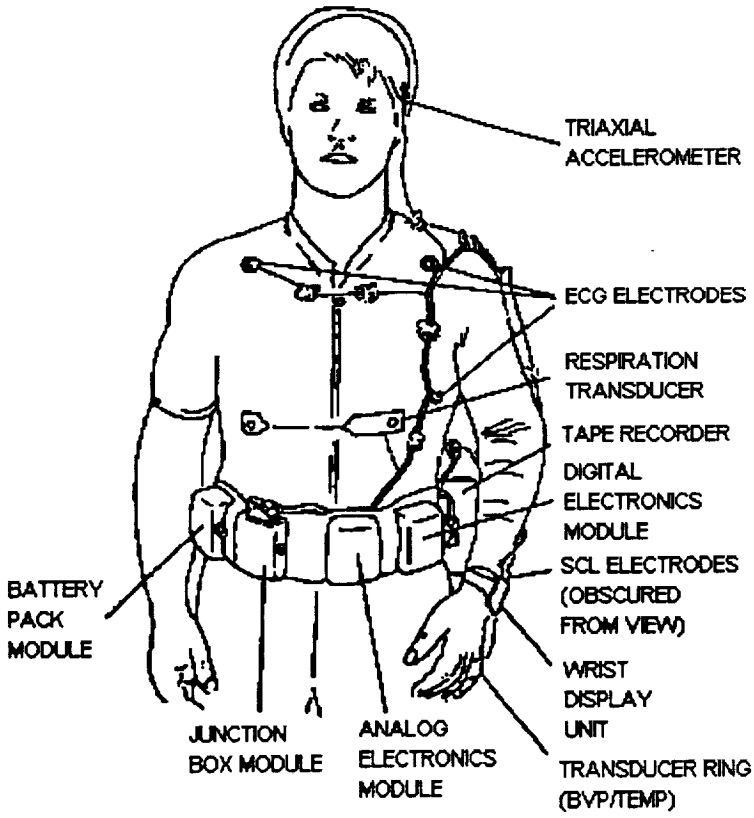


Figure 5. The Autogenic-Feedback System-2 (AFS-2). An ambulatory monitoring system as worn by crewmembers.

SUBJECT'S ID#_____ PRE AFT____ POST AFT____

TIME (GMT)_____

TIME	SYMP			SYMPTOMS OBSERVED								
LINE	CONT	VMT	TMP	DIZ	HAC	DRZ	SWT	PAL	SAL	NSA	ED	EA
		I	I,II	I,II	I	I,II,III	I,II,III	I,II,III	I,II,III	I,II,III	I	I

COMMENTS: _____

Figure 6. Illustration of the diagnostic log book.

chose to make in either describing symptoms or evaluating the effectiveness of the AFT treatment. Treatment group subjects could further indicate on this page of the log book if symptoms were experienced before or after performing AFT (i.e., PRE AFT, POST AFT).

Timelined and symptom-contingent AFT sessions– The treatment subject (only) was required to perform daily 15-minute AFT sessions during which control of specific physiological responses was practiced with the aid of the wrist-worn display unit. If that crewmember were to experience symptoms in space, he or she was required to apply the AFT methods learned. Symptom-contingent AFTs were to be performed at the same time that a crewmember conducted other payload activities. It was anticipated that no more than 30 minutes would be required to counteract symptoms.

Postflight Procedures

On the day of landing, AFT investigators participated in a brief (10-minute) interview with the crewmembers on their experiences with the AFT experiment. Flight hardware, data tapes, and diagnostic log books were returned to the P.I. laboratory within 24 hours of touchdown. These data are processed and used within 2 weeks postflight during a 2-hour private debriefing with each of the crewmembers where the final evaluation of AFT effectiveness during the Spacelab-J mission was determined.

Conclusions

Finding an effective treatment for the motion sickness-like symptoms that occur in space has become a high priority for NASA. This experiment utilizes a behavioral medicine approach to solving this problem. This method, Autogenic-Feedback Training (AFT), involves training subjects to voluntarily control several of their own physiological responses to environmental stressors. AFT has been used to reliably increase tolerance to motion sickness during ground-based tests in over 200 men and women under a variety of motion sickness conditions. Such general success would be expected because the effects of AFT are on the final common response mechanism rather than on initiating stimuli. Thus, we might expect AFT to be effective for space sickness, and our preliminary data suggest that it is.

Further validation of the effectiveness of AFT as a treatment for space motion sickness will require obtaining data on a total of 16 individuals in space, 8 treatment and 8 control subjects. With the completion of Spacelab-J, this procedure will have been tested on six people. Future manifests are planned to obtain the necessary data for evaluating this treatment. Because of the success of the AFS-2 hardware used for ambulatory monitoring, the investigators have recommended two significant changes in the present experimental design which may be incorporated in subsequent flights. First, the ground-based motion sickness inducing tests (VARD and rotating chair) will be eliminated. In their place, physiological data can be obtained during aerobatics maneuvers in high performance aircraft (e.g., T-38) or during zero-g maneuvers in the KC-135 aircraft. Lastly, work is under way to incorporate the AFT methods within an expert system, enabling training of crewmembers at any location, and with greater flexibility of scheduling.

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13. ABSTRACT ***(Maximum 200 words)***

Finding an effective treatment for the motion sickness-like symptoms that occur in space has become a high priority for NASA. This paper reviews the background research and presents the experimental design of a formal life sciences shuttle flight experiment designed to prevent space motion sickness in shuttle crew-members. This experiment utilizes a behavioral medicine approach to solving this problem. This method, Autogenic-Feedback Training (AFT), involves training subjects to voluntarily control several of their own physiological responses to environmental stressors. AFT has been used reliably to increase tolerance to motion sickness during ground-based tests in over 200 men and women under a variety of conditions that induce motion sickness, and preliminary evidence from space suggests that AFT may be an effective treat-ment for space motion sickness as well. Proposed changes to this experiment for future manifests are included.

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