INTRODUCTION. A serious problem experienced by astronauts during long-duration space missions is muscle loss. In order to develop countermeasures for this problem, a simple method for monitoring in vivo function of specific muscles is needed. Previous studies document that both intramuscular pressure (IMP) and electromyography (EMG) provide valuable information of muscle contraction properties. However, at present there are no data available concerning the usefulness of IMP versus EMG in simulating flight conditions. METHODS. IMP (Myopress catheter) and surface EMG activity (Caddwell, Inc.) were measured simultaneously in 19 male subjects during bed rest with the head raised 15 degrees (antero posterior) and supine (SOL) muscles of 9 normal male volunteers (28-54 years). These parameters were recorded during both concentric and eccentric exercises which consisted of plantarflexion and dorsiflexion of the ankle joint. A Lido Activa Isokinetic Dynamometer concurrently recorded ankle joint torque and position. RESULTS. Intramuscular pressure correlated linearly with contraction force for both SOL (r²=0.837) and TA (r²=0.948) during concentric exercise. SOL and TA EMG did not correlate as well with force during concentric exercise (r²=0.716 and r²=0.702, respectively). During eccentric exercise, SOL and TA IMP also correlated linearly with eccentric force (r²=0.80), but SOL and TA EMG correlated poorly with force (r²=0.489 and r²=0.702, respectively). CONCLUSIONS. IMP measurement provides a better index of muscle contraction force than EMG during concentric and eccentric exercise. IMP reflects the properties of individual muscles, such as length-tension relationships. Although invasive, IMP provides valuable information about muscle contraction and relaxation, while EMG provides valuable information about muscle recruitment patterns. However, additional studies are needed to determine the usefulness of EMG in simulating flight conditions.


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EVALUATION OF A MAN-MACHINE INTERFACE FOR CREW-AIDED TARGET ACQUISITION SYSTEMS. A. Sobel† Wright State University, Dayton, OH. G. Kuperman, Armstrong Laboratory, Wright-Patterson AFB, OH. J.T. Rieqler, L.J. Ramirez, and A. B. Price. Human Engineering Division, Crew Systems Directorate; Wright-Patterson AFB OH 45433-6573.

INTRODUCTION. Due to lack of field data regarding user concerns with night vision devices, a survey of all Air Force command were initiated by our laboratory. The purpose of the survey was to develop an improved night vision devices, and identify human factors concerns for future study. METHODS. The survey consisted of open-ended questions that were answered by operational users included comeal users from all available users and Air Force command users currently using fielded ANVIS systems. PROVIDERS. The survey resulted in decreasing environmental systems performance. CONCLUSIONS. Users indicated that design considerations for future helmet-mounted night vision systems must take better account of the demands imposed by individual missions, and the requirements of individual crewmembers. Specific recommendations relate to helmet weight and center of gravity, helmet-goggle integration, and cockpit lighting.


INTRODUCTION. Degraded visual cues associated with the use of night vision devices (NVDs) combined with the adverse environmental conditions of Southwest (SW) Asia often produce unexpected visual effects and illusions. This study described the variety of sensory illusions experienced by U.S. Army aviators in SW Asia while using NVDs. METHODS. An open-ended questionnaire was distributed to aviation units while deployed. Aircrew were asked to report any episodes of disorientation, sensory problems, or illusions noted while flying with NVDs. RESULTS. Of the 87 returned questionnaires, 98% reported single- or multiple-ocular sensory illusions. Among these, the sensory events occurred during good weather, over open desert terrain, during low levels of illumination, in all phases of flight. Degraded visual cues accounted for over half of all reports, with loss of visual horizon and degraded resolution most frequently mentioned. Over one-third reported a negative outcome ranging from fatigue or being unable to navigate to hard landing. CONCLUSIONS. Familiarity with sensory illusions is critical for safe NVD-flight. These findings can be used to better prepare aviators to fly at night in a desert environment.
COMPARISON OF UPPER BODY STRENGTH IN A STANDARD EVA FOOT RESTRAINT WITH A RIGID EVA ENCLOSEMENT IN A NEUTRAL BIOHYDRAULIC SETTING. B. Barratt*, Department of Aerospace Medicine, Wright State University, Dayton, OH 45403.

