

[270] SUBJECTIVE AND NEUROHORMONAL COMPARISONS OF A VIRTUAL REALITY VERSION OF THE OPTOKINETIC-NYSTAGMUS DRUM

Taylor Casey¹, John French², Diego Garcia²

¹University of Pittsburgh Medical Center - Harrisburg, Harrisburg, PA, United States; ²Embry Riddle Aeronautical University, Daytona Beach, FL, United States

(Original Research)

INTRODUCTION: The Optokinetic Nystagmus (OKN) drum has been used to induce nystagmus and symptoms of motion sickness for many decades. The advent of virtual reality (VR) goggles made it possible to virtually create the traditional drum stimulus patterns at less cost and with more stimulus control. The current experiment compared subjective symptoms and neurohormonal responses from the traditional OKN drum experience with those from Vive VR goggles.

METHODS: Healthy college students (n=12) were exposed to the drum and VR-OKN in a crossover design. Half the students received OKN drum exposure first and half received the VR OKN exposure first before the crossover. Comparisons of symptoms and responses were measured before, during, and after exposures using the standard SSQ and salivary assays of cortisol and melatonin. Friedman's test was used to determine if a difference existed between SSQ results and ANOVA was used to evaluate differences in neuroendocrine results, between the two exposures. Additionally, the VR-OKN was presented to the 12 participants in a non-repeated, non-crossover design as either the typical horizontal drum stripes pattern (n=6) or in a vertical stripes pattern (n=6). **RESULTS:** The drum and VR OKN exposures were not statistically different in any segments from any measures. Both drum and VR OKN were significantly different during the exposure segment compared to the pre-exposure and after segments on SSQ. There were no differences between the horizontal or vertical OKN exposures on the SSQ. Exposure to the drum OKN or the VR OKN, significantly reduced the SSQ scores on the crossover results, the VR OKN or the drum OKN, respectively. **DISCUSSION:** The lack of difference between drum and VR OKN measures implies VR-OKN could be used in place of the traditional drum OKN. This is advantageous because traditional methods are unavailable to many clinicians and researchers due to cost and testing inconvenience and far more stimulus presentation options are available with VR. The crossover results suggest that pre-exposure to VR or drum OKN may reduce symptoms on subsequent exposures, perhaps for desensitization to motion sickness. VR-OKN holds promise for reliably and quickly inducing nystagmus in various clinical and research applications.

Learning Objectives

1. The audience will learn about the underlying physiologic principles of optokinetic-nystagmus.
2. The audience will learn about a cheaper, more efficient alternative to testing nystagmus in the setting of diagnosing brain injuries.

[271] BASELINE VESTIBULAR FUNCTION OF AIR FORCE CANDIDATES

Dana Berger¹, Aya Ekshtein¹, Maya Avni¹, Yuval Kozlov², Oded Ben-Ari¹

¹Aeromedical Center, Israeli Air Force, Ramat-Gan, Israel; ²Hebrew University of Jerusalem, Jerusalem, Israel

WITHDRAWN

WEDNESDAY, MAY 08, 2024

Wednesday, 05/08/2024

8:30 AM

Grand Ballroom CD South, EF

[S-48]: PANEL: BEHAVIORAL HEALTH AND PERFORMANCE OPERATIONS AND RESEARCH IN HUMAN SPACEFLIGHT

Chair: Stephen VanderArk

PANEL OVERVIEW: BODY: Optimizing behavioral health and performance of astronauts as they prepare for and complete spaceflight missions is a team effort for research and operations. The Behavioral Health and Performance (BHP) Operations Group and BHP Laboratory at NASA Johnson Space Center (JSC), in collaboration with NASA Ames Research Center's Fatigue Countermeasures Laboratory, have a shared goal of promoting optimal performance during all mission phases. This goal is demonstrated by the bi-directional relationship of operations informing research questions, and research results providing guidance to operational work with astronauts. The BHP Operations team within the Space Medicine Division is active in astronaut selection, training, behavioral healthcare services, and work-rest schedule development. The BHP Laboratory is engaged in research in space and analog platforms to address the risks and other challenges associated with future exploration missions beyond low earth orbit. The NASA Ames group works closely with both operations and research at NASA JSC to inform fatigue management services for astronauts and flight controllers and leads circadian desynchrony research. This panel will provide details of recent work by these groups and will demonstrate their shared goals, and contributions toward, optimizing performance, and maintaining the behavioral health and well-being of astronauts during all mission phases. One presentation will discuss the behavioral competency work being completed by NASA and its International Partners to select and train their astronauts using a common model. A second presentation will discuss one example where NASA Operational Psychologists implement this competency work in field trainings with Astronaut Candidates (ASCANs) and assigned crews, with the goal of teaching expeditionary skills, including Teamwork, Communication, Leadership, and Self-care. A third presentation will discuss the relationship between schedule changes and predictions made about crew alertness and performance, which is important data for the BHP Operations and Flight Surgeons to inform their pre-flight and in-flight work with crews. The panel will also include two presentations discussing research by the BHP Laboratory within ISS and spaceflight analogs that use a common set of measures to characterize the behavioral health and performance risks related to exploration missions—providing foundational work for future BHP work to train and monitor astronauts.

[272] COGNITIVE PERFORMANCE IN ISS ASTRONAUTS ON 6-MONTH LOW EARTH ORBIT MISSIONS

Sheena Dev¹, Alaa Khader², Sydney Begerowksi¹, Millennia Young³, Suzanne Bell³, Gilles Clement¹

¹KBR, Inc/NASA JSC, Houston, TX, United States; ²JESTech/NASA JSC, Houston, TX, United States; ³NASA JSC, Houston, TX, United States

(Original Research)

INTRODUCTION: The NASA Human Research Program has identified the risk of decrements to cognitive performance as a primary behavioral health concern. In this study, we systematically assessed

a wide range of cognitive domains among astronaut crew before, during, and after 6-month missions to the International Space Station (ISS). **METHODS:** Twenty-one astronaut crewmembers were administered the full Cognition Battery at five timepoints: baseline (BDC), early inflight, late inflight, one-week post-landing, and one-month post-landing. Speed and accuracy outcomes for each subtest were corrected for practice effects and z-transformed using the sample's BDC scores. Speed and accuracy scores were averaged to create respective summary metrics. Linear mixed models with random subject intercepts nested within gender determined the relationship between timepoint and performance. Age was included in the models as a covariate. Post-hoc pairwise comparisons using Tukey's HSD to correct for Type I error examined differences between each timepoint. **RESULTS:** Average z-scores across all outcome measures (range: -.53 to .17) varied mildly around the sample's baseline mean performance. However, approximately 12% of all individual observations were below 1 standard deviation of the full sample baseline mean (i.e., z-score < -1). Linear mixed models revealed a significant main effect of timepoint for the summary accuracy score ($\beta = -.06, p = 0.001$), such that accuracy was statistically lower at both post-landing timepoints (p 's = .03) relative to BDC though the absolute differences were minimal (z-score's = 0.22). Results across subtests varied. For example, there was no significant effect of timepoint on a subtest assessing sensorimotor speed, while in contrast performance on a risk-taking task ($\beta = -.33, p < 0.001$) suggested that crew demonstrated the greatest propensity for risk taking at early inflight and one-week post-landing timepoints relative to BDC. **DISCUSSION:** As a group, astronaut crew on 6-month ISS missions demonstrated very mild transient changes in cognitive performance. Future directions include an examination of contextual factors that may contribute to low scores (i.e., fatigue) and validation against operationally relevant outcomes to characterize meaningful change. Taken together, these and future findings can inform operational strategies to optimize crew performance.

Learning Objectives

1. The audience will be able to discuss the most recent data characterizing cognitive performance in spaceflight.
2. The audience will learn about behavioral health optimization in spaceflight by discussing how contextual factors may contribute to changes in cognitive performance.

[273] HUMAN FACTORS AND BEHAVIORAL PERFORMANCE EXPLORATION MEASURES IN SPACE AND SPACE ANALOG ENVIRONMENTS: ASSESSING ASTRONAUT RISK

*Suzanne Bell*¹, Sheena Dev², Steven Anderson², Lauren Landon², Jennifer Miller³, Alaa Khader³

¹NASA JSC, Houston, TX, United States; ²KBR, Inc/NASA JSC, Houston, TX, United States; ³JESTech/NASA JSC, Houston, TX, United States

(Education - Tutorial/Review)

INTRODUCTION: The Human Factors and Behavioral Performance Exploration Measures (HFBP-EM) suite is a set of standardized measures to assess behavioral health and performance risk related to future long duration space exploration (LDSE) class missions, and to support reduction of the Human Research Program's (HRP) Behavioral Medicine (BMed), Team, Sleep, and Human Systems Integration Architecture (HSIA) risks. The suite includes 1) surveys that assess team, psychosocial, and behavioral functioning, 2) tasks of cognitive functioning and operationally relevant performance, and 3) physiological biomarkers of sleep and heart rate. This presentation will provide an overview of the suite, describe implementation in spaceflight and terrestrial analogs, report on workload, fatigue, stress, and social support, and discuss the applicability of these results and the HFBP-EM suite in general to audience members. **TOPIC:** HFBP-EM is a research program designed to examine the validity and reliability of measures within the HFBP-EM suite, serve as a test bed for measures being considered for spaceflight, and used to test the efficacy of countermeasures. Each campaign of data collection also has additional specific aims such as the identification of thresholds or

development or shorter forms for survey measures. To date, HFBP-EM has been collected in Human Exploration Research Analogs campaigns 4, 5, 6 and the SIRIUS19 and SIRIUS21 missions in the Russian Ground Based Experiment Complex. A subset of the HFBP-EM suite was collected during spaceflight. Data was collected from a total of 87 multinational astronaut and astronaut-like crewmembers (mean age: 39.3, SD = 7.8; 39% female; 92% advanced degrees). We will provide an overview of the HFBP-EM program; what the suite currently includes; results for workload, fatigue, stress, and social support; and next steps in the suite's development. We will also discuss the application to aerospace practitioners and researchers. **APPLICATION:** Astronaut teams selected for future LDSE missions will face challenges that pose significant yet unknown risks to their behavioral health and performance. The HFBP-EM suite provides a comprehensive assessment of behavioral health and performance in space analog and spaceflight settings. This suite can be applied to both operational and research settings to advance risk reduction research for LDSE missions.

Learning Objectives

1. The audience will learn about the Human Factors and Behavioral Performance Exploration Measures suite and its application to both operational and research settings to advance risk reduction research for future long duration space exploration class missions.
2. The audience will be able to describe trajectories of reported fatigue, stress, and social support across different spaceflight and spaceflight analog settings.

[275] IMPACT OF SLEEP SCHEDULE CHANGES ON SLEEP OUTCOMES AND PREDICTED CREW ALERTNESS ON THE INTERNATIONAL SPACE STATION

Rachel Jansen, Erin Flynn-Evans, Zachary Glaros
NASA, Moffett Field, CA, United States

(Original Research)

INTRODUCTION: Astronaut crews have historically averaged six hours of sleep per night. In recent years, ISS crew have had more stable schedules, with consistent bed and wake times. Despite these improvements, there remain uncontrollable operational events that require crewmembers to shift their sleep. It is unclear what impact these acute schedule changes have on sleep and performance outcomes. The aims of this analysis are to characterize approaches to sleep shifting, including shifting sleep earlier or later and splitting sleep, and to determine the impact on sleep outcomes and crew alertness and performance.

METHODS: Crewmembers (n = 19) on the ISS were provided with actiwatches that they wore for two bouts of data collection before flight, inflight, and immediately upon return to Earth. We first characterized the impact of "split sleep," whereby a person attempts sleep on two separate occasions in a 24-hour period that are similar in length, and its impact on sleep outcomes. **RESULTS:** Nine crewmembers engaged in 14 episodes of split sleep while inflight. These periods surrounded six separate visiting vehicle events that interfered with their nominal sleep window (2130 to 0600). The first sleep opportunity typically took place during the afternoon before the disrupting event, while the second episode took place the following morning. On average, the first sleep opportunity was shorter than the second (M1=2.79±0.74 vs. M2=4.28±1.56), as were sleep duration (M1=2.65±0.81 vs. M2=4.11±1.57) and efficiency (M1=76.06±13.43 vs. M2=83.49±8.46). On inflight nights with no split sleep, these crewmembers averaged 6.71±0.52 hours of sleep per night with a sleep efficiency of 83.51±2.61. **DISCUSSION:** Next, we will compare the crewmembers' split sleep outcomes to those from other strategies to determine which yield the best sleep outcomes. We will use biomathematical modeling to analyze the predicted alertness on these schedules. Understanding these impacts will aid in decision making for future spaceflight operations and will inform on the impacts of various strategies to adjust sleep and help guide scheduling in future missions where consistent schedules may not be possible.

Learning Objectives

1. Participants will learn how sleep shifts impact crewmember sleep outcomes.
2. Participants will learn how sleep shifts impact predicted crew alertness.

[274] DEFINING COMPETENCIES NEEDED AT THE TIME OF SELECTION FOR ACTIVE AND NON-ACTIVE ASTRONAUT CREW MEMBERS

Alexa Doerr¹, James Picano²

¹KBR, Houston, TX, United States; ²NASA, Houston, TX, United States

(Education - Program/Process Review)

BACKGROUND: NASA has worked with international partners in developing and standardizing selection guidelines for minimal behavioral competencies needed upon selection. Spaceflight poses significant risk to crew and individual, and to mitigate risk, training should be provided on behavioral competencies required for spaceflight including those that are required but are not measured at selection. We provide an overview of the process of identifying competencies important to assess as part of a multi-method selection program for active and non-active astronauts.

OVERVIEW: NASA, ESA, CSA, and JAXA agency representatives used their vast combined knowledge and experience to develop competency requirement standards that future selection programs should assess when selecting astronauts. The astronaut role is expanding to include astronauts whose purposes are quite varied. NASA and its international partners recognize the need to identify and standardize the competencies required for anyone who will be experiencing the incredible demands, risks, and unique circumstances associated with spaceflight. Competencies include those required for individual and team functioning within the isolated, confined, and extreme environment. This need grew out of greater commercialization of spaceflight and other budding spaceflight prospects. The process was as follows: 1. Each agency rated previously defined spaceflight required competencies (*not important 0, somewhat important .5, or extremely important 1*) to assess during selection. We did this for short duration (<14 days) and for long duration (>14 days) missions as some competencies appear to become of greater importance with longer duration missions. 2. Competencies for non-active crew were rated, and previous ratings for active crew were updated. 3. Agency ratings for non-active/active and short-duration/long-duration requirements were compared and discussed until consensus was reached. Ratings will be used to compile selection standards for active and non-active astronauts. **DISCUSSION:** Our working group has vast operational experience and knowledge of the risk factors present during spaceflight that can disrupt individual and team functioning. Selection is one of the most important countermeasures for mitigating risk to individual and team health and performance. Our work should inform future programs for selecting crewmembers for short- and long-duration spaceflight among active and non-active crews.

Learning Objectives

1. The audience will learn about our process of identifying behavioral competencies that can and should be assessed during selection of active and non-active astronaut crew members.
2. The audience will learn about the behavioral competencies that were identified as important to assess during selection of active and non-active astronaut crew members.

[35] STELLAR MINDS: BENEFITS OF INTEGRATING OPERATIONAL PSYCHOLOGISTS INTO ASTRONAUT FIELD TRAINING

Anna Cejka

KBR, NASA JSC, Houston, TX, United States

(Education - Tutorial/Review)

INTRODUCTION: Astronauts face a high degree of environmental challenge involving unknown and uncontrollable situations, resulting

in complex skills and critical psychological characteristics necessary for optimal performance. As such, unique challenges exist when preparing astronauts for high-tempo, high-risk missions, particularly when opportunities for expeditionary training are limited to didactics. While didactics provide a foundation for understanding expeditionary skills, application during field training allows trainees to practice these skills in higher fidelity scenarios that echo the demands of the environments and mission objectives that crews will encounter in space. This presentation will describe the process and benefits of integrating operational psychologists into astronaut field training. **TOPIC:** Space missions demand key competencies, including cooperation with others, adaptability, judgment, motivation, physical ability and stamina, and initiative. As such, operational psychologists at NASA JSC ensure specialized technical and expeditionary competencies necessary to be effective on long-duration spaceflight missions. These competencies mitigate risks to team functioning and the overall mission by preserving crew cohesion, minimizing conflict, and enhancing communication. To ensure the successful application of technical and expeditionary competencies during spaceflight, operational psychologists engage in field training with astronaut candidates and crews. Their involvement facilitates observation of team dynamics, immediate feedback, skill reinforcement, and collaboration with specialists (e.g., survival trainers, geologists, etc.), ultimately allowing for the enhancement of psychologist-crew rapport, enabling timely interventions, fostering interdisciplinary collaboration, and bolstering skill retention. **APPLICATION:** The involvement of operational psychologists in astronaut field training is crucial to aeromedical professionals working with small, high-performing teams. Specifically, the integration of operational psychologists in training can guide professionals aiming to optimize individual and team performance in mission-critical, isolated environments.

Learning Objectives

1. The audience will learn about the benefits of including operational psychologists in astronaut field training.
2. The audience will learn techniques used by operational psychologists to train behavioral competencies during field trainings.

Wednesday, 05/08/2024

8:30

AMGrand Ballroom A

[S-49]: PANEL: CHARACTERIZING THE EFFECTS OF VARIABLE RESPIRATORY DYNAMICS IN MILITARY AVIATION

Chair: Stephanie Warner

Co-Chair: Kara Blacker

PANEL OVERVIEW: Over the past decade, tactical aviators have reported experiencing unexplained physiological symptoms, both on the ground and in-flight. These physiologic events or episodes (PEs) have caused temporary groundings, aborted missions, and in-flight mishaps, which led to PEs becoming the number one safety priority in Naval aviation. Recent emphasis was placed on characterizing the role of the aircraft life support system (LSS) and resultant changes to respiratory conditions as contributing factors to PEs. As a result, research efforts across the Department of Defense (DoD) have focused on the neurophysiological, cognitive, and performance effects of breathing varied combinations of pressure, flow, oxygen concentration, and fluctuations in gas delivery. This panel aims to highlight several studies that have utilized high fidelity testing equipment, actual LSS components, and behavioral, physiological, and neurophysiological measures of performance. This body of work will contribute to a better understanding of the complex human response to variable respiratory dynamics as experienced in tactical aviation. **PANEL STRUCTURE** The first presentation describes Naval Medical Research Unit Dayton's (NAMRU-D) development of a magnetic resonance imaging (MRI)-compatible, simulated aircrew LSS, test configuration as part of the DoD and Wright State University's (WSU)

Center of Neuroimaging and Neuro-Evaluation of Cognitive Technologies (CoNNECT) to support several current and future DoD efforts evaluating respiratory dynamics. The second presentation describes an MRI-based research study completed by NAMRU-D and WSU in the CoNNECT facility investigating the neurophysiological markers of hyperoxia and non-standard oxygen delivery pressure. The third presentation describes a research study by NAMRU-D investigating the effects of repeated hyperoxia exposure on respiratory and physiological response. The fourth presentation from a 711th Human Performance Wing and NAMRU-D joint effort demonstrates the use of exhaled breath samples for detecting potential novel biomarkers of acute normobaric hypoxia. The final presentation describes a functional near-infrared spectroscopy (fNIRS) study by NAMRU-D investigating the effects of intermittent acute hypoxia exposure and breathing resistance.

