INTRAMUSCULAR PRESSURE: A BETTER TOOL THAN EMG TO
OPTIMIZE EXERCISE FOR LONG-DURATION SPACE FLIGHT.
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INTRODUCTION. A serious problem experienced by astronauts during long-dura-
tion space flight is muscle atrophy. 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 valid indicators of muscle contraction
strength. However, at present there are no data available concerning the usefulness of IMP versus
EMG for monitoring dynamic exercise. METHODS. IMP (Myopress catheter) and surface EMG
activity (Cadalwad, Inc.) were measured concurrently in the vastus lateralis
anterior (TA) and soleus (SOL) muscles of 9 normal male volunteers (28-54 years).
These parameters were recorded during both concentric and eccentric exercise which consisted of
plantarflexion and dorsiflexion of the ankle joint. A Lido Active Isokinetic Dynamometer
concurrently recorded ankle joint torque and position. RESULTS. Intramuscular pressure correlated
linearly with contraction force for both SOL (r=0.837) and TA (r=0.948) during concentric exercise.
SOL and TA EMG did not correlate as well with force during concentric exercise (r=0.716 and r=0.702,
respectively). During eccentric exercise, SOL and TA IMP also correlated linearly with force
(r=0.905 and r=0.916, respectively), but SOL and TA EMG correlated poorly with force (r=0.489 and
r=0.702, respectively). CONCLUSIONS. IMP measurement provides a better index of muscle contraction
force than EMG during concentric and eccentric exercise. IMP reflects contractile properties of
individual muscles, such as length-tension relationships. Although invasive,
IMP provides an objective means for monitoring dynamic exercise and
protocols for astronauts exposed to long-duration flight. (Supported by NASA)

EVALUATION OF A MAN-MACHINE INTERFACE FOR CREW-AUGMENTED,
TARGET ACQUISITION SYSTEMS. A. Sobel, D. Wright State University, Dayton,
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INTRODUCTION. The next generation of target recognition algorithms (TRAs)
that have failed to achieve the level of robustness required for autonomous
application in military systems. The triad is still required to reduce the
triple number of false alarms generated by non-machine interfaces, capable of supporting the operator in the
cast of cued target confirmation, in a current challenge to the
crew station design community. METHODS. A non-in-the-loop crew
system simulator was modified to include a target acquisition
sensor and ATC capability. A structured rating scale debriefing
instrument was developed to capture subject variability and
judgmental and objectives regarding the importance and criticality
of related information elements. Sixteen radar navigators
participated in this MKE concept demonstration and assessment study.
RESULTS. Descriptive statistics revealed strong and consistent
user reports regarding non-intrusive cues to target location and a
mechanism for "decluttering" ATC symbology and alphabets.
CONCLUSIONS. These results will apply directly to crew station
configuration for the future Full-Purpose Fighter and Offensive Counter
Force Theater Missile Defense attack aircraft.

GROUND REACTION FORCES DURING RUNNING ON ACTIVE AND PASSIVE
TREADMILL IN SIMULATED ZERO-GRAVITY. R.L. Davis, P. R. Caravaghi.
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INTRODUCTION. The lack of gravity during flight reduces ground
reaction force (GRF) and muscular activity (EMG) required to
achieve a gravitational acceleration. The aim of this study was to
examine GRF and EMG during running and jogging on a treadmill
simulator that provided a zero-gravity environment. METHODS. Twelve
subjects performed concentric and eccentric muscle actions and
jogging and running during treadmill exercise in simulated hypogavity.
RESULTS. There were no differences in GRF or EMG between
centripetal and centripetal muscle actions. However, concentric
and eccentric muscle actions were significantly different,
producing a greater GRF and EMG when compared to
centripetal muscle actions. CONCLUSIONS. The results suggest that
the reduction in GRF and EMG required to achieve a gravitational
acceleration in flight is not sufficient to produce a measurable
response in GRF or EMG during running and jogging on a
zero-gravity environment. (Supported by NASA)

SENSORY ILLUSIONS REPORTED WHILE USING NIGHT VISION DEVICES IN
SOUTHWEST ASIA. D.T. Fitzpatrick*. U.S. Army Safety Center, FT.
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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 identified 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 included data for over 500
participants, including crew and ground support personnel, and
parameters, and environmental conditions at the time of the event
was also obtained. RESULTS. Of the 87 returned questionnaires,
96% reported sensory illusions or illusions. The sensory events occurred during good weather,
open desert terrain, during low levels of illumination, in all phases of flight. The
sensory illusions were most frequently mentioned. Over one-third reported a negative outcome ranging from
fatigue or aborting the mission to ground impacts or hard landings.
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 ENCLOSURE IN A NEUTRAL BUOYANCY SETTING. M. Barrag* 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 task 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, backward, right, left). RESULTS. ANOVA revealed a global enhancement of strength for exertions performed in the enclosure (p<0.001). Use of the opposite hand for restraint enhanced strength (p<0.001). No significant changes in the susceptibility level of all subjects to motion sickness was observed. CONCLUSION. A rigid enclosure offers a strength advantage over a standard EVA foot restraint. Overall strength in the enclosure without opposing hand use was greater than overall strength in the foot restraint with opposing hand use. Thus, the enclosure allows a stronger force exertion while sparing the opposing hand from fatigue induced by grasping.

