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AUTOGENIC-FEEDBACK TRAINING: A PREVENTIVE METHOD FOR SPACE ADAPTATION SYNDROME

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This is a report on the progress made to date on the reduction of data for Spacelab 3 Shuttle experiment, No. 3AFT23. Four astronauts participated as subjects in this experiment. Crewmen A and B served as treatment subjects (i.e., received preflight training for control of their own motion sickness symptoms) and Crewmen C and D served as controls (i.e., did not receive training). A preliminary evaluation of Autogenic Feedback Training (AFT) was made from visual inspections of graphs that were generated from the preflight and inflight physiological data which included:

a) Baseline rotating chair tests for all crewmen.

b) Posttraining rotating chair tests of treatment groups subjects.

c) Preflight data from Joint Integrated Simulations for all crewmen.

d) Flight data for all crewmen during mission days 0 through 4, and mission day 6 for treatment subjects only.

Skin temperature and acceleration data collected during the JIS and the SL-3 mission have not yet been reduced and will be included in a later report.

A summary of the findings suggested by these data is outlined below: The preflight training schedule given to treatment group subjects was, on average, 90 days longer than planned because of delays in the launch date. This change in the schedule and its effect on training performance was discussed in two earlier reports (SL-3 Flight Readiness Review, dated April 25, 1985 and the SL-3 30-day Report, dated June 12, 1985). The investigators have concluded that the generally poorer performance of crewmembers in this study was primarily due to the change in the schedule, although motivation may have been a secondary factor. The data of crewmen A and B was compared to the data of 40 test subjects who were given AFT using a more optimal schedule in the laboratory. The increase in the number of rotations tolerated from the pre- to post-training rotating chair tests was computed for all subjects and their scores were ranked from the largest to smallest increase. Crewman A shows an increase of 398 rotations and his score among the sample of 42 subjects was about average, at the 54th percentile. Crewman B, however, showed much less improvement in motion sickness tolerance after training, with an increase of only 102 rotations. His score among the larger sample of subjects was at the 18th percentile.

Each crewman's initial susceptibility to motion sickness (i.e., number of rotations tolerated before reaching severe malaise), was recorded during their baseline rotating chair test. The physiological responses of treatment subjects which changed the most during motion sickness stimulation from their resting baseline levels were selected as training measures for subsequent AFT sessions.

Both Crewmen A and B were each given 12 preflight AFT sessions without rotation in which they were taught to increase and decrease, on alternate trials, their heart rte (HR), skin conductance (SC), and finger pulse volume (FPV) with the aid of visual and auditory feedback (Fig. 1). These subjects were also instructed to use the feedback from the three different responses to change a pattern (i.e., HR and SC up, FPV down or HR and SC down, FPV up) without changing respiration rate or muscle activity. An example of physiological data from one training session is included in this report.

The physiological data of Crewman A collected during his pretraining rotating chair test was compared to the data from his posttraining rotating chair test (Fig. 2). A visual inspection of the data for this subject showed a reductio in sympathetic tone (i.e., decreased stress) for all three physiological responses in his posttraining test. Further, while this crewman maintained lower physiological levels, he was able to tolerate much higher rotational velocities than during his pretraining test. When the pre- and post-training rotating chair tests of Crewman B were compared there was some reduction in heart rate, while skin conductance and finger pulse volume showed more of a stress response, and only a moderate increase in motion sickness tolerance was observed after training.

On the basis of their preflight training and motion sickness test data, the investigators predicted (documented in the SL-3 Flight Readiness Review, dated April 25, 1985) that Crewman A (Fig. 3) would have a higher probability of success at preventing or controlling his symptoms in space than Crewman B (Fig. 4).

The inflight symptom reports revealed that crewman A did not experience any severe symptom episodes during the mission, while Crewman B reported one severe symptom episode. Both control group subjects, C and D (who took anti-motion sickness medication), reported multiple symptom episodes on mission day 0. When the inflight physiological data of Crewman A was compared to that of the other crewmen participating in this study, he showed reduced sympathetic tone for all physiological variables measured (Fig. 5).

The following recommendations were made by the investigators for future flights: First, use a more optimal preflight training schedule for treatment subjects that would begin at 10 months to one year prior to launch with "follow-up" AFT sessions at launch-3 months. Second, reduce inflight requirements for physiological monitoring to the first three mission days only. Third, modify flight hardware to facilitate crew mobility and comfort.