[276] DEVELOPMENT OF AN MRI-COMPATIBLE SIMULATED AIRCREW LIFE SUPPORT SYSTEM FOR EVALUATION OF VARIABLE RESPIRATORY DYNAMICS IN MILITARY AVIATION

Stephanie Warner¹, Frank Robinson¹, Matthew Sherwood²

¹Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States; ²Wright State University, Dayton, OH, United States

(Education - Program/Process Review)

BACKGROUND: Mitigating physiological episodes is an ongoing priority for the aeromedical research community. Life support system (LSS) output can contribute to variable respiratory dynamics experienced by military aviators even while operating within requirements. To address the impact of this exposure, new research has focused on hyperoxia, hypoxia, low regulator inlet pressure, increased breathing resistance, and their interactions. Parallel work is underway to understand the neurophysiological and performance effects of these respiratory conditions. However, to elicit symptomology similar to that experienced in flight, a high-quality aviation LSS simulation is essential. Naval Medical Research Unit Dayton (NAMRU-D), Wright State University (WSU), and the 711th Human Performance Wing collaborated to create a high-fidelity magnetic resonance imaging (MRI)-compatible simulated LSS to evaluate variable respiratory dynamics in military aviation. **OVERVIEW:** The Department of Defense (DoD) and WSU partnered to acquire a 3-Tesla MRI for the new Center of Neuroimaging and Neuro-Evaluation of Cognitive Technologies (CoNNECT). The first research efforts utilizing the CoNNECT facility are evaluating the neurophysiological effects of respiratory dynamics in military aviation. Leveraging NAMRU-D's Hypoxia Ventilation Research Device and fabrication specialists, a fully-functional LSS configuration was designed and installed in the CoNNECT facility. This setup allows dynamic manipulation of gas content, pressure, and flow to simulate aviation breathing scenarios. Additionally, NAMRU-D coordinated with Eaton to provide two MR-compatible CRU-103 breathing regulators with and without safety pressure, as well as with Gentex to modify the MBU-20/P mask to be MR-compatible. **DISCUSSION:** Systems such as functional near-infrared spectroscopy, electroencephalography, and MRI are useful to evaluate the neurophysiological effects of variable respiratory dynamics. However, incorporation of actual LSS equipment, a precision gas delivery system, and appropriate task scenarios are key to simulate the aviation environment and capture the physiological changes with high fidelity. The DoD-WSU CoNNECT facility is the only MRI location with these custom testing capabilities. This robust research setup allows for rapid advancement of DoD imaging research and supports the understanding of the complex human response to variable respiratory dynamics in military aviation.

Learning Objectives

1. The audience will learn about a new custom MRI-compatible simulated aircrew life support system available to support research evaluating variable respiratory dynamics in military aviation.
2. The audiences will be able to identify components and testing capabilities of a new MRI-compatible simulated aircrew life support system used to elicit symptomology similar to that experienced in flight.

[277] EVALUATING THE NEUROPHYSIOLOGICAL EFFECTS OF HYPEROXIA IN A HEALTHY COHORT USING 3D PCASL PERFUSION AND 3D APTW MRI: A PILOT STUDY

Matthew Sherwood¹, Kelsie Pyle¹, Stephanie Warner²

¹Wright State University, Dayton, OH, United States; ²U.S. Navy, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: The neurologic response to hyper- and hypoxia is extremely complex and likely involves alterations of cerebral hemodynamics. The response to hypoxia has evolutionary implications but only recently have species been exposed to hyperoxic conditions, thus, a natural response mechanism may not exist. Hyperoxia, a regular component in military aviation, is considered safe; however, it can induce reduced CO₂ levels in the blood producing harmful effects. Thus, hyperoxia may be the source of cognitive and task fatigue that have been reported in military aviation. **METHODS:** Six healthy volunteers have completed 3 experimental sessions using a 3T magnetic resonance imaging (MRI). All subjects received 100% O₂ during the entire 90-minute scan procedure via a custom gas delivery system. This system delivered 100% O₂ to an aviation regulator (Eaton CRU-103) connected to a modified aviation mask (Gentex MBU-20/P). The scanning sequence was identical at each session: 30 minutes of baseline, 30 minutes of exposure where the pressure of O₂ or the CRU-103 was altered, and 30 minutes of recovery. This study is part of a larger program; however, the work presented here utilized all three MRI scans to assess the main effect of exposure time to hyperoxia. Images of amide proton transfer-weighted (APT_w) and pseudocontinuous arterial spin labeling (pcASL) were acquired during baseline and recovery. Cerebral perfusion and APT_w maps were evaluated to determine changes from baseline to recovery. **RESULTS:** Decreased APT_w was observed in numerous regions including the right fusiform, amygdala and superior temporal gyrus. Frontal areas including the left superior frontal gyrus and right anterior cingulate cortex and middle frontal gyrus appeared with increased APT_w. These changes suggest altered protein content in various regions of the brain associated with emotion, attention and executive function. pcASL findings were limited due to the small sample size at this time. **DISCUSSION:** Changes in the APT_w signal, mostly restricted to white matter, may be indicative of altered cellular oxidative stress, neuroprotection and/or bioenergetics metabolism. These findings suggest that hyperoxia may initiate biochemical cascades leading to cortical hypoarousal and neuroinflammation and further behavioral implications. Recruitment in this study is on-going and the results will be updated as the sample increases.

Learning Objectives

1. Become knowledgeable of various advanced MRI sequences and their application in military aviation.
2. Understand the neurophysiologic conditions that alter signals in advanced MRI imaging such as 3D pcASL and 3D APT_w.

[278] EFFECTS OF REPEATED HYPEROXIA EXPOSURE ON RESPIRATORY AND PHYSIOLOGICAL RESPONSE

Caitlin O'Guin, Barbara Shykoff, Kara Blacker

Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Fighter pilots are routinely exposed to high levels of oxygen. The U.S. Navy uses the on-board oxygen generating system's maximum output, nominally 94%, at all altitudes. However, the effects of repeated exposure to the oxygen partial pressures (PO₂) at this concentration have yet to be fully evaluated. This study explored some acute and cumulative effects of elevated PO₂ compared to air. The PO₂ of interest was that for 94% O₂ at 8,000 ft above mean sea level, equivalent to 73% O₂ in our laboratory. **METHODS:** This IRB-approved, between-subjects,

single-blinded study included 57 healthy adults ages 19 to 44 (median 29) years. Participants were randomized into two groups, 73% O₂ or 21% O₂. Participants completed five consecutive days of testing with a two-hour seated gas exposure in each of the first four days. Measurements were respiration during the exposures, grip strength, ventilatory response to exercise, spirometry, lung diffusing capacity, orthostatic tolerance, plasma erythropoietin concentrations, and a set of inflammatory markers. Each exposure day included pre- and post-tests of one variable. Not all variables were tested each day. **RESULTS:** Two-way, repeated measures ANOVA examined the effects of O₂ condition and time. Variables not listed here showed no significant effects. No interactions of time and condition were found. End-tidal CO₂ (etCO₂) showed a main effect of condition, $F(1, 47)=14.571, p<.05$; participants exposed to 73% O₂ had etCO₂ levels 8.7% lower than did those breathing air. Main effects of time were found for ventilatory response to exercise (minute ventilation per O₂ uptake rate, $V'_E/V'O_2$) [$F(3, 141)=4.020, p<.05$] and for some spirometry variables. $V'_E/V'O_2$ increased with time for both O₂ conditions. The spirometry variables decreased over time for both O₂ conditions while remaining within normal standardized ranges. **DISCUSSION:** The results indicate no acute or cumulative difference between O₂ conditions other than on etCO₂. Participants exposed to 73% O₂ hyperventilated slightly, as anticipated, without signs or symptoms. Time effects on spirometric variables and $V'_E/V'O_2$ may indicate fatigue or prolonged sitting, not O₂-related inflammation. Overall, the evidence indicates that repeated acute hyperoxic exposure has no substantive effect on the measured factors imperative to mission success.

Learning Objectives

1. This experiment explored exposure to acute hyperoxia as relevant to aviation and suggested that those conditions do not have a substantial effect on the measured physiologic factors.
2. This experiment suggested that pulmonary inflammation is not evident after single or repeated two-hour hyperoxic exposures to a PO₂ of 500 Torr (94% O₂ at 8,000 feet MSL).

[279] BIOMARKER DISCOVERY IN CONTROLLED NORMOBARIC HYPOXIA EXPOSURES

Sean Harshman¹, Alena Vdigi¹, Anne Jung¹, Kiersten Weatherbie², Madison Stoner-Dixon¹, Aburianne Dash¹, Christopher Land¹, Julia Milo², Dylan Slizewski¹, Christina Davidson¹, Kara Blacker³
¹Air Force Research Lab, 711th Human Performance Wing, Wright-Patterson AFB, OH, United States; ²Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States; ³Naval Medical Research Unit - Dayton, Air Force Research Lab, 711th Human Performance Wing, OH, United States

(Original Research)

INTRODUCTION: Hypoxia remains a source of significant concern for those piloting high performance aircraft within the Department of Defense. Therefore, the ability to detect and mitigate the risks associated with individuals who are hypoxic is of grave importance to pilot safety. However, options to non-invasively monitor pilots in flight remain low. As a result, exhaled breath has become a promising candidate to fulfill this role [1,2]. **METHODS:** To confirm and identify novel biomarkers of hypoxia, controlled mask free normobaric hypoxia, equivalent to 17,500ft., and sea level exposures were performed on 22 individuals over 45 minutes while analyzing exhaled breath and electroencephalogram (EEG) throughout the exposures. **RESULTS:** Preliminary results indicate hypoxia exposures induced a mean SpO₂ drop of 17.9% and an average 10bpm increase in heart rate compared to normoxic conditions. Exhaled nitric oxide illustrated an approximate 2.4 fold increase during the hypoxic exposure, compared to normoxia, and returning to baseline in a post exposure sample. Initial principal component analysis (PCA) of all global exhaled breath data by proton transfer reaction mass spectrometry, acquired throughout the two conditions, show approximately 40.2%

of the overall variation in the data is represented by PC1 (25.4%) and PC2 (14.8%). The breath data suggest variation in the data based on the exposure condition. The EEG results indicate a reduction in the amplitude of the P3a component during hypoxia compared to normoxia, which is indicative of impairment in auditory reorienting of attention under hypoxic conditions. **DISCUSSION:** Collectively, these data illustrate the potential for non-invasive sources, such as exhaled breath and EEG, as potential biomarkers of normobaric hypoxia.

Learning Objectives

1. Understand the rationale for exhaled breath monitoring for hypoxic stress.
2. Understand the current state of the data analysis and the path moving forward.

[280] INVESTIGATING THE EFFECTS OF INTERMITTENT ACUTE HYPOXIC EXPOSURE AND BREATHING RESISTANCE

Frank Robinson¹, Jeremy Beer², Nathaniel Spencer³, Barbara Shykoff³, Zachary Kerns², David Freeman²
¹Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States; ²KBR, San Antonio, TX, United States; ³Naval Medical Research Unit - Dayton/Leidos, Wright-Patterson AFB, United States

(Original Research)

INTRODUCTION: Research on the effects of hypoxia has traditionally focused on steady state exposures. Under certain conditions, however, aircraft On-Board Oxygen Generation Systems (OBOGS) may intermittently deliver gas that is insufficient to maintain normal blood oxygenation at altitude. In addition, aircraft life support systems may also impose breathing resistance. This study examined the effects of intermittent exposures to acute hypoxia, continuous exposure to breathing resistance, or both stressors simultaneously. **METHODS:** This study utilized a within subjects design. Six participants completed four visits in which they experienced normobaric plus 1) a control condition breathing 65% oxygen with no added breathing resistance; 2) intermittent acute hypoxia in which they alternated between one-minute periods of breathing 65% oxygen or 7% oxygen (simulated 25,000 foot altitude); 3) continuous breathing resistance slightly outside the allowed air standard with 65% oxygen; or 4) intermittent acute hypoxia and continuous breathing resistance together. Participants completed high and low workload variants of a color word Stroop task throughout each profile. We recorded pulse oximetry, fNIRS, end-tidal CO₂, respiratory dynamics, performance, and subjective symptom data. **RESULTS:** We observed experimental effects on multiple outcome measures. Breathing condition and workload both affected breathing period (both $p < 0.01$), tidal volume (both $p < 0.01$), and end-tidal CO₂ (both $p < 0.05$). fNIRS data identified mental activity in the prefrontal cortex when performing the Stroop compared to baseline ($p = 0.03$) but could not distinguish between periods of high and low workload within the Stroop task and failed to identify differences across breathing condition. **DISCUSSION:** Multiple outcome measures responded to differences in breathing condition. Notably, the effects of the intermittent hypoxia/resistance condition were often distinct from the response to either insult in isolation. We further observed that mental workload had a significant effect on several outcome measures. fNIRS was unable to detect multiple physiological and cognitive impacts of our manipulations, as revealed by other outcome measures. The unique effects of different respiratory stressors and the effect of cognitive task should be accounted for in the development of future cockpit sensors and alert systems for real-time aircrew monitoring.

Learning Objectives

1. Participants will learn the ways in which different types of respiratory and cognitive challenges may affect breathing patterns.
2. Participants will learn how various physiological indicators can be differentially responsive to respiratory challenges.

Wednesday, 05/08/2024
Grand Ballroom B

8:30 AM

[S-50]: PANEL: OPHTHALMIC AEROMEDICAL WAIVER CASES

Chair: Micah Kinney

Co-Chair: Adam Preston

PANEL OVERVIEW: TITLE: *Ophthalmic Aeromedical Waiver Cases*

BODY: This panel will present unique ophthalmic aeromedical clinical cases and the return to flight or waiver adjudication process that followed. Vision and ophthalmic standards are often thought of as the most rigorous for aviation occupations. First, this panel will present an Army aviation candidate who presented with a presumed Congenital Simple Hamartoma of the Retinal Pigment Epithelium (CSHRPE). Next, a case on the forces of high G maneuver flight causing valsalva retinopathy in a student Naval aviator. The third, a series of cases which will discuss cranial nerve IV palsies and the unique presentations, etiology, and waiver decision of three aircrew. Fourth, a rare but relevant complication following LASIK called transient light sensitivity syndrome in a naval flight officer will be discussed. Finally, the FAA will present on the use of the Special Medical Flight Test (MFT) to verify performance and safety of flight, including two cases in which the MFT was performed for failure to meet visual acuity standards due to amblyopia, and one case in which the MFT was performed to remove the limitation for failed color vision testing for Class 1 medical certificate. Through advancements in clinical and operational research, data driven waiver decisions provide a method to retain aircrew or offer justification for disqualification.

[281] TRANSIENT VISION LOSS IN A STUDENT NAVAL AVIATOR DURING A DYNAMIC MANEUVER TRAINING FLIGHT IN A MILITARY JET: A CASE REPORT

Stephen Jaggi, Makala Bascome
U.S. Navy, Meridian, MS, United States

(Education - Case Study)

INTRODUCTION: This case report describes a student naval aviator who experienced transient complete vision loss in her right eye during a dynamic maneuver training flight secondary to a Valsalva event. **BACKGROUND:** Military training jets are exceptionally agile and dynamic flights can lead to nausea and other physiological symptoms. The physiologic responses to a dynamic high-G flight environment (e.g., nausea, coughing, and Valsalva) compounded with using the anti-G strain maneuver, can lead to unique sequelae in the sensory system, including the eyes and visual system. The type of maneuvers executed during these training flights are typical of jet maneuvers during tactical missions, and awareness of unforeseen aeromedical complications should be recognized for increased situational awareness, safety, and mission accomplishment. **CASE PRESENTATION:** A 25-yr old female student naval aviator presented to sick call with the Flight Surgeon after loss of vision to right eye for ten minutes after performing dynamic high-G flight maneuvers. The patient denied pain or any other health concerns at that time and was seen by the Aerospace Optometrist the following morning. She reported that while flying, she felt nauseous, removed her mask, and coughed forcefully. She immediately experienced a complete loss of vision in her right eye, and subsequently began her return to base procedures. As she descended, her vision began to return, and returned fully to normal after 10 minutes. A comprehensive dilated eye exam was performed, and it was determined the student naval aviator had experienced Valsalva Retinopathy and was cleared for resuming flight duties after being monitored and completing an unremarkable follow-up with an

ophthalmologist. **DISCUSSION:** This case highlights the potential for seldom discussed or considered conditions that may arise during or after dynamic flights with a high amount of +Gz exposure, or other dynamic maneuvers, as well as the operational importance of having easy access to trained aeromedical subspecialists. Other conditions will be discussed for familiarity of those performing the follow up care, and educating the aviators and flight crew of symptoms or conditions they may experience.

Learning Objectives

1. The audience will become more familiar with the potential for seldom discussed or considered conditions that may arise during or after dynamic flights with a high amount of +Gz exposure, or other dynamic maneuvers.
2. The audience will discover evidence of the operational importance of having easy access to trained aeromedical subspecialists.

[282] CN IV PALSY WAIVER CONSIDERATIONS AND RECOMMENDATIONS: CASE REPORT

Megan Rieman

Naval Aerospace Medicine Institute, Pensacola, FL, United States

(Education - Case Study)

INTRODUCTION: This presentation discusses three cases of CN IV palsy in members with varying Aviation Class and level of experience. **BACKGROUND:** Single, fused/stereoscopic, simultaneous binocular vision in all fields of gaze is a requirement for safe and effective flight duties. Congenital or acquired defects of ocular alignment as well as any surgery to correct ocular misalignment can cause mild to severe degradations to binocular vision and acuity and be a grave hazard in aviation. **CASE PRESENTATION:** Patient 1 was a 35YO male, senior USMC Major helicopter pilot, with 2000 total flight hours, 700 in combat, when his CN IV palsy was discovered in 2015. He exhibited normal stereopsis and intermittent suppression OS without diplopia. Patient 2 was a 26YO male with 300 total flight hours in the last phase of F-35 FRS training demonstrating long standing excessive vertical tropia due to his congenital CN IV palsy. The findings outside of standards were noted at an accession eye exam, but this information was not recorded in his initial flight physical and his condition was finally noted in May 2023. He exhibited reduced stereopsis and suppression OS, without diplopia. Patient 3 was a 21YO male, air traffic controller with 2 years of experience. Stereopsis and phorias are not mandatory elements of a screening for Class III aviators thus the condition went unnoticed until the flight surgeon observed a posture disparity at his annual physical. He demonstrated a large angle hypertropia with constant alternating suppression, therefore not diplopic. In the case of a well-experienced pilot, operating a dual-seated aircraft, a waiver was recommended, with the stipulation of SG3 as a safety precaution. With a pilot who is a novice in his aircraft-type, a single-seat jet, the assumption of risk is much greater, thus the member was not recommended to continue duties involving flight (DIF). For the air traffic controller, stereopsis is not required and the member was recommended for a waiver. **DISCUSSION:** These cases highlight the importance of a thorough ocular assessment and understanding of oculomotor deviations as they impact DIF. The concern of a decompensated phoria resulting in diplopia or suppression due to a long standing tropia is a critical finding when considering safety to conduct flight related operations but should be evaluated within the context of the member's experience and role in the aviation community.

Learning Objectives

1. The audience will learn about the importance of a thorough ocular assessment and understanding of oculomotor deviations as they impact duties involving flight.
2. The audience will learn about waiver considerations for CN IV palsies the context of an individual's experience and role in the aviation community.

[283] CONGENITAL SIMPLE HAMARTOMA OF THE RETINAL PIGMENT EPITHELIUM (CSHRPE) IN AN ARMY HELICOPTER PILOT CANDIDATE

Toan Trinh

U.S. Army Aeromedical Research Laboratory, Fort Novosel, AL, United States

(Education - Case Study)

INTRODUCTION: This case report describes a United States Army helicopter pilot candidate vision waiver for congenital simple hamartoma of the retinal pigment epithelium (CSHRPE). **BACKGROUND:** An Army helicopter pilot candidate must complete a flight physical, including a comprehensive ophthalmic exam before training begins. The candidate must have uncorrected distance vision no worse than 20/50 in either eye with normal color vision, cannot miss more than 2 plates on the Pseudoisochromatic Plate (PIP). Intraocular pressures no greater than 21 mmHg and no less than 8 mmHg. Stereopsis must be no worse than 40 seconds of arc. Also, no adnexal, anterior, or posterior segment pathologies on dilated fundus exam. The Exceptions to Policy may be granted on a case-by-case basis based upon potential prognosis of the condition.

CASE PRESENTATION: A 24-year-old female, active-duty Army helicopter pilot candidate, presented for her flight physical prior to entrance into flight school. During her fundus exam of the right eye, a 1/6-disc diameter, sharply demarcated, dark circular lesion inferior to fovea; no macular edema, exudates, traction, or sub-retinal fluid were observed. Optical coherence tomography demonstrated an intense surface hyper-reflectivity with complete shadowing of optical transmission through the choriocapillaris. Visual fields showed slight depression corresponding to the location of the retinal lesion without remarkable scotoma. The differential diagnosis includes choroidal nevi, hyperplasia, or adenocarcinoma of the retinal pigment epithelium (RPE), or CSHRPE. A retinal specialist was consulted, and the candidate was presumed to have a CSHRPE.