INTRODUCTION. A rigid EVA enclosure with full length anthropomorphic arms and mechanical restraint system offers several theoretical advantages over current EVA systems. To assess human factors aspects of such an enclosure, a mockup was constructed for neural buoyancy testing. Upper body strength, an important contributor to performance, was measured in subjects in the mockup and compared to that in a simulated EVA foot restraint. METHODS. Using an underwater load cell in a standardized position for force measurement, exertion profiles consisting of 16 separate configurations were assessed by 11 male subjects. Variables examined were environment (enclosure vs. foot restraint), restraint with the opposite hand (yes or no), direction of exertion (forward, side, or backward). RESULTS. ANOVA revealed a global enhancement of strength for exertions performed in the enclosure (p<.001). Use of the opposite hand for restraint enhanced strength (p<.001). Good first order interactions (p<005) were noted between environment and direction, environment and opposite hand use, and direction and opposite hand use. CONCLUSION. A rigid enclosure offers a strength advantage over a standard EVA foot restraint. Overall strength in the enclosure without opposite hand use was greater than overall strength in the foot restraint with opposite hand use. Thus, the enclosure allows a greater force exertion while sparing the opposite hand from fatigue induced by grasping.


INTRODUCTION. Lychaker proposed that motion sickness develops in man and animals when rhythmic changes in body displacement centering around 12/sec synchronize brain waves occurring in the alpha and theta ranges (10.17-0.25 Hz for zeta rhythm). The resonance hypothesis is based on some selected factors associated with MS but is inconsistent with other evidence. METHODS. Squirrel monkeys, cynomolgus monkeys and cats were exposed to continuous linear vertical swing and sinusoidal displacement on a centrifuge. METHOD. Rotational centers for vomiting (CTR) were surgically ablated in some subjects. RESULTS. Squirrel monkeys of Soviet phenotype developed MS syndrome readily during rotation but never during vertical linear oscillation. A different phenotype was highly resistant to all motion. Neither vertical displacement nor horizontal rotation created signs of MS in cynomolgus monkeys or cats. Based on data from CTR-ablated analysis, we postulated link between zeta rhythm, poisoning and MS is questionable. CONCLUSION. Contradictory findings from experimental animals suggests the resonance hypothesis of MS as it is currently formulated.


INTRODUCTION. In order to maintain crew compatibility and performance during future long-duration space missions, it is important to understand how various factors related to the space environment may influence crew member interactions. METHODS. Fifty-four American, European, and Soviet astronauts and cosmonauts who had flown in space were given a questionnaire assessing aspects of crew communication in the space environment. RESULTS. Sensory activities (Watching and Listening) were judged to significantly increase, whereas complex communicative activities (Reading, Gesturing, and Writing) significantly decreased. Four factors were perceived to significantly help inter-crew communication: Shared Experience, Excitement of Space Flight, Close Quarters, and Isolation from Earth. Three factors significantly hindered communication: Facial Swelling, Spacecraft Ambient Noise, and Space Sickness. Two factors showed no effect: Weightlessness and Facial Redness. CONCLUSIONS. The space environment may increase sensory activities and decrease complex communicative activities. Intra-crew communication may be helped by sharing a unique similar life experience or being brought closer together physically. It may be hindered by factors related to physical or physiological stress. Weightlessness per se appears to have no effect on crew member communication.

THE INFLUENCE OF AGE ON SUSCEPTIBILITY TO MOTION SICKNESS. B.S.K. Cheung, K.E. Money*. Defence and Civil Institute of Environmental Medicine, Toronto, Ontario, Canada, M3J 3B9.

INTRODUCTION. The influence of age on susceptibility to motion sickness has not been systematically studied. Most reports suggest a characteristic decline in susceptibility from a maximum in pubertal childhood to relative insensitivity by the sixth decade of life. However, Noble contends that susceptibility to swing sickness increases above the age of 40. In primates, older squirrel monkeys were reported to have longer latencies to vomiting in response to rotation than young controls. METHODS. A longitudinal study on the effects of age on the susceptibility to motion sickness was performed. The space environment may influence crew member interactions. METHODS. Fifty-four American, European, and Soviet astronauts and cosmonauts who had flown in space were given a questionnaire assessing aspects of crew communication in the space environment. RESULTS. Sensory activities (Watching and Listening) were judged to significantly increase, whereas complex communicative activities (Reading, Gesturing, and Writing) significantly decreased. Four factors were perceived to significantly help inter-crew communication: Shared Experience, Excitement of Space Flight, Close Quarters, and Isolation from Earth. Three factors significantly hindered communication: Facial Swelling, Spacecraft Ambient Noise, and Space Sickness. Two factors showed no effect: Weightlessness and Facial Redness. CONCLUSIONS. The space environment may increase sensory activities and decrease complex communicative activities. Intra-crew communication may be helped by sharing a unique similar life experience or being brought closer together physically. It may be hindered by factors related to physical or physiological stress. Weightlessness per se appears to have no effect on crew member communication.