The preliminary results from this Spacelab-3 experiment are encouraging. The measurements and inflight procedures used should eventually enable the investigators to evaluate the efficacy of AFT as a countermeasure for SAS, and to objectively document human psychophysiological responses to the microgravity environment. However, it is clear that additional data must be obtained inflight (i.e., 8 treatment group subjects and 8 controls) before these goals can be achieved.

Acknowledgment. The science team expresses their appreciation to Mr. Jen-Lin Chen, University of California, San Francisco, for his programming support for data reduction and graphics.

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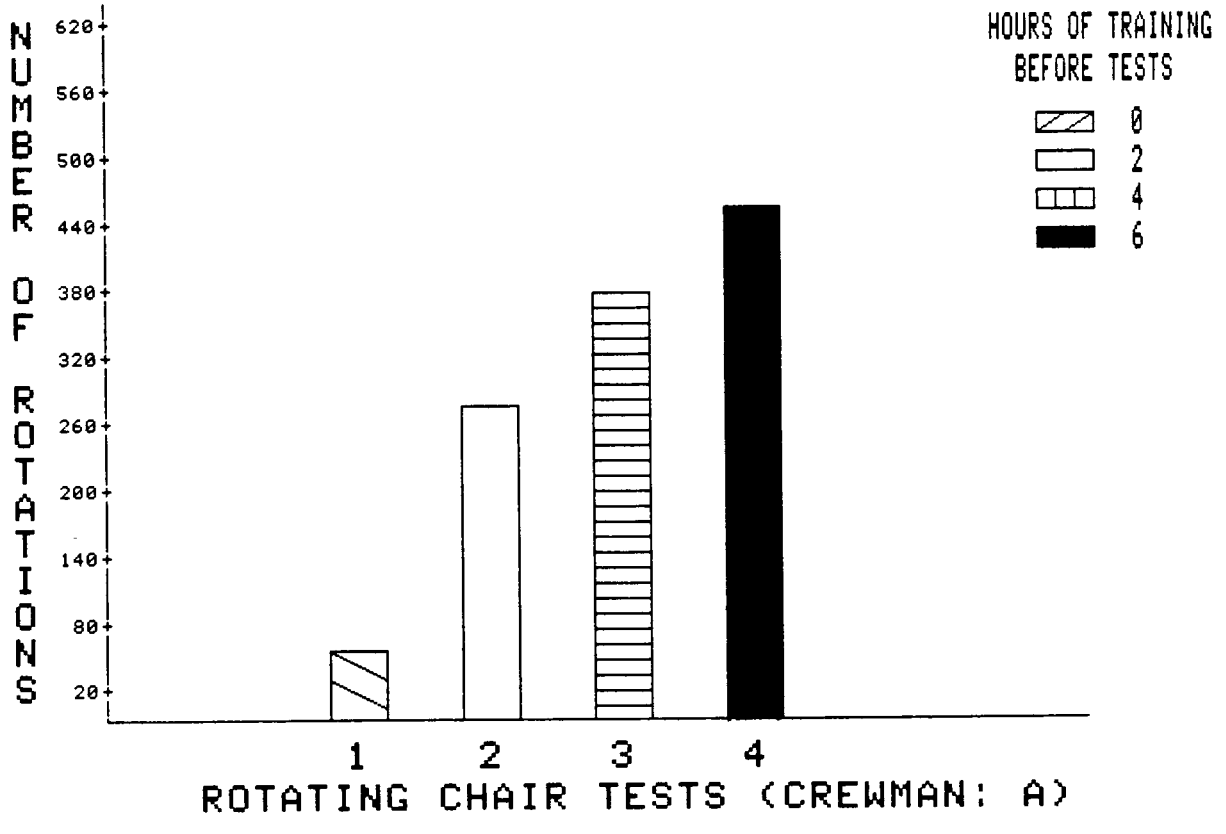

Figure 1. Motion sickness tolerance before, during, and after training.