Given the location of the CSHRPE, the patient was 20/20 OD, normal color vision and no visual significant scotoma. **DISCUSSION:** CSHRPE is a rare finding with low prevalence and usual found within the macular region. The lesion might have formed due to migration of RPE cells to the retinal surface during embryogenesis. With good vision and no visual deficits, the cones are most likely present in this lesion secondary to the unpacking effect of photoreceptors during development. The pilot candidate's ocular structures and functions are expected to remain stable, and no specific treatment is required, an Exception to Policy was granted to allow for entrance into flight school. The waiver requires an annual, comprehensive retinal examination to rule out vascular changes.

Learning Objectives

1. Inform about a rare case of Congenital Simple Hamartoma of the Retinal Pigment Epithelium (CSHRPE).
2. Discuss the vision exceptions to policy process for Army aviation.

[284] TRANSIENT LIGHT SENSITIVITY SYNDROME IN A NAVAL FLIGHT OFFICER

Micah Kinney

Naval Air Warfare Center Aircraft Division, Patuxent River, MD, United States

(Education - Case Study)

INTRODUCTION: Corneal refractive surgery (CRS) provides the opportunity for individuals to meet aviation vision standards who would otherwise be disqualified due to excessive refractive error. Generally, an individual who exceeds the refractive error requirements to be a naval pilot may be offered naval flight officer (NFO) positions which have more generous refractive error limits. Once designated, NFOs will seek CRS to reduce dependence on glasses or contacts while flying. This case presents a rare but operationally significant temporary complication in an NFO following laser in situ keratomileusis (LASIK). **BACKGROUND:** Transient light-sensitivity syndrome (TLSS) is an unusual and unpredictable complication following corneal refractive surgery. It is characterized by moderate-to-severe light sensitivity (photophobia) which becomes symptomatic two to eight weeks post-surgery. Typically TLSS is associated

with inflammation of ocular structures without clinical signs of inflammation upon examination with a slit-lamp. **CASE PRESENTATION:** A 36 year old Caucasian male NFO underwent successful LASIK in each eye at a military surgical center. His 1 day and 1 week post-operative exams were unremarkable with no symptoms of photophobia and uncorrected distance visual acuity of 20/20 in each eye. At his three week post-operative visit, symptoms of mild photophobia were reported without any clinical signs of inflammation and no reduction in visual acuity. Five weeks post-surgery, the patient called the clinic reporting debilitating photophobia without any changes in visual acuity. Upon examination the patient was visibly disturbed by light and wearing sunglasses indoors. No ocular inflammation was observed and the patient restarted corticosteroid ophthalmic drops. After a series of follow up visits and slow taper of corticosteroid ophthalmic drops, the symptoms of photophobia subsided and the patient reported positive outcomes with ocular comfort and vision. An aeromedical summary was issued for return to flight duties at his 6 month post-operative visit. **DISCUSSION:** While CRS has revolutionized aircrew selection and the reduction in reliance on eyeglasses or contacts while flying, there are unique aeromedical concerns that may impact the return to flight operations. Careful ophthalmic examination and patient follow up is necessary during the post-operative period.

Learning Objectives

1. The participant will learn about corneal refractive surgery among U.S. military aircrew.
2. The participant will learn about ocular complications following corneal refractive surgery and their aeromedical concerns.

[285] FAA MEDICAL FLIGHT TEST USE FOR ABNORMAL VISUAL FUNCTION

Harriet Lester¹, Leo Hatstrup²

¹FAA, Jamaica, NY, United States; ²FAA, Washington, DC, United States

(Education - Case Study)

INTRODUCTION: The special medical flight test (MFT) is used to help determine if a pilot is safe to fly with a functional impairment. Three cases utilizing a MFT for abnormal visual function will be presented.

BACKGROUND: Flight Standards Order 8900.1, Vol5, Ch8, Sec1 provides guidelines for the administration of a MFT and is updated as necessary. Outcomes include a Special issuance (SI), Statement of Demonstrated Ability (SODA), Letter of Evidence (LOE), or denial by the Office of Aerospace Medicine. A pilot with defective color vision who is unable to pass an FAA approved color vision test has his/her medical certificate limited with "NOT VALID FOR NIGHT FLYING OR BY COLOR SIGNAL CONTROL." To remove the limitation, additional operational color perception tests are necessary and are determined by the class of Medical Certificate requested. If successful, an LOE is granted. Pilots with defective vision in one eye, such as from amblyopia, are also evaluated by an MFT and granted a SI or SODA if successful. Since May 2023, airmen must hold at least second class medical to exercise the privileges of a commercial pilot certificate in a balloon for non-instructional flight. This has expanded the use of MFT to include balloon pilots.

CASE PRESENTATION: Case 1: A 24-year-old pilot with 52 hours and abnormal color vision sought an upgrade from a Class 3 to Class 1 medical certificate and removal of his color vision limitation. He successfully completed an Operational Color Vision Test (OCVT) as well as MFT and was issued an LOE. Case 2: A 54-year-old pilot with 576 hours and right eye amblyopia with best corrected acuity 20/100, sought Class 2 medical certificate. He passed an MFT in a balloon and was issued an SI limited to balloon operations. Case 3: A 27-year-old pilot with 354 hours and right eye amblyopia with best corrected acuity 20/60, passed an MFT and was issued SODA May 2020 for Class 3 and subsequently upgraded to an SI for Class 1. **DISCUSSION:** The MFT process involves coordination between different offices of the FAA Aviation Safety Line of Business. The MFT enables practical functional testing when medical evaluation alone is insufficient. MFTs can be accomplished in airplanes, simulators, helicopters, and balloons, as appropriate. The MFT is performed by FAA Flight

Standards Aviation Inspectors (ASI) or specially authorized Designated Pilot Examiners (DPEs). MFTs are used for multiple conditions including abnormal vision.

Learning Objectives

1. The participant will be able to identify the source document for Special Medical Flight Tests: Flight Standards Order 8900.1, Vol5, Ch8, Sec1.
2. The participant will be able to identify 2 vision abnormalities for which Medical Flight Tests can be performed.
3. The participant will identify 3 medical certification outcomes that can result after a Medical Flight Test.

Wednesday, 05/08/2024
Grand Hall J

8:30 AM

[S-51]: SLIDES: AVIATION MEDICINE- POTPOURI

Chair: Warren Silberman
Co-Chair: Roy Allen Hoffman

[286] ANALYZING TOP GUN & TOP GUN 2: CINEMATIC INSIGHTS INTO AVIATION MEDICINE FOR EDUCATIONAL ENRICHMENT

Paul Dhillon¹, Eric Juneau²

¹Canadian Armed Forces, Sechelt, BC, Canada; ²Canadian Armed Forces, Vancouver, BC, Canada

(Education - Tutorial/Review)

Aviation Medicine Pearls Unveiled: Teaching Through Film Analysis in Top Gun and Top Gun: Maverick

Aviation medicine, an intricate field vital for pilot health and safety, can be uniquely conveyed and comprehended through the lens of popular aviation films. This abstract highlights key aviation medicine pearls extracted from the iconic film "Top Gun" and its sequel, "Top Gun: Maverick," exemplifying the educational potential of aviation film analysis.

In "Top Gun," the character of Pete "Maverick" Mitchell, portrayed by Tom Cruise, embodies various aspects of aviation medicine. His enigmatic personality and risk-taking behavior provide a foundation for discussing psychological evaluations and stress management in aviation personnel. Moreover, the film's depiction of aerial combat situations allows for exploration of G-forces, spatial disorientation, and their impact on pilot physiology.

The sequel, "Top Gun: Maverick," delves further into the realm of aviation medicine. With advancements in technology and increased realism, the film provides a platform to discuss modern aerospace medicine. Topics such as cockpit ergonomics, advanced avionics, and their influence on pilot performance are readily evident. Furthermore, the film delves into the challenges of aging pilots, shedding light on medical assessments and fitness standards for senior aviators.

Engaging the audience through aviation film analysis not only fosters an appreciation for aviation medicine but also encourages critical thinking. Viewers are encouraged to question the accuracy of medical portrayals in the movies and explore the real-world implications of the depicted scenarios.

Incorporating these cinematic pearls into aviation medicine education can be achieved through interactive discussions, case studies, and simulation exercises. By dissecting the medical aspects of "Top Gun" and "Top Gun: Maverick," educators can stimulate curiosity, enhance knowledge retention, and instill a deep appreciation for the intricacies of aviation medicine.

In conclusion, the exploration of aviation medicine pearls within the context of "Top Gun" and its sequel, "Top Gun: Maverick," demonstrates the potential for effective teaching through aviation film analysis. These films offer a captivating gateway to understanding the multifaceted field of aviation medicine while engaging and educating future aviation medicine professionals in an accessible and enjoyable manner.

Learning Objectives

1. Analyze aviation medicine concepts in "Top Gun" and its sequel.
2. To promote critical thinking through film-based aviation medicine discussions centered around a singular aviation medicine franchise.

[287] TBI MECHANISMS OF INJURY IN U.S. AIR FORCE PILOTS

Allan Ward, Joseph Connolly, Aven Ford, Joseph Wagner
USAFSAM, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Traumatic brain injury (TBI) is a leading cause of disability worldwide and a disqualifying condition for U.S. Air Force (USAF) personnel on flying status. A query of the Aeromedical Information Management Waiver Tracking System (AIMWTS) database revealed over 3000 USAF Airmen with aeromedical waiver submissions between 2001 and 2023. We sought to better understand demographics such as age at TBI and most common mechanisms of injury (MOI) within a pilot subset of this population. **METHODS:** The aeromedical waiver summaries of 764 USAF pilot and pilot candidates with history of TBI were mined using the AIMWTS database. Age at TBI, TBI severity, MOI, loss of consciousness (LOC) incidence, and CT/MRI imaging results were collected. MOI was categorized as one of the following: combat/blast injury, fall, vehicular/crash, violence, struck by/against, sports related, or other. The study protocol was approved by the 711 HPW IRB. **RESULTS:** Of the 764 flyers studied, 708 (92.7%) were male and 56 (7.3%) were female. Mean age at TBI occurrence was 22.3 years (range: 0.68-56.8 years). 76.7% of TBI events occurred among ranks O-3 and below (including civilian status). Applying severity criteria defined by the USAF Aerospace Medicine Waiver Guide, 67.3% of the TBIs were categorized as aeromedically mild, 18.5% were moderate, and 12.7% severe. Regarding MOI, most TBIs in this population were sports related (34.7%), followed by falls (30.5%) and vehicular/crashes (19.4%). 65.3% of TBIs had associated or suspected loss of consciousness (LOC), and 66.6% had undergone head CT scans, most (74.0%) of which were read as normal. 91.0% of flyers with mild TBI had a normal CT scan (no intracranial injury). 19.5% of flyers with moderate TBIs had some abnormality on CT scan, although typically for reasons other than intracranial injury (e.g., non-displaced skull fracture), while most severe TBIs (87.0%) were associated with some degree of intracranial injury. **DISCUSSION:** Among USAF pilots and pilot candidates, the majority of TBIs for which aeromedical waiver was sought occurred prior to military service and in lower ranks. Most TBIs were mild and sports-related and/or due to falls, although nearly 20% were associated with vehicular mishaps. The majority who underwent evaluation with head CT scan showed no intracranial injury, whereas most moderate and severe TBIs had some imaging evidence of brain contusion (e.g., hemosiderin deposition or diffuse axonal injury).

Learning Objectives

1. The audience will be able to identify the most common TBI mechanisms of injury among USAF pilots with history of TBI.
2. The audience will learn the average age and age range for TBI events in the USAF pilot population.
3. The audience will review the current USAF aeromedical waiver standards for determining degree of head injury and requirements for aeromedical waiver consideration.

[288] DECODING THE DIAGNOSTIC ENIGMA: SUBACUTE THYROIDITIS MASQUERADING AS NEUROLOGICAL SYMPTOMS IN AN AIRLINE PILOT.

Ganesh Anbalagan

CASA, Australia, Canberra, Australia

(Education - Case Study)

INTRODUCTION: This case report illuminates the intricate complexities inherent in the diagnosis, management, and aeromedical disposition of a pilot who experienced a perplexing transient neurological

episode during pre-flight preparations. **Case Description:** The pilot's initial presentation featured a sudden-onset blurred vision, sensory deficits, and an unusual cold sensation in the left arm, leg, and neck. Initial assessments effectively ruled out stroke, transient ischemic attack (TIA), and focal seizures. Subsequent evaluations conducted by multiple specialists ensued. The first neurologist proposed anxiety as a potential cause, likely triggered by excessive caffeine intake and subsequent hyperventilation. A subsequent evaluation by a second neurologist and neuro-otologist posited a sensory migraine aura (without headache) as the primary diagnosis, despite the lack of corroborative evidence and the unconventional nature of the symptoms. While considering hyperventilation, it was regarded as less likely due to its association with symmetrical paraesthesia. **DISCUSSION:** The extensive investigation failed to pinpoint a definitive root cause for the pilot's perplexing symptoms. During this investigative phase, an endocrinologist's assessment was initiated due to an abnormal thyroid function test. Subsequently, the pilot received a diagnosis of subacute thyroiditis, supported by an elevated thyroid-stimulating hormone (TSH) and positive anti-thyroid antibodies. Subsequent thyroid function tests exhibited gradual improvement, further confirming the diagnosis. This case highlights the intricacies of diagnosing and managing unusual medical presentations in aircrew members, underscoring the importance of interdisciplinary collaboration and thorough investigation in ensuring flight safety. The most probable cause, as established by the endocrinologist, appeared to be subacute thyroiditis, known for its idiosyncratic manifestations, including neurological symptoms. The diagnosis was further supported by the clinical course of thyroid function tests and the absence of other neurological pathologies. The pilot's case underwent review by the aviation medicine complex case management panel, which resulted in the issuance of a conditional certificate enabling him to fly in a multicrew environment under surveillance.

Learning Objectives

1. The audience will be able to understand the complexities and intricacies inherent in aeromedical fitness assessment of unusual medical conditions, such as the case presented.
2. The audience will gain insights into the clinical presentation, diagnostic criteria, and management of subacute thyroiditis, a condition known for its atypical manifestations.

[289] TACTICAL USAGE OF NICOTINE FOR COGNITIVE PERFORMANCE IN LONG DURATION MISSIONS

Joseph Tierney

University of Massachusetts - Amherst, Amherst, MA, United States

(Education - Tutorial/Review)

INTRODUCTION: Nicotine use is popular in the Air Force, specifically among aviators to improve their cognitive performance. It's important to understand nicotine delivery methods and its evolution from centuries ago, the effects on the body, and the way that aviators could utilize it in critical phases of flight. **TOPIC:** The usage of nicotine has been around for centuries and until recently was primarily derived from tobacco. Historically, nicotine in the forms of tobacco from cigarettes, dip, and pipes, was seen as a drug with more negative effects than positive, leading to its cultural phase-out. This is true regarding the ingestion of carcinogens and other harmful chemicals that led to mouth, cardiovascular, and respiratory diseases from the tobacco plant. Rarely discussed is the use of nicotine itself to improve cognitive function, specifically working memory and attention. The use of modern nicotine delivery devices like gum, patches, and pouches, allow for a slow release of nicotine into the body and prolonged effects compared to smoking. This comes without tobacco and carcinogenic exposure, as well as deliberate controlled amounts from the delivery system. There are several physiological reactions when administered nicotine such as increased heart rate, increased blood pressure, and dopamine release. Nicotine can improve reaction time, working memory, and attention which directly increases

cognitive performance. With advancements in delivery methods, aviators can regulate amount and time of nicotine administration at critical phases of flight. **APPLICATION:** The use of nicotine for critical phases of flight could substitute the use of modafinil and other "GO-Pills" that have prolonged effects and can result in much more severe problems. In flight, aviators can use nicotine devices to counter the effects of withdrawal if having previous dependency, but this could expand to non-traditional users to improve their cognitive function. Additionally, nicotine is a stimulant that increases heart rate and blood pressure, a positive effect for increasing +Gz tolerance. With a slow delivery method of nicotine, the effects can be felt for a specified period with a short half life that would not interfere with an aviator's sleep after.

Learning Objectives

1. The participant can recall basic facts of the history of nicotine delivery systems.
2. The participant will understand the effects on nicotine on the human body.
3. The participant can recall the advantages of nicotine for aviators in mission critical situations.

[290] UTILIZING MACHINE LEARNING FOR PREDICTIVE DIAGNOSIS OF METABOLIC SYNDROME IN COLOMBIAN MILITARY AIRMEN

Diego L Malpica H¹, Marian Farfan²

¹Colombian Aerospace Force, Bogota, Colombia; ²National University of Colombia, Bogota, Colombia

(Original Research)

INTRODUCTION: Metabolic syndrome (MetS) is a cluster of cardiometabolic abnormalities that predispose individuals to type 2 diabetes and cardiovascular disease. This is particularly relevant to airmen, who may be exposed to occupational stressors that increase their risk of developing MetS. This study aimed to determine the prevalence of MetS among Colombian military airmen from the Aerospace Force and evaluate the utility of the Atherogenic Index of Plasma (AIP) as a diagnostic tool for MetS. **METHODS:** A retrospective cross-sectional review was conducted using clinical records and laboratory measurements from annual aeromedical examinations of 1365 military airmen from 2022 to 2023. MetS was defined according to established criteria, and various hematological and metabolic parameters were compared between individuals with and without MetS. Logistic regression and machine learning techniques were employed to identify the most influential predictors for MetS diagnosis. **RESULTS:** The prevalence of MetS was 10.6%, with significant differences observed in several key indicators between individuals with and without MetS. The AIP demonstrated high utility in identifying subjects with MetS, boasting an area under the curve of 0.92, a sensitivity of 88.4%, and a specificity of 84.4%. The optimized Random Forest model achieved an overall accuracy of 95% and an F1-score of 97% for class '0' and 63% for class '1'. **DISCUSSION:** The study revealed a considerable prevalence of MetS among Colombian military airmen, highlighting the need for risk factor management and preventive measures. The AIP emerged as a valuable diagnostic tool for MetS, with potential applications in aerospace medicine and extreme physiology research. Future studies could explore the impact of interventions targeting MetS risk factors on the health and performance of airmen.

Learning Objectives

1. Understand the prevalence of metabolic syndrome among Colombian military airmen and its implications for their health and performance.
2. Recognize the utility of the Atherogenic Index of Plasma as a diagnostic tool for metabolic syndrome in the context of aeromedical certification and its implications for risk management in public health.

[291] SEVERITY OF HYPOXIA EFFECTS IN RAPID VS. GRADUAL DECOMPRESSION

Jeremy Beer¹, Andrew Mojica¹, Kara Blacker², Todd Dart¹, Bria Morse¹, Paul Sherman³

¹KBR Science & Space, San Antonio, TX, United States; ²Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States;

³U.S. Air Force 59th Medical Wing, Joint Base San Antonio-Lackland, San Antonio, TX, United States

(Original Research)

INTRODUCTION: Legacy studies have reported that rapid decompression (RD) causes greater cognitive disruption than gradual ascent, but these findings were based on limited samples. Here, a hypobaric chamber study was conducted to identify potential differences in the cognitive and physiological effects imposed by RD vs. gradual decompression, and to determine whether hypobaria would impede performance in the absence of hypoxia. **METHODS:** Twelve altitude-qualified participants (11 male, one female) completed RD and Gradual Ascents from 2743m (9000ft) to 7620m (25000ft) altitude pressures while breathing Air (Hypoxia condition) or 100% O₂ (No Hypoxia condition). Throughout these exposures, cognition was evaluated using the SYNWIN synthetic workstation which combines memory, arithmetic, visual monitoring, and auditory tasks. Physiological indices included S_pO₂, heart rate (HR), respiration metrics, end tidal O₂ and CO₂ partial pressures (P_{et}O₂, P_{et}CO₂), and EEG. A repeated-measures design was employed, incorporating Epoch (Ground-Level, Pre-Breathe, Ascent, Recovery), Ascent Rate (RD, Gradual) and Breathing Gas (Air, 100% O₂). **RESULTS:** Altitude effects in hypoxic "Air" exposures included significantly elevated HR and Minute Ventilation (\dot{V}_E) combined with decreased S_pO₂, P_{et}O₂, and P_{et}CO₂ (all p<0.001); S_pO₂ and HR effects were greater after RD (p<0.01). HR and \dot{V}_E remained altered relative to Ground-Level baseline during Recovery from hypoxia (p<0.01). SYNWIN performance declined during Ascent on Air (p<0.001), with key metrics falling further after RD (p<0.05). Broad cognitive impairment was not recorded on 100% O₂, and no lingering impairment was recorded in Recovery. EEG signals showed increased slow-wave activity during hypoxia. **DISCUSSION:** In Air conditions, RD impaired performance more than Gradual Ascent. Notably, cognitive impairment was not observed to linger into Recovery from these brief acute hypoxia exposures. Hypobaria did not impair performance comprehensively in the absence of hypoxia. HR and \dot{V}_E metrics suggested compensatory slowing following altitude stress. Participants appeared to adjust their cognitive strategy during hypoxia, redistributing effort to preserve performance of less demanding tasks at the expense of efficiency and computational throughput.