THE INFLUENCE OF AGE ON SUSCEPTIBILITY TO MOTION SICKNESS. B.S.K. Cheng, K.E. Money*, Defence and Civil Institute of Environmental Medicine, Toronto, Ontario, Canada, M3M 3B9.

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 cosmonauts and cosmonauts who had flown in space were evaluated for how acceptable aspects of crew communication in the space environment. RESULTS. Sensory activities (watching and listening) were judged to significantly increase sensory activity in the presence of an actor (Reading, Gesturing, and Writing) significantly decreased. Four factors were perceived to significantly help intra-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. CONCLUSION. The space environment may increase sensory activity while decreasing sensory 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.

AN EMPIRICAL EVALUATION OF THE RESONANCE HYPOTHESIS OF MOTION SICKNESS. C.R. Wilpizeski, L. D. Lowry and C. Li Jefferson Medical College, Philadelphia, PA

INTRODUCTION. Lychak has proposed that motion sickness develops in man and animals when rhythmic changes in body displacement centering around 12/sec syndrome but leaves occurring in all included cats (0.17–0.25 Hz for zeta rhythm). The resonance hypothesis is based on several factors associated with MS but is inconsistent with clear evidence. METHODS. Squirrel monkeys, cynomolgus monkeys and cats were exposed to continuous linear vertical or horizontal displacement on a rotational machine. RESULTS. Squirrel monkeys of Diall 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 CTZ-ablated animals, the postulated link between zeta rhythm, poisoning and MS is questionable. CONCLUSION. Contradictory findings from experimental animals make the resonance hypothesis of MS as it is currently formulated.

MOTION SICKNESS IS ASSOCIATED WITH A GENETIC POLYMORPHISM OF THE ALPHA-2 ADRENERGIC RECEPTOR. G. Hoder, R. Shepard, T. Blaiker, Y. Hwang, S. Pifarre* and W. Lockett* Wayne State University School of Medicine, Detroit; VAMC, Allen Park; University of Michigan Medical School, Ann Arbor; Mt. Sinai, Mt. Sinai Health Research Center, San Diego.

We reported that hypertensive individuals are significantly more prone to develop motion sickness than normotensives. We also demonstrated an association between blood pressure and a specific allele of an ala-2 adrenergic receptor (CTZ) and increased susceptibility to motion sickness. To rule out the CTZ as the causative factor, we used DDAVP (1-desamino-8-D-arginine vasopressin), a synthetic V2 analogue of the diuretic hormone which inhibits the diuresis and natriuresis induced by hypotonic fluids. In our experiment, DDAVP can counter the relative volume depletion that can follow operational maneuvers at sea or during exposure to microgravity. However, since provocative motion increased plasma [AVP] in MS, we postulated that DDAVP could increase the incidence of motion sickness in these subjects. We tested an alternative hypothesis—i.e., the increase in [AVP] during motion sickness (MS) would result in an increase in plasma volume, and may therefore maintain plasma volume and decrease untoward responses to motion. We measured the Cortisol stress susceptibility index (CSSI) in six MS subjects receiving placebo or DDAVP. DS subjects had normal circadian plasma [ACTH] and DDAVP increased plasma [ACTH] and plasma [Cortisol]. Significant reduction in plasma [Cortisol] 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 their leukocytes and digested with Dra I. Southern analysis using a 4.5 kb HT probe complementary to the C-10 A2AR gene yielded a restriction fragment length polymorphism of 6.3 ± 6.7 kb. Individuals heterozygous for the 6.7/6.3 alleles had significantly lower CSSI scores (p<0.02) compared to the 6.7 homozygous individuals. These results suggest that the alpha-2 adrenergic receptor may influence the susceptibility to motion sickness. Genetic differences in central catecholamine concentrations, and catecholamines change the susceptibility to motion sickness. Genetic differences in central catecholamine concentrations 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.

VASOPRESIN DOES NOT INCREASE SUSCEPTIBILITY TO CORIOLIS STRESS. G. Hoder, R. Shepard, T. Blaiker, Y. Hwang, S. Pifarre* and W. Lockett* Wayne State University School of Medicine, Detroit; VAMC, Allen Park; and University of Michigan Medical School, Ann Arbor.

We demonstrated that intracranial administration of 1-desamino-8-D-arginine vasopressin (DDAVP), a synthetic V2 analogue of the diuretic hormone inhibits the diuresis and natriuresis induced by hypotonic fluids. Consequently, DDAVP can counter the relative volume depletion that can follow operational maneuvers at sea or during exposure to microgravity. However, since provocative motion increased plasma [AVP] in MS, we postulated that DDAVP could increase the incidence of motion sickness in these subjects. We tested an alternative hypothesis—i.e., the increase in [AVP] during motion sickness (MS) would result in an increase in plasma volume, and may therefore maintain plasma volume and decrease untoward responses to motion. We measured the Cortisol stress susceptibility index (CSSI) in six MS subjects receiving placebo or DDAVP. DS subjects had normal circadian plasma [ACTH] and DDAVP increased plasma [ACTH] and plasma [Cortisol]. Significant reduction in plasma [Cortisol] was measured by determining the number of head movements subjects could complete while being rotated at increasing velocity before they developed motion sickness. DS subjects had no discernible effect on the number of head movements completed (placebo, 318 ± 38 vs. DDAVP, 276 ± 38, 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 individuals who must perform tasks in the microgravity of space or endure prolonged water immersion.