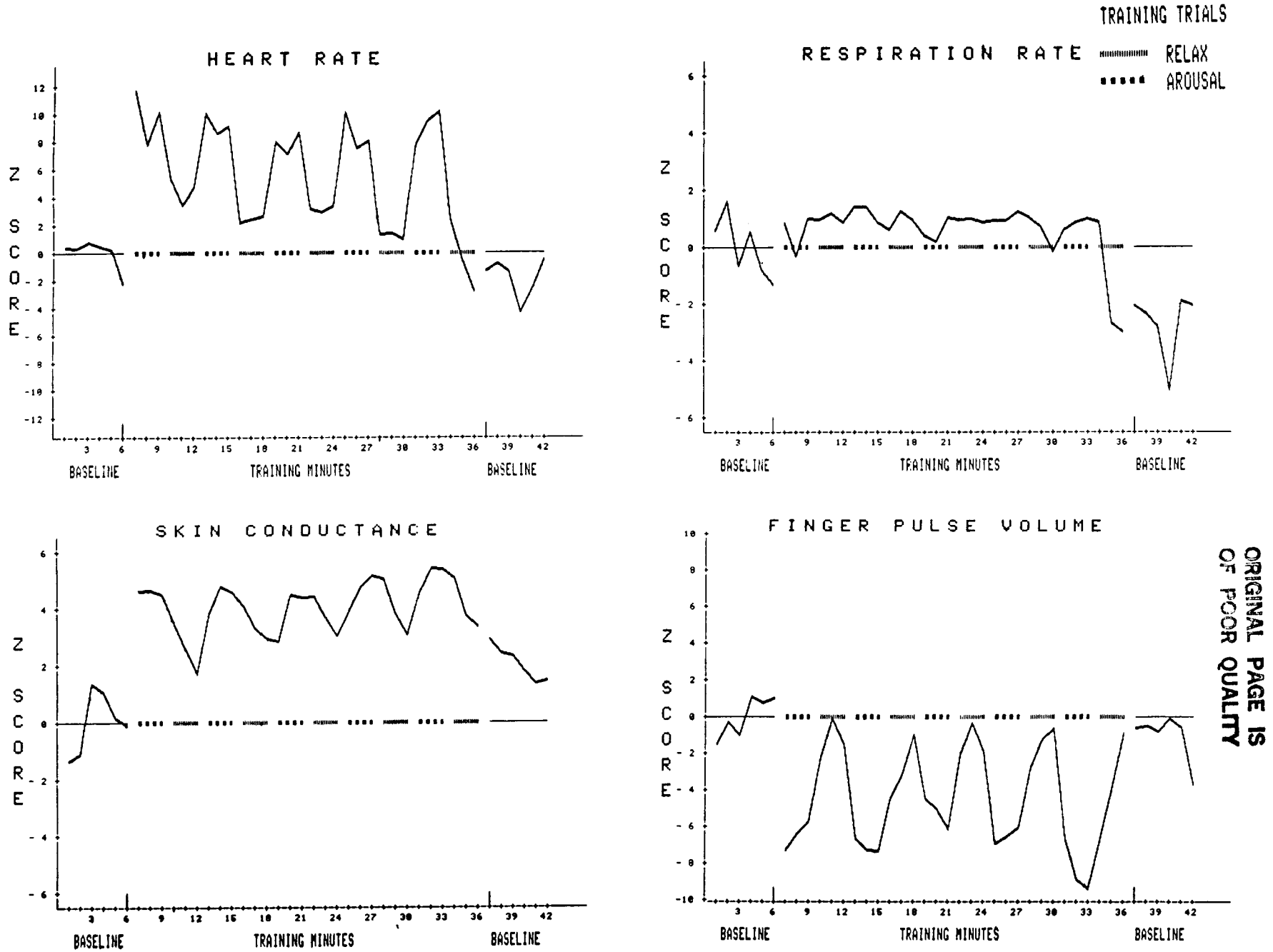

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Figure 2. Sample AFT session.