Learning Objectives

1. The audience will understand the conduct and results of a hypobaric chamber study comparing the effects of rapid vs. gradual decompression—with and without hypoxia—on physiologic metrics and performance in a synthetic workstation.
2. The audience will understand the complexities of testing whether and for how long physiologic effects and cognitive impairment linger after altitude exposure.

Wednesday, 05/08/2024

Grand Hall K

8:30 AM

[S-52]: PANEL: RESIDENT IN AEROSPACE MEDICINE (RAM) GRAND ROUNDS IV

Chair: Sonya Heidt

Co-Chair: Jonathan Elliot

PANEL OVERVIEW: Resident in Aerospace Medicine (RAM) Grand Rounds consists of 6 clinical case presentations. Each case is presented by current RAMs who will review the clinical case, diagnosis, treatment

pathway and current policies from different agencies. The aviator's aeromedical disposition and waiver or special issuance outcome (if applicable) will be discussed. These unique case presentations describe clinical aviation medicine as well as policy updates for common medical and/or mental health conditions encountered in the practice of Aerospace Medicine.

[292] DECOMPRESSION SICKNESS IN A FLIGHT SURGEON COURSE STUDENT

Cosme Belmonte

U.S. Army Medical Center of Excellence, Fort Novosel, AL, United States

(Education - Case Study)

INTRODUCTION: This case report describes a military flight surgeon course student who was diagnosed with type 2 decompression sickness following exposure to rapid decompression from ground level to 25,000 ft in a hypobaric chamber. **BACKGROUND:** Decompression sickness (DCS) occurs when dissolved gasses exit solution and form bubbles during depressurization. It can occur during diving activities while flying in unpresurized aircraft, or exposure to a hypobaric chamber. Type 1 DCS involves the skin, musculoskeletal, or lymphatic system. Type 2 DCS involves the central nervous system. The incidence of Decompression sickness itself is rare and depends on the length and depth of exposure. Tissue damage occurs from the effects of bubbles which may be direct endothelial damage and activation of inflammatory mediators. Joint pain accounts for most cases. Neurological manifestations are present in 10 to 15% of cases, and most commonly present as headaches or visual disturbances. Pulmonary DCS is uncommon in aviators due to oxygen pre-breathing protocols. **CASE PRESENTATION:** The patient was attending the Army's Flight Surgeon Course and underwent type 4 hypobaric altitude chamber protocol and subsequently developed symptoms the following day that included bilateral wrist pain and anterior elbow paresthesia. After consultation with the Naval Dive Medical Officer in Pensacola Florida, the patient was flown via MEDEVAC and treated with US Navy treatment table 6. He had complete resolution of symptoms. He underwent another round of hyperbaric oxygen treatment the next day with US Navy treatment table 5. **DISCUSSION:** Though DCS is rare, an untreated patient may develop long-term tissue damage. Often, providers must err on the side of caution in someone with symptoms that sound suspicious for DCS after exposure to depth or altitude. In this case, the presence of wrist pain developed the evening of the hypobaric altitude training, but the patient did not present to the Flight Surgeon until the following afternoon. He was appropriately treated and was placed on a downslip until evaluated by a Neurologist according to the Army aeromedical policy letters.

Learning Objectives

1. The audience will learn about the symptoms of Decompression Sickness and its related complications.
2. The audience will learn about the aeromedical implications and flight considerations of patients with Decompression Sickness.

[293] BLOCKING THE WAY TO SPACE: EVALUATION OF A PATIENT WITH RECURRENT SMALL BOWEL OBSTRUCTION FOR SPACEFLIGHT

Isaiah Reeves, Samantha King

UTMB, Galveston, TX, United States

(Education - Case Study)

INTRODUCTION: This case report describes a 40-60 year-old astronaut seeking a waiver after a small bowel obstruction status post-lysis of adhesions. The individual had a past medical history of appendicitis status post open appendectomy as a young child complicated by a small bowel obstruction (SBO) approximately 20 years later treated with laparotomy and adhesion release. They were previously granted a waiver for long duration spaceflight. They developed another SBO and underwent laparoscopic adhesiolysis without complication. After recovery,

they were evaluated for certification for long-duration spaceflight.

BACKGROUND: SBOs are a common complication of intra-abdominal surgery due to the formation of adhesions. SBOs can be treated conservatively with oral intake restriction, rehydration, and symptom management but may be treated with surgical intervention. Recurrence of an SBO is common but less frequent with operative intervention. Screening for adhesions predisposing an individual to recurrence are not commonly performed. **Case Presentation:** After recovery, this individual underwent evaluation for long-duration spaceflight. Outside of prior abdominal surgeries they had no other complicating medical conditions. Due to the concern for recurrence of SBO, the individual underwent additional screening evaluation for adhesions via abdominal ultrasound evaluation which showed "visceral slide" and did not find evidence of bowel adhesions. The astronaut was presented to the Multilateral Space Medical Board and granted certification for long-duration spaceflight.

DISCUSSION: This case presentation describes a common complication of intra-abdominal surgery, SBO, and one process for evaluation for qualification for spaceflight. Intra-abdominal surgery is a common operation that an individual may undergo for a variety of conditions, including childhood surgery for appendicitis. Any individual with a history of prior intra-abdominal surgery is at risk for a small bowel obstruction and prior SBO puts an individual at risk for recurrence. An SBO in spaceflight would put the individual at risk of uncontrollable nausea and vomiting, dehydration, and be potentially mission ending. Possible adhesions and SBOs can be diagnosed with ultrasound. Risk reduction and prediction of recurrence is important for safety of the individual and the mission.

Learning Objectives

1. The participant will understand the potential risks of a prior small bowel obstruction during medical evaluation for spaceflight.
2. The participant will understand one possible method of evaluation of a crewmember with a history of a small bowel obstruction for certification for spaceflight.

[294] This abstract was moved to S-28.

[141] I CAN SEE FINE DOC! A CASE OF ENDOTHELIAL CORNEAL DYSTROPHY IN UNMANNED AIRCREW

Greg Rogers

Naval Aerospace Medical Institute, Pensacola, FL, United States

WITHDRAWN

[295] ACUTE CRYPTOGENIC STROKE IN A PILOT STUDENT WITH PATENT FORAMEN OVALE: A CASE REPORT

Jeffrey Brown, Jesse Laverdiere

Department of Aviation Medicine, Fort Novosel, AL, United States

(Education - Case Study)

INTRODUCTION: This case report describes the acute presentation and management of a military flight school student that was found to have an acute cryptogenic stroke in the setting of a patent foramen ovale. **BACKGROUND:** Strokes are considered cryptogenic when no source can be identified. A patent foramen ovale (PFO) is detected in approximately half of patients following cryptogenic stroke. PFOs are present in about 20-25% of the adult population. An Atrial Septal Defect (ASD) is disqualifying for Army Aviation. ASD's are eligible for exception to policy or waiver with surgical correction and appropriate clearance by Cardiology. However, most people with PFOs are asymptomatic and for many patients this defect is identified following a stroke or TIA. **CASE PRESENTATION:** The military flight school student presented to the ER after his wife noticed right-sided facial droop and difficulty speaking. On arrival to the ER, he had an aphasia and a right-sided facial droop. His NIH Stroke score was 9. Non-contrast CT of his head as well as perfusion and angiogram CT studies of his head and neck were normal. The patient was treated for an ischemic stroke with tPA at 3 hours and 24 minutes from onset of symptoms. An MRI obtained post tPA revealed subacute infarct

in the left frontal lobe. A subsequent echocardiogram revealed a PFO. Doppler studies were negative for a DVT in bilateral lower extremities. No episodes of atrial fibrillation or arrhythmia were observed on EKG or telemetry. The patient was started on double anti-platelet therapy and referred to a PFO/Stroke clinic to determine if he would be a candidate for PFO closure. **DISCUSSION:** Flight school candidates are thoroughly screened prior to admission into flight school. However, there are many conditions that may be asymptomatic and clinically undetected. In this case, the flight student demonstrated no prior signs or symptoms suggestive of a PFO. This case demonstrates the humbling challenges a flight surgeon must accept when conducting medical screening, stressing the importance of managing known risks while appreciating the existence of unrecognized and unknown risks.

Learning Objectives

1. The audience will learn about cryptogenic strokes in the setting of a patent foramen ovale.
2. The audience will learn about the aeromedical implications of patients with atrial septal defects.

[296] FLY IN THE EYE

Shelby Dean

U.S. Army, Fort Novosel, AL, United States

(Education - Case Study)

INTRODUCTION: This case report describes a military pilot who was diagnosed with a delayed hypersensitivity reaction following an insect flying into his eye. **BACKGROUND:** Allergic reactions to insect venom are common, but most people think of bee, wasp, or ant stings, and they also tend to think of type 1 immediate hypersensitivity reactions that cause anaphylaxis. However, it is possible to have reactions to other types of insects, including sanguivorous insects. In fact, many people become sensitized to the saliva of these bugs. Some patients have an immediate wheal that is mediated by IgE, but others have delayed (12-24 hours) T-cell mediated reactions that result in a papule. **CASE PRESENTATION:** The 38-year-old patient noticed an insect flew into his left eye. He noted a brief immediate discomfort. Then, he later developed a white papule followed by erythema and throbbing. On exam, the patient had localized injection and fluorescein uptake on the papule surface. There was also a papillary response on the superior lateral palpebral conjunctiva and some mild serous discharge. No foreign material was noted in the eye. The patient was diagnosed with a delayed hypersensitivity reaction and prescribed a topical steroid. **DISCUSSION:** The saliva of blood-feeding arthropods contains proteins that are different from Hymenoptera venom, and there is not enough data to demonstrate cross-reactivity. Type 4 delayed hypersensitivity reactions are possible. Several sanguivorous insects live in southern Alabama, in addition to other insects, such as eye gnats, that frequently end up in eyes but do not feed on blood. If an aviator is experiencing significant eye pain or decreased visual acuity, they should be grounded.

Learning Objectives

1. The audience will learn about the symptoms of delayed hypersensitivity reactions and its related complications.
2. The audience will learn about the aeromedical implications and flight considerations of patients with ocular irritation.

Wednesday, 05/08/2024

Grand Hall GH

8:30 AM

[S-53]: PANEL: BRINGING A RESEARCH PROJECT TO FRUITION: FROM CONCEPT TO JOURNAL PUBLICATION

Chair: Douglas Boyd

Co-Chair: Frederick Bonato

PANEL OVERVIEW: INTRODUCTION In an academic setting, published research represents one of the benchmarks commonly used for peer recognition and career advancement. However, bringing a research project to fruition (i.e. a published manuscript) represents a complex multi-step process. While researchers schooled in this sphere receive training in this respect, this is less frequent for aerospace medicine professionals who have transitioned to a research path later in their career. **TOPIC** Herein, this Panel, sponsored by the Education and Training Committee, will discuss the multiple steps involved in taking a research project from a novel concept through to publication. **APPLICATION** Research starts with an idea/concept posed by the investigator. The first presentation will address how to determine if the idea is novel via a literature search and designing an appropriate experimental approach, data acquisition and analysis towards answering the question. In the second presentation, the issue of whether the research represents human subjects research and navigating the required approval process will be covered. In the third presentation, the past editor of the "Aerospace Medicine and Human Performance" journal will discuss statistical methods and statistical packages commonly used in aeromedical research projects. The following session, journal selection manuscript preparation, reference managers and the Editorial process for submitted papers will be discussed. In the final presentation, the manuscript review process will be addressed. Since, by far, the majority of manuscripts require at least one round of revision how best to respond to critiques towards getting a manuscript accepted will be addressed.

[297] BRINGING A RESEARCH PROJECT TO FRUITION: FROM CONCEPT TO JOURNAL PUBLICATION

Douglas Boyd¹, Fred Bonato²

¹Embry-Riddle Aeronautical University, Daytona Beach, FL, United States;

²St. Peter's University, Jersey City, NJ, United States

(Education - Program/Process Review)

INTRODUCTION: In an academic setting, published research represents one of the benchmarks commonly used for peer recognition and career advancement. However, bringing a research project to fruition (i.e. a published manuscript) represents a complex multi-step process. While researchers schooled in this sphere receive training in this respect, this is less frequent for aerospace medicine professionals who have transitioned to a research path later in their career. **TOPIC:** Herein, this Panel, sponsored by the Education and Training Committee, will discuss the multiple steps involved in taking a research project from a novel concept through to publication. **APPLICATION:** Research starts with an idea/concept posed by the investigator. The first presentation will address how to determine if the idea is novel via a literature search and designing an appropriate experimental approach, data acquisition and analysis towards answering the question. In the second presentation, the issue of whether the research represents human subjects research and navigating the required approval process will be covered. In the third presentation, the past editor of the "Aerospace Medicine and Human Performance" journal will discuss statistical methods and statistical packages commonly used in aeromedical research projects. The following session, journal selection manuscript preparation, reference managers and the Editorial process for submitted papers will be discussed. In the final presentation, the manuscript review process will be addressed. Since, by far, the majority of manuscripts require at least one round of revision how best to respond to critiques towards getting a manuscript accepted will be addressed.

Learning Objectives

1. generating a novel research question which adds to the current body of scientific knowledge.
2. navigating the human subjects approval process, experimental design, data acquisition and its interpretation.
3. tips for writing a scientific manuscript to improve the chances of acceptance, responding to reviewer critiques.

[298] THE NUTS AND BOLTS OF A RESEARCH PROJECT FROM CONCEPT THROUGH TO DATA ANALYSIS

Douglas Boyd

Embry-Riddle Aeronautical University, Daytona Beach, FL, United States

(Education - Program/Process Review)

INTRODUCTION: In an academic setting, published research represents one of the benchmarks commonly used for peer recognition and career advancement. However, bringing a research project to fruition (i.e. a published manuscript) represents a complex multi-step process. While researchers schooled in this sphere receive training in this respect, this is less frequent for aerospace medicine professionals who have transitioned to a research path later in their career. **TOPIC:** Herein, the author will discuss the steps involved in a research project from the germinating seed of an idea to data acquisition. **APPLICATION:** Research starts with an idea/concept posed by the investigator. One of the first steps is to determine whether this question has been addressed previously-this is important as priority in research is accorded more to novelty than a confirmation of older findings. Towards answering this question, various literature search platforms (e.g. PubMed, Google Scholar) will be discussed and how to bypass the fee required by some journals for non-subscribers. Consequently, selection of research methods which most directly answer the question posed will be addressed as well as data collection and analysis. Will research funding be required? Does the research lend itself to multiple experiment approaches to corroborate each other? What factors affect the population size needed? Importantly, is the allotted experimental time frame (including approvals for human subjects' research, acquisition of research funds) within that achievable by the investigator? This presentation will segue to the next two where human subject research approval and manuscript preparation are addressed.

Learning Objectives

1. coming up with a novel research question which advances scientific knowledge,
2. literature searches: has similar work been done previously or does yours differ in a specific way?
3. what experimental design/methods are appropriate for the research question posed?

[299] NAVIGATING INSTITUTIONAL REVIEW BOARDS AND SURVIVING THE JOURNEY

Michael Wiggins

Embry-Riddle Aeronautical University, Daytona Beach, FL, United States

(Education - Program/Process Review)

INTRODUCTION: Research involving human subjects is required by law to be reviewed and approved by an institutional review board (IRB). Understanding the requirements and insuring your application contains the necessary information are the keys to success. **TOPIC:** Any research involving human subjects is required by law to be reviewed and approved by a qualified IRB to ensure that the rights and welfare of participants who volunteer in research activities. Institutional review boards are federally mandated by the Department of Health and Human Services to regulate this protection by the respective institution. The processes and requirements are clearly defined and are published by the institution. Key components of the regulations found in Title 45 of the Code of Federal Regulations (CFR) Part 46. These key components are based on the "Common Rule" and 45 CFR Part 46. These components set the basis for the review process. Each institution will have unique process flow based on these components. Understanding both the regulatory requirements and the specific process flow established by individual institutions will help ensure an applicant is successful and help research get approved in a timely manner. **APPLICATION:** Researchers who conduct research involving human subjects will need to follow their institution's process for gaining approval prior to conducting the research

and to ensure the research is conducted in a manner that protects the rights, dignity, and safety of participants. **RESOURCES:** Office of Human Research Protections, U.S. Department of Health and Human Services, <https://www.hhs.gov/ohrp/regulations-and-policy/regulations/45-cfr-46/index.html>

Learning Objectives

1. New researchers will learn about the role of institutional review boards in research involving human subjects.
2. New researchers will learn about the processes needed to successfully gain institutional review board approvals when planning and conducting research involving human subjects.

[300] STATISTICS FOR AEROSPACE MEDICINE

Frederick Bonato

St. Peter's University, Jersey City, NJ, United States

(Education - Tutorial/Review)

INTRODUCTION: Scientific rigor in most research endeavors demands rigorous statistical analysis of the collected data before drawing any conclusions regarding changes in an endpoint. However, in aerospace medical training, the emphasis on statistical comprehension can sometimes fall short. **TOPIC:** In this presentation, we aim to provide a comprehensive overview of the different categories of data that are frequently generated in aerospace medicine research. We will delve into suitable statistical tests and delve into the nuances of interpreting their results. To enhance understanding, we'll draw upon examples from published studies to illustrate key points. **APPLICATION:** Any research project typically amasses datasets, which necessitate statistical scrutiny to decipher whether an observed alteration is genuinely significant or merely an outlier. The choice of a statistical test is contingent on the research question at hand, and whether the data adheres to a parametric (normal distribution) or non-parametric structure. The ensuing discussions will revolve around common research scenarios:

1) Do differences exist in the mean/median values of a specific parameter across two or multiple groups? Such variations can be assessed using statistical tools like the Student's T-test or ANOVA for parametric data, and Mann-Whitney U tests for non-parametric datasets. 2) Is there a pronounced representation of a specific trait or parameter in a population? Proportion analyses, such as the Chi-Square test or logistic regression (when dealing with multiple variables), are apt for such inquiries. Further, we'll elucidate on the interpretation of statistical outputs, emphasizing the determination of association strength, confidence intervals, and significance thresholds. To conclude, we will highlight the appropriateness of several statistical software options for aerospace medicine professionals, emphasizing user-friendliness and accessibility for those not well-versed in statistics.

Learning Objectives

1. Participants will understand the correlation between the type of data and the selection of statistical tests, distinguishing between parametric and non-parametric data.
2. Insights will be provided on how to interpret statistical results from tests frequently employed in aerospace medicine.
3. The session will introduce attendees to select statistical software, highlighting user-friendliness for those without a statistical background.

[301] DRAFTING AND SUBMITTING A MANUSCRIPT TO AN ACADEMIC JOURNAL

Frederick Bonato

St. Peter's University, Jersey City, NJ, United States

(Education - Tutorial/Review)

INTRODUCTION: Publishing in a scientific journal, such as Aerospace Medicine and Human Performance, not only propels one's professional trajectory but also contributes valuable insights to the

broader community within the specific field or specialty. The decision to select an appropriate journal is multifaceted, encompassing factors like the journal's indexing, its impact factor, the relevance of the content ('fit'), the availability of Open Access, and the expected review duration.