MOTION SICKNESS IS ASSOCIATED WITH A GENETIC POLYMORPHISM OF THE ALPHA-2 ADRENERGIC RECEPTOR. G. Holdner, R. Shepard, T. Balber, Y. Hong, S. Parfitt*, and W. Lockette*. Wayne State University School of Medicine, Detroit; VAMC, Allen Park; University of Michigan Medical School, Ann Arbor; Mt. Sinai and the Henry Ford Health Research Center, San Diego.

We reported that hypertensive individuals are significantly more prone to develop motion sickness than normotensives. We also described an association between the alpha-2 adrenergic receptor (A2AR) gene and both a wide polymorphism of a gene coding for the alpha-2 adrenergic receptor (A2AR). We now hypothesize that polymorphism of the A2AR gene may significantly influence susceptibility to motion sickness in healthy subjects. Coriolis stress susceptibility (CSSI) was measured in 23 volunteers with normal vestibular function. CSSI was measured by determining the number of head movements subjects could complete while being rotated at increasing velocity before they developed motion sickness. Genomic DNA was isolated from leukocytes and digested with Dra I. Southern analysis using a 4.5 kb HI probe complementary to the C-10 A2AR gene yielded a restriction fragment length polymorphism of 6.3 and 7.6 kb. Individuals heterozygous for the 6.7/6.3 alleles had significantly lower CSSI scores (p<0.02) compared to the 6.6 homozygous individuals; no 6.3/6.3 homozygotes were found. A2AR modulate central catecholamine concentrations, and catecholamines decrease motion sickness susceptibility. Genetic differences in central catecholamine release may predispose an individual to motion sickness. A further search for other candidate genes that may contribute to the etiology of motion sickness and sub-pair analysis using anonymous markers is warranted.

VASOPRESSIN DOES NOT INCREASE SUSCEPTIBILITY TO CORIOLIS STRESS. G. Holdner, R. Shepard, T. Balber, Y. Hong, S. Parfitt*, and W. Lockette*. Wayne State University School of Medicine, Detroit; VAMC, Allen Park; and University of Michigan Medical School, Ann Arbor.

We demonstrated that intranasal administration of l-desamino-8-D-arginine vasopressin (DDAVP), a synthetic V2 analogue of anti-diuretic hormone inhibits the diuresis and natriuresis induced by prolonged volume expansion. DDAVP can counter the relative volume depletion that can follow operational maneuvers at sea or during exposure to microgravity. However, since provocative motion sickness in plasma volume (AVP) produced by 10% decrease in plasma volume does not maintain plasma volume and decreases untoward responses to motion. We measured the Coriolis stress susceptibility index (CSSI) in six subjects receiving placebo, DDAVP (0.1-0.5 p.p.m.), and a combination of DDAVP and AVP. Each subject was exposed to a 240rpm 17° inclined plane at 2 g and the number of head movements by subjects was measured by determining the number of head movements subjects could complete while being rotated at increasing velocity before they developed motion sickness. DDAVP had no discernible effect on the number of head movements completed (placebo, 313 ± 38; vs. DDAVP, 15.4 ± 6.0; p = n.s.) or CSSI score (placebo, 16.3 ± 6.0; vs. DDAVP, 15.4 ± 6.0; p = n.s.). DDAVP can be a helpful, adjunct measure for patients who are prone to develop motion sickness and normal responders to AVP. In summary, the present study confirmed our earlier findings and suggested that AVP could increase the incidence of motion sickness in these environments. We tested an alternative hypothesis—the increase in [AVP] during motion sickness is causally related to MS. Using DNA from healthy individuals, we have postulated a possible link between zeta rhythm, poisoning and MS is questionable.