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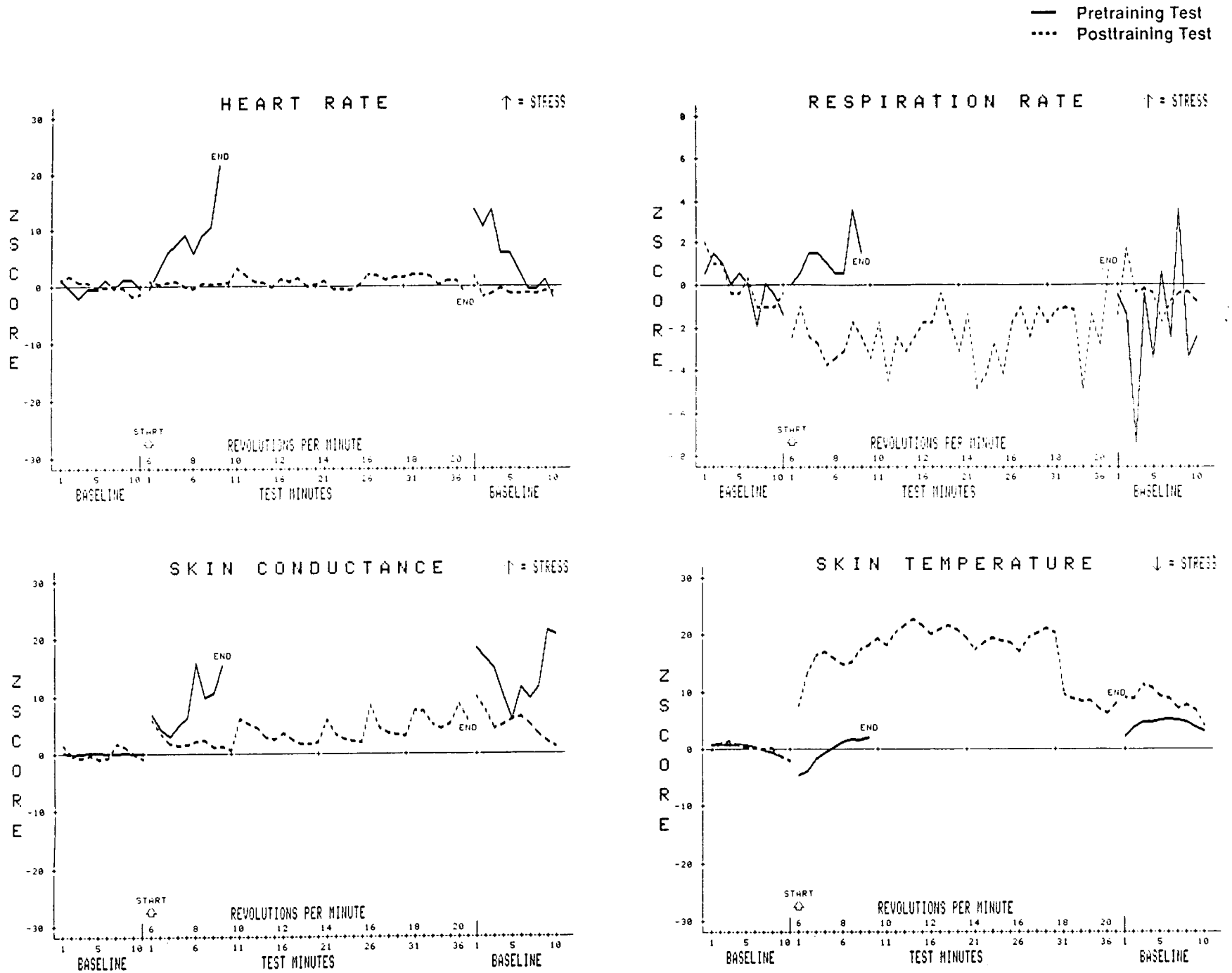

Figure 3. Physiological data during rotating chair tests, Crewman A.