TOPIC: Navigating the world of scientific publication begins with discerning the most fitting journal tailored to your research content. Once this is established, it's crucial to invest time and effort into crafting and structuring a well-prepared manuscript. It's equally paramount to ensure that the necessary ethical clearances, such as those from the Institutional Review Board or Institutional Animal Care and Use Committee, are in place. As you move forward, a grasp of the editorial process, from the peer-review phase to understanding review turnaround durations, becomes essential. Throughout this journey, establishing and maintaining constructive communication with the editorial board and journal management can play a significant role in streamlining the publication process. **APPLICATIONS:** The meticulous approach to manuscript submission, from the preparatory stage to eventual submission, is vital. Ensuring the appropriate selection of a journal and then adhering to outlined steps in manuscript preparation, submission, and revision can substantially increase the chances of manuscript acceptance and eventual publication. These tenets are generally relevant across various scientific journals.

Learning Objectives

1. Attendees will be provided a systematic approach to writing and submitting a manuscript for publication.
2. The audience will be given a "behind-the-scenes" look at the editorial review process.

[302] A BEHIND THE SCENES LOOK AT THE MANUSCRIPT REVIEW PROCESS-HOW BEST TO HANDLE REVISIONS (AND REJECTIONS)

Douglas Boyd

Embry-Riddle Aeronautical University, Daytona Beach, FL, United States

(Education - Program/Process Review)

INTRODUCTION: In academia, peer-reviewed published papers represent one of the benchmarks used for peer recognition/career advancement. After submission, a research manuscript is subjected to at least one round of reviews by subject matter experts/reviewers/referees and rarely accepted "as is." **TOPIC:** In this presentation, the author, (a reviewer for over 30 journals in as many years), will discuss the various elements that reviewers scan for and how best to deal with referee critiques. **APPLICATION:** A manuscript Introduction should be concise, state the gap in knowledge and the research question posed. Too often, Introductions read like a graduate thesis and/or contain irrelevant material (red herrings). In the Results, how consistent are the data with each other? For example, if data from 200 and 230 subjects were presented in two separate tables/graphs, the discrepancy warrants explanation. In the **DISCUSSION**, were the conclusions drawn by the author(s) supported by the data? Did this section represent a regurgitation of the Results - suggesting a poorly read author out of touch with the literature? Also in the **DISCUSSION**, did the author address how the new research fits in with the bigger picture and importantly other work? Were the limitations of the research clearly stated? Commonly, authors are invited to revise/resubmit a manuscript after addressing a reviewer's concerns. Shortcomings highlighted by the referee should be addressed via new data acquisition/analysis/experiments. Finally, responding to the reviewer in a non-confrontational manner will improve one's chances of final acceptance.

Learning Objectives

1. pertinent elements to include in a manuscript Introduction, how to present the Results section in a logical manner,
2. importance of highlighting the "take home" message in the discussion, discussing the findings in context of the bigger picture and practical applications.
3. strategies for revising and resubmitting a manuscript.

Wednesday, 05/08/2024
Grand Hall I

8:30 AM

[S-54]: PANEL: ADVANCES IN AEROSPACE MEDICINE IN IBEROAMERICA

Chair: Pilar Garzon

PANEL OVERVIEW: For this panel, the aids are presented in English and the speakers' interventions are made in Spanish. Aerospace medicine in Latin America has gradually gained space in areas of research, generation of regulations, and support for air operations. At this meeting, the work of professionals from different countries associated with aspects of education, research and clinical cases will be presented.

[303] ALTERNATIVE PHARMACOLOGIC MANAGEMENT OF HEART FAILURE SECONDARY TO COVID-19 IN COMMERCIAL AVIATION PILOTS

Jean Duenes

Country Medical Center Cardiocountry, Orlando, FL, United States

(Original Research)

INTRODUCTION: During the Covid-19 pandemic, research revealed that heart failure and acute myocarditis were post-covid -19 complications of concern. Previous studies showed elevations in D-dimer, ferritin, and C-reactive protein, which normalized within two (2) months after medical discharge. Post-Covid-19 heart failure became evident, as reports of hospitalized patients with elevated troponin levels of unknown causes emerged. In this study, most pilots had ongoing symptoms and signs associated with Heart Failure, leading to the initiation of Pharmacological Resynchronization Therapy, already an established treatment for patients with CHF and Ejection Fractions less than or equal to 35%. **MATERIALS AND METHODS:** This retrospective study reviewed the case findings of twenty-three (23) pilot [eighteen (18) men, five (5) women] presenting with dyspnea, tachycardia, cough, moderate to severe systolic dysfunction. All were unsuccessfully treated using standard measures for heart failure, so it was decided to institute a pharmacological alternative with Sacubitril-Valsartan. **DISCUSSION AND ANALYSIS:** The 23 pilots received the standard of care for management of CHF, however, most subjects presented alterations in functional class and tachycardia. Alternative pharmacological resynchronization treatment with Sacubitril-Valsartan improved symptoms and LVEF in less than 6 months in more than 60% of the patients. This is of great importance to our pilot populations because angiotensin receptor antagonists are permissible per the current standards for continued use after reinstatement to work under a management.

Learning Objectives

1. Know the number of commercial pilots who suffered from Covid-19 and were diagnosed with heart failure refractory to treatment.
2. Determine the percentage of the population that started this resynchronization therapy.
3. Identify which users improved post-medication myocardial contractility and ejection fraction Estimate which population returned to aeronautical activity post Heart Failure.

[304] SECONDARY AERO-RESCUE, "THE NEW CONCEPT OF MEDICAL CARE IN THE TRANSFER OF CRITICAL PATIENTS BY AIR"

Wagner Samaniego¹, Vicente Ciancio², Marcos Saldivia³

¹Transportes Aereos San Rafael, Coyhaique, Chile; ²Universidad Nacional de la Plata, La Plata, Argentina; ³Samu, Coyhaique, Chile

(Education - Program/Process Review)

One of the key points in patient care is pre-hospital medicine, therefore, every aspect of it becomes essential in order to avoid delays

and offer better health care. In Chile, since 2011, law 83 regulates the air transportation service for sick or injured people. There are two types of medical transportation based on the need and requirement of the patient. 1.- primary, that which is carried out from the place where the sick or injured person is, previously stabilized, to a hospital center. 2.- secondary, that which is carried out from the healthcare center where the patient is located to a healthcare center of greater complexity. However, in the southern part of the country, due to geographical, meteorological and access characteristics of the hospital system, it is challenging to correctly apply this classification since patients frequently have to be transferred without having been completely stabilized. In the Chilean region of Aysen, according to the last population census data, there are 107,334 inhabitants living in an area 108,494 km², with a population density of 1.01 inhabitants per km². The healthcare network is made up of 30 rural health facilities, 4 low-complexity hospitals and a regional hospital. In this environment, aeronautical medical transportation represents an important role. A patient who is in the town of Villa O'Higgins, 563.4 km south of the regional hospital, and who has a life-threatening condition, should in principle be treated in a rural facility where there is no relevant equipment or personnel, the patient does not meet the criteria for primary transportation, since the stability of the patient not yet been achieved, and must be transferred to a healthcare center to change the prognosis. Patient also does not meet the criteria for secondary transportation. In these circumstances, we propose the concept of secondary air rescue to include this type of patients. This mode of medical transportation enable patients to reach their destination quickly and efficiently, eliminating geographical barriers and more importantly, saving lives.

Learning Objectives

1. The participant will be able to understand the evacuation by air of critical patients.
2. The audience will learn about our proposal. A new concept of aeromedical evacuation from remote and difficult geographical zones.

[305] COGNITIVE ALTERATIONS OBSERVED IN NORMOBARIC ALTITUDE TRAINING IN CIVIL AVIATION IN LATIN AMERICA: A CASE STUDY FROM ANTIOQUIA, COLOMBIA.

Diana Carolina Gutierrez¹, Juan Carlos Camacho¹, Orlando Gracia², Tatiana De la Hoz³, David Puerta⁴, Adriana Zuluaga¹

¹Universidad Nacional de Colombia, Medellín, Colombia; ²Servicios Gran Colombiana, Bogotá, Colombia; ³MAISO IPS, Medellín, Colombia;

⁴Independiente, Medellín, Colombia

WITHDRAWN

[306] IDIOPATHIC FACIAL PARALYSIS IN AIRCREWS: A CLINICAL AND EPIDEMIOLOGICAL ANALYSIS IN THE COLOMBIAN AEROSPACE FORCE

Alejandra Correa, Laura M. Pineda, Diego Malpica
Colombian Aerospace Force, Bogotá D.C., Colombia

WITHDRAWN

[307] FLIGHT-RELATED NECK AND LOWER BACK PAIN AMONG COLOMBIAN ANTI-NARCOTICS POLICE PILOTS: PREVALENCE AND RISK FACTORS

Marian Farfan¹, Martha Marichal², Alexandra Mejía³,
Diego Malpica¹

¹National University of Colombia, Bogotá, Colombia; ²National Police of Colombia. Anti-narcotics Division, Aviation Medicine, Bogotá, Colombia;

³Aerocivil Colombian Civil Aviation Authority, Bogotá, Colombia

(Original Research)

INTRODUCTION: The Anti-Narcotics Police of Colombia command one of the largest police aviation enforcement divisions in South America. With a surge in flight missions in recent years, there has been a corresponding increase in reported musculoskeletal complaints among its pilots. Research focusing on military pilots has identified various factors like aircraft type, flight hours, and ergonomic conditions as predictors for neck and back pain. However, data focusing explicitly on police aviation sectors remain conspicuously absent in current literature. **METHODS:** We conducted a comprehensive cross-sectional study involving 261 pilots, which represents 70.9% of the intended sample population. The sample consisted of 81 fixed-wing pilots (31.0%), 145 rotary-wing pilots (55.5%), and 35 remotely piloted aircraft (RPA) pilots (13.4%). Participants were administered an anonymous online survey segmented into demographics, flight history including aircraft type, musculoskeletal symptoms, and Night Vision Device usage. Anthropometric measurements were also acquired. Statistical analyses employed included univariate assessments and binary logistic regression models for identifying factors significantly associated with neck and back pain. The research protocol was approved by the National Police's institutional ethics review board. **RESULTS:** The reported 12-month prevalence for low back pain was 31.42%. Significantly, rotary-wing aircraft operations were associated with an elevated risk (OR: 2.18; 95% CI: 1.26 - 3.77). Neck pain had a 12-month prevalence of 26.67%, with RPA operators marking the highest incidence at 37.14%. Engaging in physical activity for durations exceeding 20 minutes, a minimum of thrice weekly, was identified as a protective factor against cervical pain (OR: 0.47; 95% CI: 0.34 - 0.66). **DISCUSSION:** The study's outcomes largely align with existing data on 12-month prevalence rates for low back and neck pain in the military aviation domain. However, we identify RPA operators as a unique cohort deserving targeted ergonomic and safety research. The evidence collected here necessitates further longitudinal investigations, along with research into preventive methodologies and the efficacy of treatment modalities to strengthen the scientific basis of these initial findings.

Learning Objectives

1. The audience will recognize remotely piloted aircraft (RPA) pilots as a new target population for research on ergonomics, morbidity, and operational safety impact.
2. The participant will be able to identify potential risk factors for neck and lower back pain among anti-narcotic police pilots.

Wednesday, 05/08/2024**8:30 AM****Grand Suites 2 & 3****[S-55]: POSTERS: NEUROPHYSIOLOGY****Chair: Ryan Mayes****Co-Chair: Samir Alvi****[308] THE EXAMINATION OF INDIVIDUAL FACTORS AND AFTE TRAINING OUTCOMES**

Tayton Hess¹, Patricia Cowings², William Toscano², Gary Ellis³, Mary Nimmer¹, Allison Ludwig³, Mariateresa Sestito¹, Fernando Espinosa⁴, Kevin Novak⁵

¹Naval Medical Research Unit - Dayton/ORISE, Dayton, OH, United States;

²NASA Ames Research Center, Mountain View, CA, United States; ³Naval Medical Research Unit - Dayton/Leidos, Dayton, OH, United States;

⁴NASA Ames Research Center/SJSUF, Mountain View, CA, United States;

⁵Naval Medical Research Unit - Dayton, Dayton, OH, United States

(Original Research)

INTRODUCTION: Motion sickness is common among military aviators. It describes a specific group of symptoms that include epigastric awareness, nausea, pallor, sweating, salivation, and fatigue. Occurrences of these symptoms can pose a significant risk to safety and adversely

impact mission success. Accordingly, researchers have developed specific interventions to act as countermeasures. For example, Autogenic Feedback Training Exercise has been empirically validated as a training method that mitigates the impact of motion sickness. However, it remains unclear the extent to which individual factors moderate (or mediate) the effects of this intervention. The examination of individual factors such as interoceptive accuracy (IA) and specific personality traits might provide insight into whom may benefit most from AFTE. **METHODS:** Participants were administered the Big Five Inventory (BFI) and State Trait Anxiety Inventory (STAI). In addition, they were given an interoceptive accuracy task (i.e., heartbeat counting task). The participants' reported value was then compared to the actual number of heart beats obtained via ECG. Completion of the IA task was followed by pre- AFTE and Post-AFTE rotating chair tests to evaluate motion sickness and the effects of AFTE training. **RESULTS:** Participants (n=16) were evaluated on IA, personality factors (i.e., BFI & STAI) and performance on the rotating chair. IA was unrelated to personality traits ($p > .05$), but inversely related to state anxiety post training ($p < .05$). Finally, IA did not predict performance on rotating chair $F(1, 14) = 1.18, p > .05$. **DISCUSSION:** 1. IA is unrelated to personality traits as measured by BFI and STAI. 2. Individual factors are unrelated to AFTE training outcome. 3. AFTE training can be beneficial for all.

Learning Objectives

1. The audience will learn about evaluating whether IA is associated with individual personality factors.
2. The audience will learn about examining whether individual personality factors are predictive of AFTE training outcomes.

[309] COLOR VISION DEFICIENCIES, HYPOXIA AND THE HOLMES WRIGHT LANTERN

Jeffery Hovis¹, Thomas Nesthus², Nelda Milburn²

¹University of Waterloo, Waterloo, ON, Canada; ²FAA, Oklahoma City, OK, United States

(Original Research)

INTRODUCTION: Pilots in the United States are allowed to fly without supplemental oxygen up to 12,500 ft (3800 m). Previous research has shown that the color vision of individuals with normal color vision (NCV) can be mildly affected near this altitude, but little information exists regarding the ability of individuals with congenital red-green color vision defects (DCV) to identify signal light colors in this environment. **METHODS:** Thirteen NCV and 17 DCV individuals participated as part of a larger study at the Civil Aerospace Medical Institute. CAMI's hypobaric chamber simulated ground and 12,400 ft (3780 m) pressure equivalents. The Holmes-Wright Type A Lantern (HWA) was used to assess a subject's ability to identify red, green and white navigation lights. The point brilliance corresponds to viewing lights from 1 nautical mile at a low photopic adaptation state. Nine pairs of lights were presented in each of 3 trials at the two altitudes. A failure was any red light called green or vice versa, or more than two other types of errors on the 3 trials. **RESULTS:** The pass rate for NCV subjects at ground was 92.3% and 100% at 12,400 ft. The DCV pass rate was 11.8% at both altitudes. Only one NCV subject had errors on the lantern at either altitude. In contrast, only 2 DCV subjects had perfect scores at both altitudes. The percentage of errors made by the DCV subjects was the highest for the white light, followed by green and red. The DCV error rates for the different colored lights were significantly different (RMANOVA; $p < 0.001$), but the main effect of altitude ($p = 0.900$) and the interaction term were not significant ($p = 0.432$). **CONCLUSIONS:** The negative findings for the NCV performance are similar to previous studies, which reported no change or subtle changes in color vision at 12,400 ft/3780 m for photopic vision. The lack of an altitude effect on DCV performance is likely due to a ceiling effect. The HWA is challenging for most DCVs, so that the numerous errors might have masked any slight change in color discrimination in our study.

Learning Objectives

1. Understand how mild hypoxia can influence color identification of red, green and white aviation signal lights.
2. Understand how challenging identifying red, green and white signal lights is for individuals with color vision deficiencies.

[310] PILOT ADAPTATION TO MODERN HELMET MOUNTED DISPLAYS (HMD) IN 5TH GENERATION FIGHTER JETS.

Karsten Lindgaard

Aviation Medicine Center, Danish Medical Command, Vojens, Denmark

(Original Research)

INTRODUCTION: The development of Head-Up Displays (HUDs) in modern fighter jets has seen significant advancements, ensuring pilots have immediate access to critical flight data without looking away from their viewpoint. HUD technology has evolved, with color coding being used to display key information efficiently. Furthermore, modern fighter jets like the F-35 and Eurofighter have transitioned to Helmet-mounted Displays (HMDs), which project essential flight data onto the pilot's visor, providing a more integrated and immersive information display. The ergonomic design and evaluation of visual coding for aircraft HUDs are crucial to mitigate potential visual stress, which may be exacerbated in complex flight environments with varying weather, terrain, and other environmental conditions. Furthermore, the pilots' individual visual parameters may influence how well the pilot adapts to using HMDs. This study investigates the adaptation to new HMD in 5th generation fighter jets. **METHODS:** 25 Danish pilots received a questionnaire 3 times during their transition training to the F-35 aircraft. The questionnaire had questions related to quantification of a certain potential discomfort on a scale from 1-10. Questions included information about how tired the pilots felt in their eyes after flying, how clear their vision was after flying and symptoms like headache/mental tiredness and fatigue. The pilots' answers were crosslinked with previous measurements of visual parameters such as visual acuity, color vision, phoria and stereopsis. **RESULTS:** 25 pilots returned a total of 70 filled questionnaires. In general they were all relatively satisfied with the HMD system. The average score on questions relating to visual discomfort was 2.2 and regarding fatigue the score was an average of 3.2. There were not found any correlation between previous individual measured eye parameters and discomfort score in the questionnaires. **DISCUSSION:** This study found that pilots adapt well to the HMD systems in newer fighter jets. This suggests keeping the high visual standards for initial pilot applicants in the Danish Airforce. A limiting factor to our study is that it only represents discomfort scores after relatively short flying sorties (1-2 hours). An exposure to the HMD system over prolonged hours might produce a different result.

Learning Objectives

1. The audience will learn about adaptation to modern helmet mounted displays.
2. The audience will learn about visual standards for fighter pilots.

[311] EVALUATION OF A BONE-CONDUCTED VIBRATION (BCV) DEVICE FOR AIRSICKNESS MITIGATION

Darci Gallimore, Kendra Carter, Frederick Patterson, Richard Folga, Alexandra Kaplan

Naval Medical Research Unit - Dayton, Dayton, OH, United States

(Original Research)

INTRODUCTION: Airsickness (AS) continues to impact pilot training and combat readiness. Recent experiments suggest bone-conducted vibration (BCV) technology may have the potential to mitigate AS in military flight environments. The experimental BCV device is a non-invasive, flight helmet worn device designed to apply vibrations directly and unilaterally to the vestibular system. The aim of this study is to evaluate the effectiveness of a BCV device in mitigating airsickness in a provocative motion environment. **METHODS:** Participants ($n = 12$)

passively experienced two, 30-minute pre-recorded, simulated flights using NAMRU-D's motion-based platform, the Disorientation Research Device, while wearing either the experimental BCV device or a placebo. The device presentation order was counterbalanced between participants with a minimum of one day between flights. During each flight, participants completed a target tracking task and verbally reported subjective motion sickness ratings every two minutes using the Baxter Animated Retching Faces (BARF) scale. Time to nausea (BARF ≥ 1) and time to failure (BARF ≥ 4) were also assessed. The Motion Sickness Assessment Questionnaire (MSAQ) was administered post-flight.

RESULTS: No significant differences were observed for MSAQ, BARF, tracking task, time to nausea, or time to failure across BCV conditions. Significant differences were observed for MSAQ, BARF, time to nausea, and time to failure across study visits. On average, MSAQ and BARF scores were lower and time to nausea and time to failure were longer for visit two compared to visit one. **DISCUSSION:** The BCV device failed to mitigate AS in a provocative motion environment compared to a placebo. Previous research has shown that repeated exposure to a nauseating stimulus mitigates motion sickness. This could explain the differences in motion sickness scores across visits regardless of BCV condition. Another limitation of this study was the session termination procedures. To avoid emesis, sessions were terminated once the participant reached a BARF of ≥ 5 . Time between visits and study termination cutoffs should be increased in future studies. Future research should also examine whether vestibular stimulation could contribute to undesirable outcomes such as spatial disorientation and headaches, as these outcomes were reported by several participants.

Learning Objectives

1. The audience will learn about the scientific theory behind the Bone Conductive Vibration (BCV) device and how it may interact with the vestibular system to aid in the mitigation of motion sickness symptoms.
2. The audience will learn about common measures used to determine motion sickness severity during experimental studies.

[312] COMPARISON OF ACTIVE AND PASSIVE HEAD IMPULSE TESTING OF THE HORIZONTAL VESTIBULO-OCULAR REFLEX: EXPLORING DIFFERENT APPROACHES FOR SPACEFLIGHT

Matthew Carey¹, Matthew Ehrenburg², Timothy Macaulay³, Scott Wood⁴

¹UT Southwestern Medical School, Dallas, TX, United States; ²Baylor College of Medicine, Houston, TX, United States; ³KBR, Houston, United States; ⁴NASA JSC, Houston, TX, United States

(Original Research)

Astronauts experience sensorimotor disturbances primarily due to microgravity-induced vestibular changes in spaceflight. Head Impulse Testing (HIT) examines changes in horizontal vestibulo-ocular reflex due to rapid head movements to detect changes in vestibular function. Interpretation requires consideration of artifacts and constraints across different mission phases. Therefore, the aims of our study were to (1) examine reliability across test operators and (2) compare results of active (aHIT) vs passive (pHIT) methods for self-administered vs operator-assisted approaches. Comparison of normal vs occluded vision evaluated other oculomotor influences across conditions, and comparison with machine-generated rotation (rHIT) examined full-body movement effects on ocular responses.

Seventeen non-astronaut volunteers completed HIT using video-oculography goggles and a rotator system with these conditions: (1) default passive head-on-torso (pHIT) using two operators (Op1, Op2), (2) active head-on-torso (aHIT, subject initiated), and (3) passive head and torso using a rotary chair (rHIT). Eye and head movement data processing generated gains in each direction. The primary outcome measures were average gain, asymmetry, and the percentage of acceptable trials with sufficient head amplitude and limited artifact.

While pHIT gains were similar with vision (1.032 ± 0.043) and occluded (1.029 ± 0.038), acceptable trials were greater with vision (Op1=93.0%, Op2=93.2%) vs occluded (Op1=70.7%, Op2=67.6%). The reliability between operators was greater for pHIT gain (ICC=0.66, $p=0.001$) than for pHIT asymmetry (ICC=0.57, $p=0.01$). Acceptable trials decreased by ~20% during aHIT for both visual conditions. While aHIT gains were not significantly different from pHIT, measures were poorly correlated. aHIT and pHIT gains were significantly greater than rHIT gains, presumably due to the reduced peak rotator velocity. Asymmetry measures were poorly correlated across conditions, although no subjects had asymmetries greater than 16%.

The findings support the feasibility of pHIT for spaceflight. Similarities between visual conditions reflect that these responses were mediated by the peripheral horizontal canals rather than other oculomotor mechanisms. The inter-tester reliability was acceptable despite training differences. In addition to non-vestibular interference during aHIT, pHIT resulted in more acceptable trials and should be more efficient and reliable measures for spaceflight.

Learning Objectives

1. The presenter will demonstrate the necessity for reliable, replicable vestibular function assessments during spaceflight, where as previous assessments have been predominantly limited to testing only before and after missions.
2. The audience will learn about the feasibility of standard clinical vestibular testing to evaluate changes in vestibulo-ocular reflexes during spaceflight.

[313] MODIFIED AUTOGENIC FEEDBACK TRAINING PRODUCES EFFECT ON MOTION SICKNESS

Allison Ludwig¹, Patricia Cowings², William Toscano², Gary Ellis¹, Mary Nimmer¹, Tayton Hess¹, Mariateresa Sestito¹, Fernando Espinosa², Kevin Novak¹

¹Naval Medical Research Unit - Dayton, Dayton, OH, United States;

²NASA-Ames Research Center, Moffett Field, CA, United States

(Original Research)

INTRODUCTION: Motion sickness is a common physiological reaction to provocative motion and is characterized by a constellation of symptoms, including stomach awareness, nausea, emesis, pallor, sweating, hypersalivation, and fatigue. The emergence of these symptoms can pose a significant threat to safety, particularly in the context of aviation. Given its prevalence among aviators and its detrimental impact on performance, researchers have endeavored to identify effective countermeasures for motion sickness. Currently, many of the existing interventions are pharmacological in nature and while effective, they present a problem due to their associated adverse side effects. A modified two-hour version of Autogenic Feedback Training Exercise (AFTE) could be an effective countermeasure to motion sickness without adverse side effects. AFTE combines principles of autogenic therapy, biofeedback, and learning to teach individuals to control their own internal physiological reactions through a series of relaxation and arousal exercises. **METHODS:** AFTE was administered over 6 days. On the first day, participants were exposed to provocative motion via a rotating chair test to collect baseline physiological data. AFTE sessions were conducted on four consecutive days and lasted approximately 30 minutes each session. Participants were exposed to the rotating chair again on the 6th day. **RESULTS:** Participants ($n = 16$) were evaluated on the number of rotations experienced and cumulative minutes spun in the chair. Participants tended to ride longer ($M = 21.0$ min, $SD = 16.56$) and tolerated more rotations ($M = 244.8$ rotations, $SD = 310.62$) on their second rotating chair test compared to baseline ($M = 14.0$ min, $SD = 9.35$; $M = 125.8$ rotations, $SD = 124.08$; $t(15) = 2.21$, $p = .02$). A moderate effect size was recorded (Hedges's $g = 0.44$). **DISCUSSION:** A modified two-hour version of the AFTE is effective at increasing tolerance of symptoms associated with motion sickness.

Learning Objectives

1. To demonstrate that brief autogenic feedback training allows greater tolerance to nauseogenic environments.
2. To show that Autogenic feedback training can effectively mitigate the adverse effects of motion sickness without side effects.

[314] ONE SMALL STEP: A LOOK AT THE IMPACT OF OPENING UP CREW POSITIONS TO BELOW THE KNEE PROSTHETIC USERS ON ANALOG ASTRONAUT MISSIONS

Lucas Brane¹, Mary Cooper², Madison Diamond³, Nicolas Heft⁴
¹AstroAccess, Houston, TX, United States; ²Stanford University, Stanford, CA, United States; ³AstroAccess, Toulouse, France; ⁴University of Texas Health Science Center at Houston, Houston, TX, United States

(Original Research)

INTRODUCTION: Recent shifts in human spaceflight have shown interest in including astronauts who fall outside the historical standards for selection. Most recently this trend has included persons with disabilities, however no data on the impact of this inclusion exists within the literature. **METHODS:** This observational study was conducted in the setting of at the LunAres ICares-2 analog mission in Poland. The crew consisted of six people, 4 women, 2 men ranging in age from 23-42yrs, including one person with a disability (lower-limb amputee). The crew members were assigned anonymized numbers, which they used to fill out questionnaires after events where performance was to be measured. This included a perceived-effort rating scale (Borg RPE), perceived time taken, and any changes or modifications needed to complete a task. Additionally, objective time performance and error-rate data was obtained through video data with those tasks where these metrics pertained. **RESULTS:** In all activities that were measured the crewmember using the prosthetic scored in the middle range of values for perceived effort, time performance, and error rate. Additionally, there were only a few occasional modifications undertaken to complete a task, but it was not always the prosthetic-user needing to make the modifications. **DISCUSSION:** Acknowledging the paucity of data including persons with disabilities in this setting, and the small n involved in this study, the data interpretation must be undertaken with caution to its wider applicability at this time. However, the notable lack of performance delta in our crewmember using a prosthetic lower limb as compared with the able-bodied crew during normal operations opens up an interesting discussion on crew selection and performance measures in the analog environment. It also sets the stage for follow-up studies that might inform mission planners about where failure points could be when considering a prosthetic user for crew. Based on the findings in this study, this would require more examples of prosthetic users, different prosthetic systems, and likely more extreme testing environments to identify salient deltas in performance.

Learning Objectives

1. To understand what mission impacts, planning considerations, or equipment adaptations might facilitate this inclusion, there needs to be a deliberate study of these ideas in a relevant setting. Because so few analog missions have included people with disabilities, this lack of data acts as a further barrier to their inclusion.
2. Impact of inclusion of persons with disability in spaceflight endeavors are, in many cases, not as onerous as it might first seem. The actual impact may be negligible, but there might also be a few small, but important details needed to facilitate inclusion, which must be studied to be understood.
3. Normal operations in this analog study did not produce a delta in performance between crew members. In highlight potential relevant deltas, additional studies which more aggressively focus on aspects of the crew member's disability, will be needed.

[315] ANTHROPOMETRIC SURVEY OF JAPAN AIR SELF-DEFENSE FORCE AIRCREWS

Koji Okano, Shunsuke Hayashi, Hiroto Kikuchi, Yuriko Koga, Yuko Aiba, Satoshi Maruyama, Hiroshi Katoh, Takenori Nomiyama
Aeromedical Laboratory, JASDF, Sayama, Japan

(Original Research)

INTRODUCTION: Since the Japan Air Self-Defense Force (JASDF) conducted initial anthropometric survey in 1961, anthropometric datasets had been replaced every ten years until the survey in 1998. Twenty years after that, females have begun to be recruited as fighter pilots. In addition to the percentile values conventionally used as design criteria of equipment, multivariate analysis are required to properly determine accommodation. In light of the above, the latest anthropometric survey was conducted to update the data including female pilots and to do multivariate analysis. In this presentation, we will present the basic statistics of the body dimension data obtained in this survey. **METHODS:** Sixty two items (61 for males) were selected for the JASDF anthropometric surveys to be applied as ergonomic data for the design of equipment and other products. The measurement method was the same as in the previous study, using a Martin-type anthropometer. A total of 429 subjects were measured: 303 males (pilots, navigators, and candidates) and 126 females (pilots, navigators, candidates, and others). Measurement and recording errors were excluded. **RESULTS:** The data for the analysis included 401 subjects: 279 males and 122 females, excluding 28. Percentile values were calculated as basic statistics to obtain the dimensions needed for equipment development. **DISCUSSION:** The latest body measurements obtained in this study can be utilized in the equipment and clothing design process. Because the JASDF aircrews tend to be small in stature and long in body length, careful consideration must be given to their suitability in the design of equipment.

Learning Objectives

1. The participant will understand the body dimensions required for designing equipment.
2. The participant will understand the characteristics of the Japanese body type.

[316] PULMONARY FUNCTION TEST VALUES IN US AIR FORCE INSTRUCTOR PILOTS ACROSS TIME

Donna Marie Fearon¹, Thomas Blossom², Elizabeth G. Damato¹, Michael J. Decker¹
¹Center for Aerospace Physiology, Departments of Physiology & Biophysics, Neurosciences, School of Medicine, Case Western Reserve University, Cleveland, OH, United States; ²University School, Hunting Valley, OH, United States

(Original Research)

INTRODUCTION: High performance aviators require optimal lung function to counter the environmental stressors of tactical aviation. Pulmonary function tests (PFTs) are key measurements of respiratory health. We sought to characterize PFT values in US Air Force instructor pilots following successive sorties across a work week. The purpose of this study was to use pulmonary function testing to characterize respiratory performance over a two-week period of time. **METHODS:** This study was approved by both the Air Force Research Laboratory Institutional Review Board and Case Western Reserve University. Portable spirometry was used to assess pulmonary function at 6 time points across two weeks in T6 and T38 instructor pilots at two Air Force training bases. Frequencies and descriptive statistics (Mean \pm Standard Deviation) were calculated for percent predicted PFT metrics of forced vital capacity (FVC), forced expiratory volume in one second (FEV-1), FEV-1/FVC ratio, and forced expiratory flow at 25%-75% of vital capacity (FEF 25-75%). Paired t-tests were used to determine if values changed from baseline (Sunday) to final (Thursday) across each week of the study. **RESULTS:** Instructor pilots (N=35; 31 male + 4 female) ranged in age from 25-48 years (M=34.7 \pm 5.6) with 10.9 \pm 5.2 years military pilot experience. Approximately 10% of

instructor pilots had suboptimal percent predicted FEV-1 values (\leq 80%) for Week 1 and Week 2. Four pilots had 3 suboptimal FEV-1 measurements and three pilots had suboptimal FEV-1 levels at each assessment. FVC increased across the work week from the Sunday baseline (94.63 \pm 9.1) to the Thursday measurement (96.37 \pm 10.1) in Week 1 ($p=0.47$). **DISCUSSION:** Limitations of the cross-sectional study design and small sample size preclude the ability to determine if the suboptimal FEV-1 results in a small subset of instructor pilots represent an acute pulmonary response or unrecognized chronic condition. This suggests a need for future longitudinal research studies of pulmonary function in high performance aviators.

Learning Objectives

1. The participant will describe the range of pulmonary function test values of US Air Force instructor pilots across the work week following successive training flights.
2. The participant will learn that suboptimal percent predicted FEV-1 values may exist in a subset of instructor pilots experiencing successive sorties.

[317] PRELIMINARY FINDINGS: ONLINE COGNITIVE TRAINING (CTR) ENHANCES IN-COCKPIT EXPERIENCES IN STUDENT PILOTS

Thomas Schaner¹, Shawn Pruchnicki², John Milanovich³
¹FlightSafety International, Columbus, OH, United States; ²Ohio State University, Columbus, OH, United States; ³MindMatters Neuropsychology and Optimal Aviation, Ann Arbor, MI, United States

(Original Research)

INTRODUCTION: This cornerstone project at The Ohio State University explored the use of a structured online brain exercise program to potentially reduce hours of flight training, and thereby costs, through strengthening underlying neurocognitive abilities known to be associated with flight performance and safety ("Aviator Cognition"). **METHODS:** Qualitative and quantitative data were collected to determine Part 141 flight student experiences related to the effects of completing brain exercises on the ground with actual skill development in the sky. Seven student volunteers were asked to complete a 5 week, coached, online cognitive training program (CTr) designed for pilots, as well baseline and post-training questionnaires that examined personal in-cockpit experiences; instructor impressions were also collected. Cost-effectiveness analysis estimated changes in throughput at an institutional level. **RESULTS:** No student completed the full CTr program, while the 71% who had sufficient CTr data showed significant cognitive gains of 21.8 percentile points. Qualitative data indicated students perceived CTr as a means by which they overcame personal obstacles to flight training in 80% of those who sufficiently engaged with the online CTr platform. Reported benefits ranged from "auditory-related memory skills improved, which correlated to conversing with ATC and remembering their instructions" to "maneuvers and landings seemed to get better due to better awareness." Instructors also perceived improvements, especially as related to focus and attention in the cockpit. Flight students estimated CTr would lead to over a 10% reduction in in-cockpit training time and associated costs, which would also have the effect of allowing this particular flight school to enroll up to 10 more students per year based on throughput analyses. **DISCUSSION:** These findings indicated direct training of Aviator Cognition led to perceived improvements in memory and multi-tasking capacities, which in turn allowed some flight students to overcome personal obstacles to their progress. Such improvements in flight training efficiency have a network effect that benefits both pilots and organizations alike. To enhance numbers of participants, flight students suggested future studies use CTr during summer months, when more time is available, while providing additional educational materials.

Learning Objectives

1. Participants should understand underlying elements of Aviator Cognition (AC) and known effects of AC on flying.

- Participants should understand the “network effect” of enhancing a pilot’s brain functioning to peak performance levels on improving performance, safety, and organizational functioning in the aviation environment.

[318] MAXIMAL AEROBIC TESTING LOGISTICS AND ITS APPLICATION AS A PRE-FLIGHT COUNTERMEASURE FOR MICROGRAVITY-RELATED VASCULAR DEGRADATION: A REVIEW

Erik LeRoy^{1,2}, David Wassell¹, Brett Bennett^{1,3}

¹Association of Spaceflight Professionals, St. Petersburg, FL, United States;

²NYU Grossman School of Medicine, New York, NY, United States; ³University of Colorado Boulder, Boulder, CO, United States

(Education - Tutorial/Review)

INTRODUCTION: If VO₂max can be optimized closer to launch, health and performance during long-duration missions are less compromised as vascular health is preserved. TOPIC: Of fourteen ISS crew members during a long duration mission, eight began with a VO₂max of 40 mL/kg/min or above. Out of those eight, four maintained their VO₂max. These findings suggest that not all crew members maintain their aerobic capacity in microgravity. Just over half began this mission with an above average VO₂max. Of the crewmembers that were tested during the Gemini Program, all but one experienced a decrease in aerobic capacity. EVA’s require an aerobic capacity of ~32.9 mL/kg/min. If crew members are starting a mission with a VO₂max of 40 mL/kg/min and are not maintaining it, EVA ability could be compromised. Aerobic testing in relation to launch date is also significant. During the Skylab program VO₂max was assessed about twelve and six months prior to missions. Typically testing takes place six months before flight, and submaximal testing thirty days prior. Estimates of VO₂max from submaximal data are widely used in clinical populations however in healthy individuals a standard error of estimate of 4.234 mL/kg/min was found. Aerobic capacity can be lost rapidly; thirty days of bed rest elicited a decline of almost 1% per day. The importance of optimizing aerobic capacity pre-flight extends beyond the ability to perform mission tasks. Healthy mice were exposed to galactic cosmic ray illumination to simulate the microgravity environment. These mice exhibited increased elastin dissolution; After sixteen weeks of exercise training, there was a significant increase in elastin volume in the aorta of young rats. In a systematic review over 94% of the literature showed that exercise training promoted protective effects on a cellular level in the context of radiation exposure. These findings have implications for aerospace and terrestrial based medicine. APPLICATION: ISS crew members have expressed that added volume for preflight exercise training is needed. Optimizing aerobic capacity closer to launch date may help maximize vascular integrity as a pre-flight countermeasure for the inevitable decline.

Learning Objectives

- The audience will be able to understand the current/past aerobic testing protocols for long duration missions.
- The audience will be able to understand the effect of the microgravity environment on aerobic capacity and vascular health.
- The audience will be able to understand the effects of exercise training and optimizing aerobic capacity on vascular health.

[319] INTEGRATION OF A MOBILE PHYSIOLOGICAL MONITORING SYSTEM INTO AIRCREW EQUIPMENT

David Cyrol, Stefan Sammito

German Air Force Centre of Aerospace Medicine, Cologne, Germany

(Original Research)

INTRODUCTION: A flying weapon system is equipped with a variety of sensors to gather information about the current situation, but up to now, there is no systematic monitoring system for physiological data of jet pilots in flight. In particular, the excessive demand on the pilot in the

human-machine interface can lead to excessive mental workload. This excessive demand can be recognized using physiological parameters. In order to be able to assess the workload in a fighter aircraft more precisely the German Air Force Centre of Aerospace Medicine (GAFCAM) is working on recording physiological parameters during flight. For this purpose, the data acquisition system must be integrated into the aircrew equipment, must be robust enough to withstand the loads during a flight under high G-loads and must not restrict the airworthiness of the aircraft. **METHODS:** In order to provide the relevant evidence, a test was accomplished in the long-arm centrifuge at the GAFCAM in Königsbrück. A male test pilot who had several hundred hours of flight experience in a Panavia PA-200 Tornado jet aircraft as a weapon system officer (WSO) was equipped with a mobile physiological laboratory (mobPhysioLab). This device records ECG, respiration rate, oxygen saturation, skin conductance, body temperature, and environmental conditions such as G-load, ambient pressure, temperature and relative humidity. The subject completed a run in the centrifuge with (1) a ramp profile and (2) a rapid on set profile. The centrifuge internal measurement system PowerLab is used as a reference. **RESULTS:** Our results show that the data recorded by the mobPhysioLab during the centrifuge runs are evaluable and plausible, as shown by a comparison with the established system. We were able to proof that this mobile system is robust enough to be used at high G-loads while maintaining data accuracy. **DISCUSSION:** The setting we tested can be stowed in the pilot’s flight suit, takes up as little space as possible and does not impair the pilot’s comfort during the flight. The physiological monitoring system fulfills the requirements for in flight test, which will be our next step.