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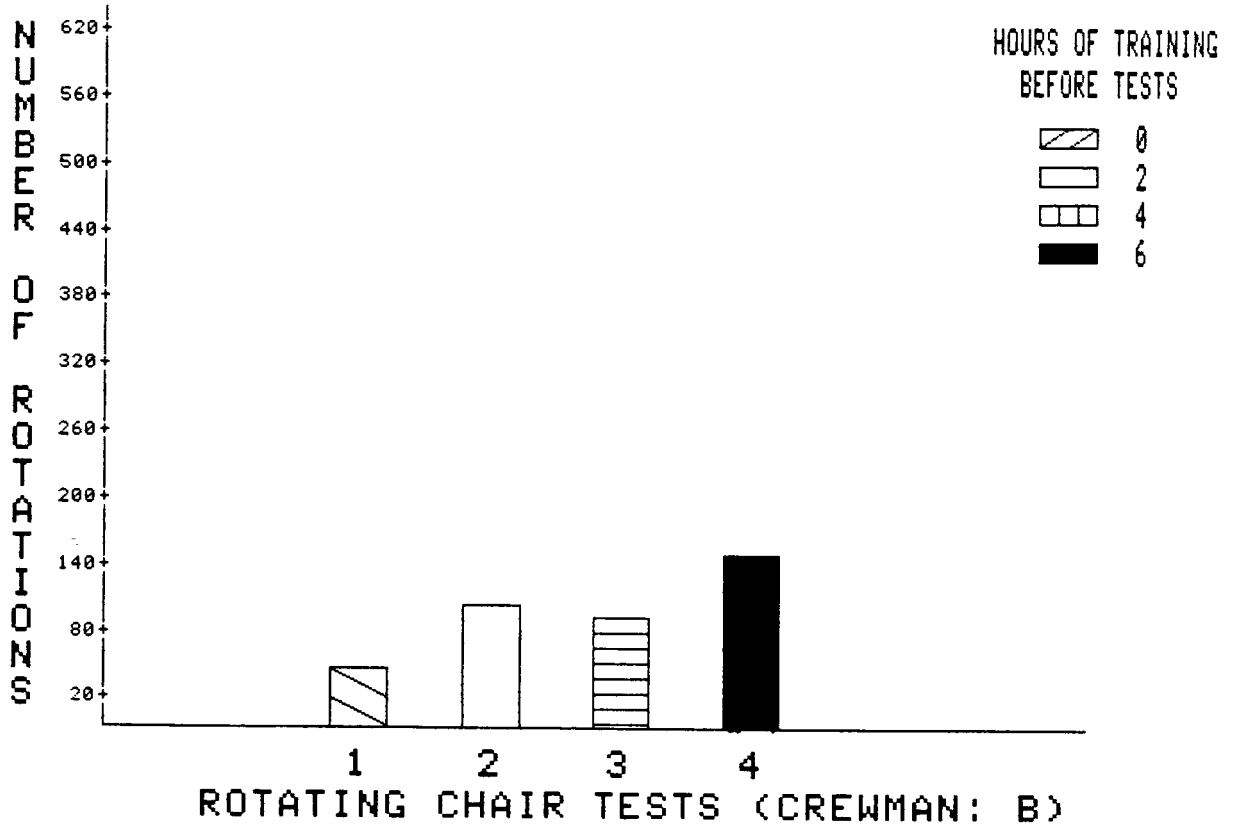

Figure 4. Motion sickness tolerance before, during, and after training.