Learning Objectives

- The participant will be able to understand the result of the test in the centrifuge and the possibility to use the mobile physiological monitoring system to record data under G-loads.
- The participant will understand how the physiological monitoring system will be used in the next step for in flight measurement by the German Air Force Centre of Aerospace Medicine.

[320] THE EFFECT OF SPATIAL DISORIENTATION TRAINING ON GROUND FOR DUTY FIGHTER PILOTS IN JAPAN AIR SELF-DEFENSE FORCE

Yuka Horiuchi, Tetsuya Iwamoto

Aeromedical Laboratory, JASDF, Sayama, Japan

(Original Research)

Spatial disorientation (SD) is one of the important causes of critical aircraft mishaps. In these five years (2019-2023), Japan Air Self-Defense Force (JASDF) has lost three fighter pilots due to mishaps. The Accident Investigation Board concluded that one of the causes of these mishaps was unrecognized SDs. Since then, JASDF decided to start SD training for duty fighter pilot using the SD Trainer (GL-4000, ETC, USA.). But, there is no clear evidence whether the SD training would be effective for pilots to recognize SDs during flight. To evaluate the effectiveness of SD training, we asked the trainees of SD training to participate in the questionnaire survey. The SD training consists of the 1-hour lecture and SDs experience by SD Trainer. The questionnaire was answered while the trainees had been engaged in the ordinary flight duties approximately 3 months after SD training. Among 234 research participants, we received 32 answers and analyzed them (as of October 31, 2023). 13 pilots (40.6%) experienced the actual SDs after SD training and most of them (11; 34.3%) felt it is easy to recognize SDs compared to before. Especially, some of them answered their SDs would induce the severe mishap unless they could recognize them. However, some pilots (2; 6.25%) could not realize the effectiveness of SD training. SD training was seemed to be potentially effective to easily recognize SDs during flight, but effectiveness of single-time training might be limited. To prevent the severe mishaps related to SDs, it would be important to establish the system to undertake SD training repeatedly.

Learning Objectives

1. The audience will learn about the Spatial Disorientation Training On ground how effect to recognize the SD in flight.
2. The audience will learn about the SDs' episode in JASDF in flight.

[321] BARRIERS TO MENTAL HEALTH SEEKING AMONG ARMY AVIATION PERSONNEL: PRELIMINARY FINDINGS

Aric Raus

Liberty University, Lynchburg, VA, United States

(Original Research)

INTRODUCTION: Aviation operations require constant vigilance where personnel must perform their duties under significant physical and psychological stress. Prolonged or intense stress events can lead to mental health issues, even among those with formal resilience training. Barriers to mental health seeking prevent military aviation personnel from receiving the assistance they need, yet little is known about these barriers. **METHODS:** Quantitative survey responses were collected from current and former U.S. Army Aviation personnel recruited via social media and snowball sampling between October and December 2023. Information regarding barriers to mental health seeking were determined using the Barriers to Access to Care Evaluation - Version 3 (BACE V3). The BACE V3 provides 30 statements covering attitudinal, instrumental, and stigma barriers, asking participants to select the extent to which the provided questions stopped, delayed, or discouraged them from seeking mental health care. Selections range from "Not at All" (1) to "A Lot" (4). **RESULTS:** Fifty responses have been received at this point, 49 of which had sufficient data to determine barriers to mental health seeking. The average values for attitudinal-related questions were 2.29, stigma questions averaged 2.22, and the average responses for instrumental were 1.54. **DISCUSSION:** The preliminary results indicate that attitudinal and stigma barriers play the largest role in inhibiting mental healthcare seeking among U.S. Army Aviation personnel, while instrumental issues played a lesser role. Examples of attitudinal barriers include perceived treatment ineffectiveness, belief that the problem will pass on its own, and a self-reliant problem-solving mindset. Stigma barriers include concerns about social, practitioner, and organizational biases. These findings indicate that approaches to overcoming mental health hesitance should focus on overcoming aviation personnel's perception of stigma by their friends, employees, and regulators, along with dispelling the internal mindsets on mental health among Army aviation community members. As this research progresses, the intent is to determine the effects of age, gender, and aviation career field on barriers to mental health seeking.

LEARNING OBJECTIVE 1. This research provides additional insight into the effects of attitudinal, instrumental, and stigma barriers to mental healthcare seeking among U.S. Army Aviation Personnel.

Learning Objectives

1. The audience will gain insight into the effects of attitudinal, instrumental, and stigma barriers to mental healthcare seeking among U.S. Army Aviation Personnel.
2. Participants will learn about the impact of pilot mindset and perceived biases on Army Aviation members' propensity to seek assistance for mental health symptoms

[322] CHARACTERIZING FATIGUE DURING CIRCADIAN DISRUPTED SHORT-HAUL AVIATION OPERATIONS: STUDY METHODOLOGYErin Flynn-Evans¹, Nicholas Bathurst¹, Lucia Arsintescu², Kevin Gregory¹, Laura Barger³, Amanda Lamp⁴, Hannah Baumgartner⁵, Thomas Nesthus⁵, Cassie Hilditch²¹NASA Ames Research Center, Moffett Field, CA, United States; ²San Jose State University, Moffett Field, CA, United States; ³Brigham and Women'sHospital, Boston, MA, United States; ⁴Washington State University, Spokane, WA, United States; ⁵FAA Civil Aerospace Medical Institute, Oklahoma City, OK, United States

(Original Research)

INTRODUCTION: Fatigue is a challenge in short-haul aviation flight operations due to irregular schedules that often involve circadian disruption. Specifically, schedules that encroach on the window of circadian low, including redeye flights, and those that switch between early starts and late finishes can cause circadian disruptions. These schedules reduce sleep opportunity and may require additional fatigue mitigation. Such sleep loss and circadian disruption, together with high workload factors common to short-haul operations (e.g., fast turnarounds, multiple takeoffs and landings) may impact cognitive performance and safety. The FAA NextGen Human Factors Division has funded this research, conducted by the Civil Aerospace Medical Institute in support of the FAA Aviation Safety Organization. Therefore, we are characterizing the impact of these circadian disrupted schedules on pilot fatigue and performance during short-haul operations using validated objective and subjective methods. **METHODS:** Participants include commercial passenger pilots from four US airlines (target n = 144). Volunteers collect data for 1-3 days before, during, and 1-3 days after two trip types, one involving circadian disruption (i.e., a trip with a redeye or a trip that switches between early and late duties) and one without circadian disruption (i.e., all duties scheduled between 0700 and 2359). Participants are recruited in a counterbalanced order, with an equal number of pilots completing each trip type first. Data collection includes continuous actigraphy and daily sleep, meal, and exercise logs. Participants also complete the five-minute psychomotor vigilance test (PVT), Karolinska Sleepiness Scale, and Samn-Perelli fatigue scale three times per day on days off, and after waking, pre-duty, at top-of-descent for each flight, post-duty, and before bed on duty days. Pilots report hassle-factors and complete a NASA Task Load Index after each flight to characterize workload. Data are collected using the NASA PVT+ application on an iPod that is provided to the pilots. **RESULTS:** To date, 116 participants have consented to participate. Participants have contributed 4,613 PVTs over ~1,075 days of data collection, suggesting the study methodology do not involve excessive burden to the pilots while on duty. **DISCUSSION:** This study is ongoing, but preliminary findings suggest that the pilots are compliant with study procedures.

Learning Objectives

1. Understand what types of short-haul operations are being targeted for study.
2. Understand how data collection is being approached to characterize short-haul operations.

[323] TACTILE GUIDED SLOW AND DEEP BREATHING TO COUNTERACT HYPOXIA IN HELICOPTER PILOTSYuval Steinman¹, Monique Frings-Dresen², Eric Groen³¹Centre for Man in Aviation, Soesterberg, Netherlands; ²University of Amsterdam, Amsterdam, Netherlands; ³TNO, Soesterberg, Netherlands

(Original Research)

INTRODUCTION: It has previously been shown that slow and deep breathing (3–6 breaths/min) significantly increases oxygen saturation (SpO₂), which makes it an interesting technique to cope with the effects of altitude-induced hypoxia. A tactile signal could be useful to prompt aircrew to initiate slow and deep breathing as it is less affected by hypoxia compared to vision and hearing. We investigated the effect of tactile guided slow and deep breathing compared with that of spontaneous breathing on SpO₂, alertness, and hypoxia symptoms during acute hypobaric hypoxia. We also evaluated the usability of this tactile breathing guidance. **METHOD:** Twelve male military pilots were exposed to a simulated altitude of 15,000 ft in a repeated measures study during spontaneous breathing and during tactile guided slow and deep

breathing. We measured the following physiological parameters: SpO₂, heart rate (HR), respiratory frequency (RF), minute ventilation (V_E), tidal volume (V_T), end-tidal oxygen partial pressure (PetO₂), and end-tidal carbon dioxide partial pressure (PetCO₂). We also investigated the effect of workload on the pilot's adherence to the tactile guidance by engaging them with a cognitive task. Alertness was measured with the Stanford Sleepiness Scale. Hypoxia symptoms were reported using a list of general hypoxia symptoms. Usability of the tactile guidance was evaluated in a questionnaire. **RESULTS:** Compared to spontaneous breathing slow and deep breathing significantly increased SpO₂, HR, VT and PetO₂, and significantly decreased PetCO₂. We found no effect of slow and deep breathing on alertness or the number of hypoxia symptoms. The usability questionnaire showed that pilots were positive about the intensity and sensation of the vibration signal, but had difficulty following the vibration pattern during the cognitive task. **DISCUSSION:** The increase in SpO₂ during guided slow and deep breathing did not alter alertness and hypoxia symptoms. This indicates that PetCO₂ may play a role in the development of these symptoms. Pre-training may improve the ability of pilots to follow the vibration pattern while being occupied with a cognitive task. Future studies may examine the effect of tactile guided slow and deep breathing on these variables under dynamic conditions that represent real operational flight.

Learning Objectives

1. The audience will learn about the physiological response to slow and deep breathing under hypoxia.
2. The audience will learn about the role that PetCO₂ may play in the development of hypoxia symptoms.

Wednesday, 05/08/2024
Grand Ballroom CD South, EF

10:30 AM

[S-56]: PANEL: MEDICAL CAPABILITIES AND TECHNOLOGIES TO ENABLE SPACE EXPLORATION BEYOND LOW-EARTH ORBIT

Chair: Rahul Suresh

Co-Chairs: Moriah Thompson, Kris Lehnhardt, Ben Easter, Courtney Schkurko

PANEL OVERVIEW: Building upon the success of the last two decades of human spaceflight medical operations onboard the International Space Stations (ISS), NASA now must start to evolve to a deep space medical operations model. This new paradigm will include numerous challenges such as communication delays and blackouts, infrequent or nonexistent resupply opportunities, significant vehicle resource constraints, and delayed or non-existent evacuation options. To overcome these challenges, the Exploration Medical Integrated Product Team (XMIPT) of NASA's Mars Campaign Office has defined a strategic roadmap that identifies required medical capabilities for exploration and outlines an approach for maturing technology development and integrating new medical capabilities across disciplines. During this panel, the XMIPT will present an overview on how medical capability gaps are defined and addressed and provide details on current XMIPT projects including a ground study to assess the effects of vacuum on pharmaceuticals, technology demonstrations of highly integrated multi-functional medical devices, development of an integrated data architecture, and development of an onboard automated medical inventory system.

[324] EXPLORATION MEDICAL INTEGRATED PRODUCT TEAM (XMIPT) OVERVIEW AND STRATEGIC ROADMAP UPDATES

Moriah Thompson¹, Rahul Suresh¹, Justin Yang², Phyllis Friello³
¹NASA JSC, Houston, TX, United States; ²Aegis Aerospace, Houston, TX, United States; ³Leidos, Houston, TX, United States

(Education - Program/Process Review)

BACKGROUND: The Exploration Medical Integrated Product Team (XMIPT) is focused on formulating a medical system for exploration missions to Mars. Such a medical system must overcome expected mass, volume, resupply, and communication delay constraints and address current gaps in medical capability. The XMIPT's portfolio consists of activities to close 10 medical gaps that were derived based on inputs from NASA flight surgeons, clinical providers, and other NASA subject matter experts. These activities and gaps reside on the XMIPT's exploration medical integrated roadmap and are used to communicate progress, areas of need, collaboration, and programmatic infusion to stakeholders internal and external to NASA. **OVERVIEW:** This presentation will provide an overview of the required planned gap-closing activities and current efforts within the exploratio medical domain. The XMIPT's approach to prioritizing development is based on factors such as operational need, the maturity of the technology, and activities being performed by other NASA organizations. Current XMIPT activities to meet exploration mission needs include development of an in situ intravenous fluid generation device, development of an Exploration Electronic Health Record, evaluation of medications after exposure to vacuum, as well as performing market surveys and down select of Clinical Decision Support, Mini X-ray, Compact Laboratory Analysis, and Behavioral Health and Performance tools. The importance and status of these specific activities will be discussed here and in subsequent panel presentations. **DISCUSSION:** The XMIPT integrated medical roadmap is reviewed and revised annually providing a status of activities by groups across NASA to close exploration medical capability gaps. XMIPT projects are focused on advancing technology readiness level and conducting ground and in-flight demonstrations to enable programmatic infusion. The XMIPT partners with external organization such as the DoD and commercial partners to leverage shared resources to achieve gap closure priorities. Collectively, the XMIPT's curated, integrated medical roadmap and development activities seek to mitigate medical risk for crews on Mars missions.

Learning Objectives

1. The participant will be able to describe the XMIPT's current activities and how they contribute to exploration medical gap closure.
2. The participant will be able to understand the process by which exploration medical capability gaps and resulting roadmap activities were identified and prioritized.

[325] PILOT STUDY OF MEDICATIONS EXPOSED TO VACUUM

Phyllis Friello¹, Justin Yang², Moriah Thompson³, Rahul Suresh³, Tina Bayuse⁴, Sincy Mathew⁴, Craig Nowadly⁵

¹Leidos, Houston, TX, United States; ²Aegis, Houston, TX, United States;

³NASA, Houston, TX, United States; ⁴KBR, Houston, TX, United States;

⁵DoD, San Antonio, TX, United States

(Education - Program/Process Review)

BACKGROUND: Few studies have been conducted regarding the effects of vacuum on medications and their packaging. While relevant on the International Space Station, understanding these effects becomes even more critical as future NASA missions venture farther away from Earth. Vehicles supporting the Artemis missions will have dedicated, vehicle-specific medical kits as well as crew medical accessory kits. Although most of the kits will be stored in a pressurized, climate-controlled volume, there are specific scenarios in which they may become exposed to vacuum. These include the vehicle being brought to vacuum to enable clearance of atmospheric contaminants, and on Human Landing System (HLS), in the airlock (in which kits may be stored) during extravehicular activities. **OVERVIEW:** The Exploration Medical Integrated Product Team (XMIPT) in collaboration with the Department of Defense is conducting a pilot study to assess the effects of vacuum on the medications and their packaging to be used in exploration missions. Phase A of this study will focus on manufacturer's package integrity and

Phase B on identifying chemical changes through active pharmaceutical ingredient (API) testing of the medications at 0, 4.5 and 9 months post exposure. Two exposure durations, 1 hour and 8 hours were selected to represent the expected time at vacuum for an Orion contaminated atmosphere vent/repress and the time at vacuum for a lunar surface EVA. The medications for this study were identified based on those currently being considered for future Artemis missions and represent the types of pharmaceuticals and formulations that are likely to comprise an exploration formulary. **DISCUSSION:** The results from this pilot study will aid in decision making related to the development of medical kits, medication packaging and stowage for long duration lunar and Mars missions, and inform the direction of future medication in vacuum studies.

Learning Objectives

1. The audience will gain an understanding of the potential vacuum exposure scenarios of exploration medications.
2. The audience will learn about the planned testing for medications in vacuum exposures.

[326] CREW HEALTH AND PERFORMANCE INTEGRATED DATA ARCHITECTURE PROJECT

Amanda Smith¹, Brandon Schmitt², Dennis Beaugrand², Philip Augustine³, Melissa Lyons², Michele Beaugrand², Luis Montalvo¹

¹KBR, Houston, TX, United States; ²Alidyne, Houston, TX, United States;

³NASA JSC, Houston, TX, United States

(Education - Program/Process Review)

BACKGROUND: Future Human Exploration missions introduce a new paradigm as crews move further from the resupply and near real-time ground support typical of Low Earth Orbit missions today. Without immediate support from ground-based personnel, exploration crews will be more reliant on in-flight data and technology to respond to emergencies and anomalies. A data architecture to support a new generation of technologies, employing advanced analytical and predictive modeling techniques, is needed to enable crew autonomy. **OVERVIEW:** The Crew Health and Performance Integrated Data Architecture (CHP-IDA) project funded by NASA's Exploration Medical Integrated Product Team (XMIPT) is laying a foundation for future in-flight informatics by providing a back-end architecture for collecting, storing, and integrating multiple sources of data generated by and around the crew. CHP-IDA provides a platform for common data models and Application Programming Interfaces to access, integrate, process, and display CHP data (e.g., environmental, exercise, medical, sleep, performance, etc.). This will facilitate the increased situation awareness and decision support required by the crew and remote support of exploration missions. This presentation will describe the currently ongoing effort to develop and evaluate a path-to-flight concept of the CHP-IDA software and its core capabilities. Current integrations will be discussed, including analytics for Extravehicular Activity metabolic rate and data ingestion from a multi-functional integrated medical device. The presentation will also provide examples of scenarios used to demonstrate the CHP-IDA through human-in-the-loop test bed activities as well as examples of appropriate system performance metrics. **DISCUSSION:** Today, in-flight data is often siloed, unsynchronized, and largely inaccessible in real time. Many data sets require manual entry and/or data transfer between vehicles and the ground. These issues contribute to risks in supporting exploration medical capabilities. The CHP-IDA is a back-end data system providing core capabilities needed for timely and meaningful data insights across CHP domains to crew and remote personnel to enable increased crew autonomy. Future work includes collaboration with additional CHP domains, new technology integrations, and further demonstrations of the IDA within different vehicle and communication latency contexts.

Learning Objectives

1. The audience will understand that the CHP-IDA is a back-end system, providing a platform to facilitate access, promote decision tools, and provide meaningful insights to crew and to remote stakeholders during exploration missions.

2. The audience will gain insight into human-centered research and activities used to discover CHP domain data needs and pain points and how this information is used to guide development of the IDA.

[327] AN AUTOMATED MEDICAL INVENTORY SYSTEM (AMIS) TO ENABLE EARTH-INDEPENDENT MEDICAL OPERATIONS

Courtney Schkurko¹, Justin Yang², Moriah Thompson³, Rahul Suresh³, Kimesha Calaway⁴

¹NASA Glenn Research Center, Cleveland, OH, United States; ²Aegis

Aerospace, Houston, TX, United States; ³NASA JSC, Houston, TX,

United States; ⁴ZIN Technologies, Cleveland, OH, United States

(Education - Program/Process Review)

BACKGROUND: Inventory of medical consumables and durables (medications, treatment aids, diagnostic equipment, etc.) aboard the International Space Station is a manual process whereby crewmembers reach out to their flight surgeon to relay when items are used. Performing a full medical system inventory is time intensive. However, as exploration progresses to long duration missions with little to no resupply or evacuation capabilities, maintaining an accurate account of inventory and location for medical systems across the mission will become increasingly critical. A new system must be developed for future exploration missions to meet the need for a crew-facing, real time method of managing medical inventory. **OVERVIEW:** NASA's Exploration Medical Integrated Product Team (XMIPT) is funding the AMIS project to mature the technology readiness level and to conduct a flight demonstration of a medical inventory capability. AMIS will leverage lessons learned from a Medical Consumables Tracking project previously demonstrated aboard the ISS in 2016 and 2017. Key components of AMIS include a database, supporting hardware and software, and interfaces to power, communications, or other vehicle or medical systems. Some medical inventory capability may be provided by the vehicle inventory management system which relies upon RFID-based technology and can track larger items such as medical kits or medical hardware. AMIS will augment these capabilities to enable tracking of individual medical kit contents. Efforts are underway to characterize the optimal solution trade space by comparing system specifications (e.g. mass and volume, etc.) across maintenance and operational use cases (e.g. crew time saved, total inventory automated, etc). **DISCUSSION:** The contents of a Mars Medical System have not been fully defined which poses challenges to defining an inventory system and requires assumptions regarding medical kit contents and medical system design. Other important considerations include minimizing crew time required, avoiding access restrictions to medical inventory in the event of an emergency, and ensuring that data is accessible to other medical system elements to enable crew autonomy in provision of medical care.