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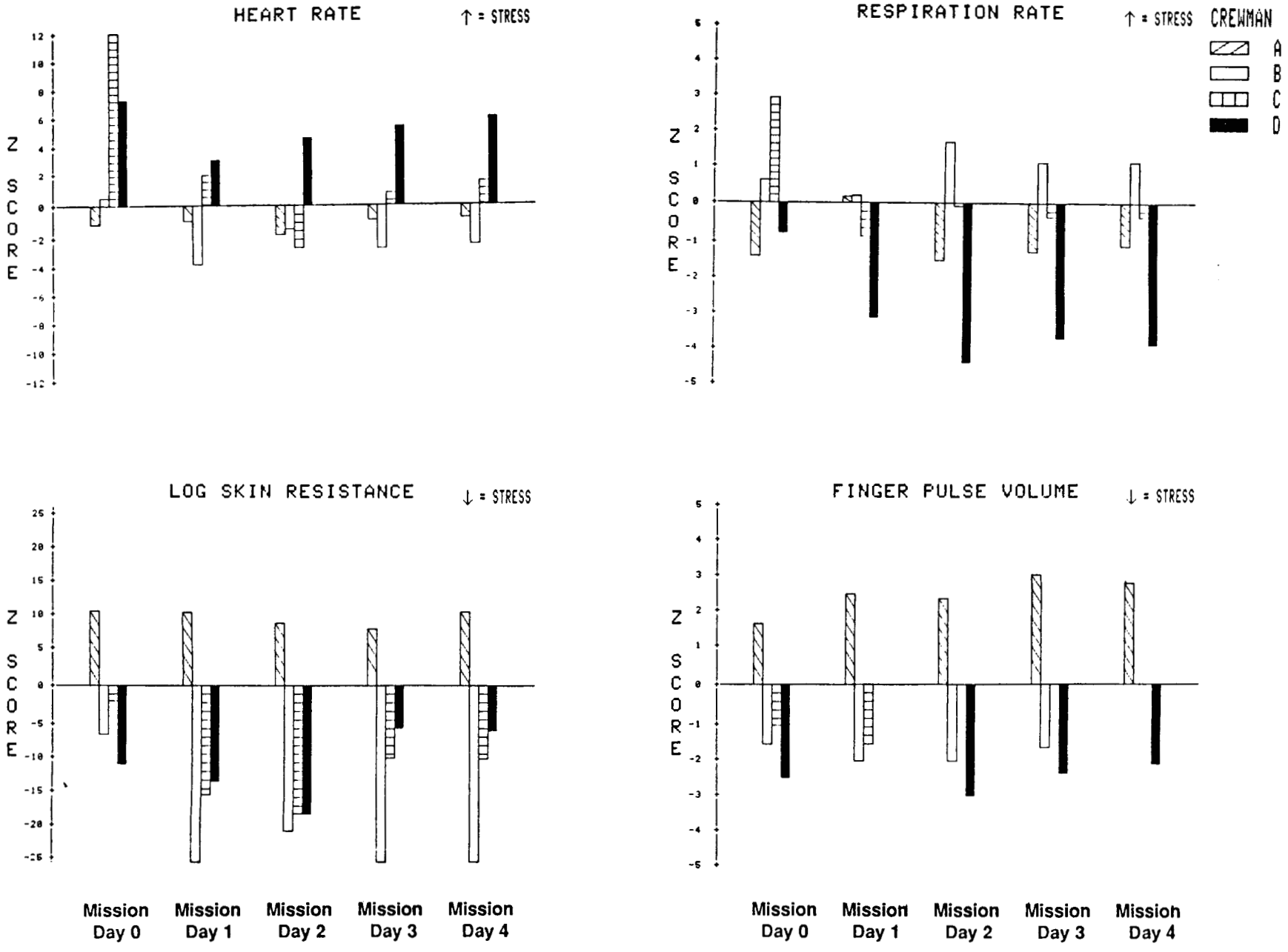

Figure 5. Daily Zscore averages of physiological data inflight.

SL-3 URINE MONITORING INVESTIGATION

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The purpose of the SL-3 Urine Monitoring Investigation was twofold: to conduct an inflight function test of the Urine Monitoring System (UMS), and to add information to our existing urinary electrolyte/endocrine data base.

The Urine Monitoring System is part of the Life Sciences Laboratory Equipment inventory. It was designed to be compatible with existing spacecraft systems and to provide life sciences investigators with a convenient means for estimating single-void urine volumes while collecting urine samples in an easily stowed, secure container.

In addition to an evaluation of the instrument from the operational standpoint, the inflight functional testing of the UMS consisted of the following specific tests related to precision and accuracy of measurement:

(1) Calibration with known masses of water injected into the instrument.

(2) Determination of residual volume, i.e., the amount of fluid (primarily flush water) left in the instrument at the end of a cycle.

Twenty-four usable data points were obtained from the inflight calibration protocol. These points were used to establish a calibration curve which could be used to convert UMS readout to mass for an unknown quantity of fluid introduced into the device. The confidence limits on the masses estimated by this procedure of inverse prediction can be established by standard statistical methods. The 50 percent confidence interval averages about +2 percent of the estimated mass. The mean residual volume estimated from eight determinations was 25.9 ml, with a standard error of 1.8 ml.

With regard to the second objective, we wished to take advantage of the capabilities of the UMS to collect samples and volume data throughout the mission, including the preflight and postflight periods, and particularly during the first 12 hours following launch. Inflight operational difficulties, due primarily to insufficient air flow through the UMS, precluded our meeting this objective.

Samples were collected on a void-by-void basis for three days preflight and for four days post-flight, however, inflight samples were limited to a single crewmember and primarily to a 25-hour period spanning MET Days 4 and 5. All samples were subjected to analysis. Biochemical and endocrine measurements included creatinine content, sodium, potassium, and chloride ion concentrations, osmolality, and levels of aldosterone and cortisol. Except for probable dilution of samples because of the residual volume mentioned above, there was no indication in any of these measurements that samples collected with the UMS would not provide valid physiological data.