Learning Objectives

1. The audience will gain an understanding of the benefit of including a medical inventory tracking system for exploration spaceflight missions.
2. The audience will gain insight into the challenges of designing a medical inventory system suitable for spaceflight.

Wednesday, 05/08/2024

10:30 AM

Grand Ballroom A

[S-57]: PANEL: MAKING SENSE OF SPECIAL SENSES III; IMPAIRED SENSORY FUNCTION AND AVIATION MISHAPS

Sponsored by AsHFA, Aerospace Medicine
Human Factors Association

Chair: Harriet Lester

Co-Chair: Benisse Lester

PANEL OVERVIEW: It's still the basics, when it comes to special senses and flight. Our limitations can be lethal. Intact visual, vestibular and auditory perception, and the accurate interpretation of sensory input, determine aviation performance and survival. Aeromedical standards help regulators identify defects in order to reduce the risk of accidents. Training and technology help offset shortcomings. The visual, vestibular and auditory systems will be discussed in terms of how failure of fundamental components including misperception can lead to mishaps, injury and death. Hearing in relationship to accidents, and abnormal visual fields and faulty stereopsis in USAF pilots will be discussed. Case report presentations will include: A mishap attributed to acute degradation of stereopsis due to monovision contact lenses; two fatal accidents involving spatial disorientation and vestibular illusions in instrument rated commercial pilots; and a fatal accident involving a monocular Flight Instructor with 22,000 hours. Failure and deficiencies of the auditory, vestibular, or visual systems, can be lethal. Aeromedical standards help mitigate risk but are not absolute. Pilots with intact sensory apparatus can have misperceptions, and pilots with abnormal sensory apparatus can under certain circumstances be well adapted. Safe flight depends upon intact special sensory systems, correct interpretation of sensory information, training and experience, and compliance with regulatory requirements designed to mitigate safety risk.

[328] ANALYSIS OF A COMMERCIAL AIRLINE MONOVISION-RELATED MISHAP: CAN AN ACUTE DEGRADATION IN STEREOPTIC THREATEN YOUR LOVED ONES?

Douglas Ivan

ADI Consultants, San Antonio, TX, United States

(Education - Case Study)

INTRODUCTION: In 1996, a Delta Airlines McDonnell Douglas MD-88 commercial aircraft sheared off its main landing gear while attempting to land visually at LaGuardia Airport in New York City. **BACKGROUND:** After making physical contact with the approach lights and runway seawall, the aircraft impacted the ground, rotated 180 degrees, and slid nearly 3,000 feet down the active runway before stopping perilously short of Flushing Bay. Miraculously, all passengers safely evacuated the aircraft with only a handful of minor injuries. Although there were several environmental and technical factors that potentially impacted this event, the National Transportation Safety Board (NTSB) concluded that the probable cause of the mishap was the pilot's unapproved use of monovision contact lenses (CLs) that prevented him from overcoming the visual illusions and correctly interpreting the normal references associated with the landing. **DISCUSSION:** This paper will analyze the post-mishap ophthalmological findings of the mishap pilot and discuss the perceptual visual factors involved in this accident, particularly the likely role that an acute degradation of stereopsis from monovision CLs played in this event.

Learning Objectives

- Attendees will learn about the visual factors and illusions associated with this particular commercial airline mishap.
- Attendees will learn about the impact of monovision on stereopsis.

[329] VISION REQUIREMENTS REMAIN DESPITE TECHNOLOGICAL ADVANCES

Jonathan Ellis

USAFSAM, Wright -Patterson AFB, OH, United States

(Education - Case Study)

The ACS Ophthalmology Branch has advanced vision standards as new data, medical/surgical treatments, and aircraft/display technology has also advanced. However, despite all of this, there remain some vision standards that remain and will continue to do so despite any future gains. Cases will be discussed regarding visual field defects and defective stereopsis to highlight unique findings in these cases as well as the continued need for full binocular vision to ensure safety of flight and mission

success. How these impairments in sensory function can contribute to aviation mishaps will be presented. Lastly, the likelihood and severity of the impact of these conditions on safety of flight will be used to quantify and highlight the level of risk using the Aeromedical Consultation Service Medical Risk Analysis and Assessment Matrix (AMRAAM).

Learning Objectives

- The audience will learn about past and present stereopsis standards in USAF aircrew.
- The audience will learn about past and present standards regarding visual field defects and conditions that can lead to visual field defects in USAF aircrew.
- The participant will hear case reports of specific examples of aircrew who did not meet standards and learn how those conditions can adversely impact aviation duties despite technological advances.

[330] MAKING SENSE OF SPECIAL SENSES: MONOCULARITY CASE REPORT

Harriet Lester¹, Heather Hunn², Scott Nicholson³, Benisse Lester⁴

¹FAA, Jamaica, NY, United States; ²Federal Aviation Institute, Oklahoma City, OK, United States; ³FAA, Oklahoma City, OK, United States; ⁴Self-employed, Washington, DC, United States

(Education - Case Study)

INTRODUCTION: A fatal accident involving a monocular Flight Instructor is presented. **BACKGROUND:** Vision is a critical and vulnerable special sense for the aviator. The loss of vision in one eye results in loss of binocular depth perception, and loss of visual field in areas not replicated by the eye with normal visual function. Monocular pilots seeking medical certification must demonstrate competency by successfully performing a Special Medical Flight Test (MFT) according to Flight Standards Order 8900.1, Vol5, Ch8, Sec1. The MFT can be performed after 6 months of visual function stability, and successful performance results either in a Statement of Demonstrated Ability (SODA) or a Special Issuance (SI), depending upon variables including ophthalmic diagnoses and Class of Medical Certification. **CASE PRESENTATION:** NTSB Report ERA13FA295 involved a 69 yo Flight Instructor with 22,000 hours and a Class 1 Special Issuance for controlled Type 2 Diabetes Mellitus. He had a prosthetic left eye since age 16, and was 20/20 in his right eye with a mild nuclear sclerotic cataract, and no diabetic retinopathy. The accident resulted in 2 fatalities, on 6/20/2013 about 1648 EST in McClellanville, South Carolina. Visual meteorological conditions prevailed and an IFR flight plan was filed. A Rockwell International 690B went into an aerodynamic stall/spin. NTSB determined probable cause to be pilot loss of airplane control during high-altitude maneuvering and his subsequent failure to recover airplane control. Contributing to the accident was the flight instructor's inadequate supervision of the pilot and his failure to perform remedial action. They had not flown together previously. The purpose of the flight was for the pilot to accomplish a CFR Part 61.56 flight review. The flight instructor's resume listed more than 5800 hours in turboprop airplanes and more than 4100 hours as a flight instructor. CAMI toxicology reported diphenhydramine in the liver and urine, and slightly elevated glucose in the urine, consistent with his Type 2 diabetes. **DISCUSSION:** This fatal accident was not attributed by NTSB to monocularity, yet illustrates how multiple factors can contribute to an accident. Incidence of monocular vision (ICD10 code blindness) among deceased individuals within the AAM-612 Autopsy Program Team's aviation accident database (MANTRA) was reviewed from October 1, 2008 to September 2023, resulting in 15 cases. This data query will be discussed.

Learning Objectives

- Participants will learn about medical certification requirements for monocular pilots.
- Participants will learn about visual functions affected by monocularity as well as adaptations.

[331] VESTIBULAR SENSORY ILLUSIONS: FIXED-WING AIRCRAFT PILOT SPATIAL DISORIENTATION CASE STUDY

Jason Sigmon

FAA, Oklahoma City, OK, United States

(Education - Case Study)

INTRODUCTION: This case report describes two instrument-rated commercial pilots' loss of aircraft control and subsequent accident with 7 resulting fatalities due to spatial disorientation. **BACKGROUND:** Vestibular illusions during flight operations lacking adequate visual horizon are a sensory response from a *normal* functioning vestibular system. Accident(s) due to spatial disorientation and resulting loss of aircraft control still account for 5-10% of aviation accidents and are associated with a 90% or higher fatality rate. Despite artificial cockpit horizon reference and instrument training pilots still succumb to spatial disorientation in both general and commercial aviation. **CASE PRESENTATION:** On May 29th 2021, at 1053:06 CST a Cessna Citation departed Smyrna, Tennessee destined for Palm Beach International Airport on an IFR flight plan with two pilots and 5 passengers. The aircraft entered instrument meteorological conditions shortly after take-off and during maneuvering flight executed a series of abnormal flight control inputs resulting in controlled flight into terrain at 1055:05. A review of radar track data revealed the aircraft executed a series of heading changes along with several climbs and descents before it entered a steep descending turn and impacted the ground with a vertical descent speed in excess 30,000 feet-per-minute. Both pilots' were instrument and type-rated in the Cessna CE-501 and held commercial pilot certificates. Weather reporting at the time of the accident included winds out of the North at 10 knots and a cloud ceiling of 1,300 ft AGL. The final NTSB determined the probable cause of the accident to be loss of aircraft control due to spatial disorientation during aircraft climb. **DISCUSSION:** While non-instrument rated pilots operating VFR into IMC is a well described and recurrent cause for spatial disorientation accidents, instrument rated experienced pilots are not immune to loss of aircraft control due to spatial disorientation. Piloting an aircraft is dependent upon the combination of valid sensory information combined with motor inputs for a complete kinesthetic response for the safe operation of the aircraft in all phases of flight. The loss of visual horizon reference introduces illusory sensations in a pilot resulting in the potential for spatial disorientation. This case illustrates the importance of pilot awareness, recurrent training, and education to help mitigate the risks for spatial disorientation.

Learning Objectives

1. The audience will learn of the unresolved problem of spatial disorientation and aircraft accidents within the US national airspace system.
2. The audience will leave with a better understanding of the challenges in mitigating spatial disorientation due to the human sensory inner ear systems functional biases.

[332] IS HEARING A FACTOR IN FLIGHT SAFETY? YES, IN MORE WAYS THAN ONE

John Allen

Star Harbor, Denver, CO, United States

(Education - Program/Process Review)

BACKGROUND: There is dearth of literature on hearing loss resulting in aviation or space activities. This may be due to the establishment of hearing standards (e.g. AFI 48-127/48-123; OCHMO STD 100.1A) for both aviation and spaceflight participation. It may also be due to hearing conservation programs (NASA NPR 1800.1) and procedures that prevent significant hearing loss. However, many things affect the ability to communicate in individuals with hearing loss. This presentation will discuss communication challenges for all levels of aerospace participation, how hearing loss may or may not present operational safety risks, and what mitigation measures are or should be applied to both reduce the risk of hearing loss or communication challenges which might result in aerospace accidents. **OVERVIEW:** Hearing loss has been noted for decades to be caused by exposure to excessive noise. Data collected through routine

medical examinations and hearing conservation programs has demonstrated the persistent degradation in hearing acuity accompanying years of noise exposure (Allen, et al, 2016). And yet military and commercial aviation and NASA space medical standards allow for progressively greater amounts of hearing loss, to a point. Standards also assume a certain level of communication ability, to a point. Program managers and engineers must understand hearing demands in all aspects of design and operations, including face to face, communications systems, and warnings and alerts. The designed acoustical environment of the air/space craft, the availability of personal hearing protection, and the noise levels of payloads that are manifested on space craft can all impact hearing and/or communications, potentially creating an unsafe environment. In addition to the above topics, this presentation will discuss the rationale for current hearing and noise standards as they relate to hearing abilities and demands on aviation and astronaut operations. **DISCUSSION:** The importance of good operational communication for the safety of any aviation or aerospace activity cannot be overstated. Accidents, whether minor or major, can be the direct result of inability to hear and understand critical messages and alerts (Casto and Casali, 2013). Vigilance in hearing protection and acoustical engineering design needs to be implemented to maintain participant health and safety.

Learning Objectives

1. The audience will learn about the importance and the insufficiency of current hearing standards.
2. The audience will learn about the need for a systems approach to preserving hearing and enhancing communication.
3. The audience will learn about the difference between "hearing" and "communication" and the importance of both.

Wednesday, 05/08/2024

Grand Ballroom B

10:30 AM

[S-58]: PANEL: PSYCHONAUTICS: EMERGING THERAPIES IN MENTAL HEALTH AND HUMAN PERFORMANCE

Chair: Cheryl Lowry

Co-Chair: Brian Pinkston

PANEL OVERVIEW: INTRODUCTION: Over the past decades, traditional mental health therapies for behavioral health diagnoses have been effective but not optimal. Psychedelic medications, glutamatergic drugs and immersive technologies using light and sound are emerging in clinical research trials as viable alternatives to traditional behavioral health therapies. New psychoactive drug development efforts are occurring on a global scale at unprecedented pace. Military forces, veterans and pilots may receive these emerging therapies via clinical trials or FDA-approved treatment protocols. Therefore, aviation medicine professionals must begin to understand these agents. This presentation is based on a review of literature regarding the clinical use of nontraditional behavioral health treatments and performance enhancements. Methodologies reviewed include psychedelic medications, glutamatergic drugs, immersive technodelic experiences, vagus nerve stimulation, and naturally-induced holotropic states of consciousness. Diagnoses considered for treatment include PTSD, depression, anxiety and substance use disorder. **TOPIC:** Nontraditional methods of treatment for common behavioral health conditions have shown beneficial results in numerous clinical trials. Treatment-specific indications and results will be discussed in separate panel sections. **APPLICATION:** Despite appropriate psychotherapy and pharmaceutical development, traditional psychotherapeutic treatment modalities remain inadequate in addressing the mental health crisis worldwide. The Veterans Administration, Department of Defense and healthcare systems have prioritized mental health disease morbidity and mortality reduction; therefore, pilots and personnel in safety-sensitive occupations may receive these novel treatments and performance enhancements. Aerospace medicine professionals must be familiar with

the psychoactive properties of these modalities, as well as their clinical indications and associated risk profiles. The development of therapeutic modalities that to reduce the burden of behavioral health disorders among aircrew must be balanced with meticulously-performed research in order to maintain aviation safety.

[333] INTRODUCTION TO PSYCHEDELIC-ASSISTED THERAPY (PAT)

Brian Pinkston

Kinetic Medical Consultants, St. Petersburg, FL, United States

(Education - Tutorial/Review)

INTRODUCTION: The clinical use of psychedelic medications in western medicine began with Albert Hofmann's synthesis of lysergic acid diethylamide (LSD) in 1939. Early research with LSD showed remarkable results as psychotherapeutic agents, as well as psychomimetic and psycholytic agents. The abuse of psychedelic medications by the counterculture in the 1960s led to the prohibition of their legal use and the cessation of sanctioned research efforts. LSD and other psychedelic medications were listed as Schedule one drugs by the Controlled Substances Act of 1970, further constraining their legal use. This presentation will review medications commonly used in PAT, potential clinical indications for PAT, and the typical architecture of PAT sessions. This presentation is based on a literature review regarding the history and clinical use of psychedelic-assisted therapy and the introduction of holotropic states of consciousness in the therapeutic environment. **TOPIC:** The utility of these medications recently re-emerged through the research efforts of Roland Griffiths at the Johns Hopkins Center for Psychedelic and Consciousness Research. The Hopkins team showed significant reduction in death-related anxiety in patients with terminal illnesses, warranting further research in their use for treatment of other behavioral health conditions. Research efforts legitimized continued research over the last two decades, ultimately resulting in the rapid worldwide emergence of PAT clinical trials. **APPLICATION:** This section provides an overview of current medications used in PAT and indications for their use. Naturally-induced holotropic states of consciousness will be discussed. The current status of clinical trials and FDA approval efforts will be explored. Finally, a case presentation will illustrate key objectives.

Learning Objectives

1. Name five substances that have been used in psychedelic-assisted therapy.
2. Describe the phases of psychedelic-assisted therapy. Discuss clinical trial findings for the uses of each substance currently used in psychedelic-assisted therapy.
3. Discuss clinical trial findings for the uses of each substance currently used in psychedelic-assisted therapy.

[334] GLUTAMATERGIC DRUGS, WITH A FOCUS ON KETAMINE AND ESKETAMINE, FOR TREATMENT-RESISTANT DEPRESSION IN PILOTS AND VETERAN

Matthew Macaluso

University of Alabama at Birmingham, Heersink School of Medicine, Birmingham, AL, United States

(Education - Program/Process Review)

INTRODUCTION: Medication selection and management is a major component of psychiatric treatment. Medication options increased dramatically over the last 50 years and will expand further during the next 10-25 years. One in three of the 21 million Americans who receives care for depression each year is not responsive to treatment and meets criteria for treatment-refractory depression (TRD). Intravenous ketamine and intranasal esketamine (ESK) have been used clinically for patients with TRD. Preliminary clinical trial results show significant symptom improvement.

Pilots and veterans with depression and TRD may pursue these treatment modalities; therefore, an understanding of their development, safety profile and therapeutic benefit is essential. **METHODS:** This presentation is based on a literature review regarding the clinical use of ketamine and esketamine for treatment-refractory depression. We also review and discuss the development and use of novel drugs affecting the central nervous system. **RESULTS:** Esketamine nasal spray, a noncompetitive N-methyl-D-aspartate (NMDA) receptor antagonist classified as a rapid-acting agent, is the first novel mechanism of action antidepressant to be approved in over 60 years. ESK is indicated for use in conjunction with an oral antidepressant for the treatment of adults with TRD as well as suicidality associated with depression. Despite ESK being FDA approved in 2019, its use in clinical practice has not been widespread, particularly considering the prevalence of treatment resistant depression TRD. Changes in psychiatric treatments occur as understanding of the pathophysiology of psychiatric illnesses advances, discoveries in genetic research and brain imaging occur, and new physiological, biochemical, and pharmacologic tools are developed. **DISCUSSION:** It is imperative that aerospace medicine practitioners and policy makers understand the risks and benefits of treating depressed or suicidal veterans and pilots with ESK. Clinicians must understand how knowledge of the pathophysiology underlying psychiatric illness led to currently-available medications and informed the discovery of the mechanisms by which they work. Understanding the process of new drug development is critical for clinicians to evaluate the literature and judge whether and how to introduce new medications for the treatment of pilots and veterans with treatment-refractory psychiatric illness.

Learning Objectives

1. Understand the drug discovery and development process as it pertains to novel mechanism of action CNS drugs.
2. Review the literature on intravenous ketamine and intranasal esketamine for treatment-refractory depression (TRD).
3. Understand how the development program and FDA approval of esketamine for TRD as well as suicidality associated with major depression can be a road map for studying other novel mechanism of action drugs for psychiatric illness.

[335] PSILOCYBIN AND PSYCHEDELICS IN AVIATION MEDICINE

Cheryl Lowry¹, William Tyler²

¹Kinetic Medical Consultants, St. Petersburg, FL, United States; ²Diamond Therapeutics, Inc., Birmingham, AL, United States

(Education - Tutorial/Review)

INTRODUCTION: Recent clinical trials have demonstrated the potential of psilocybin and related tryptamine psychedelics in addressing mental health and substance abuse disorders, as well as enhancing human performance. The Department of Veterans Affairs has recently begun clinical trials for the use of psychedelic medications for treatment of PTSD and other behavioral health diagnoses. Therefore, it is possible that pilots with a military background will have received these experimental treatments. It is important for physicians involved in both clinical aerospace medicine, as well as aeromedical policy and safety, to understand the clinical indications and implications of psychedelic medications. **This presentation is based on a review of recent literature involving the use of psychedelic medications for for treatment of** behavioral health diagnoses including PTSD and addiction. **TOPIC:** When treating depression, anxiety, PTSD, and addiction among aircrew, psilocybin therapy appears to bolster introspection and perceptions of wellbeing, potentially diminishing aviation safety risks attributed to mental health. Separately, there is emerging evidence indicating non-medical advantages of psilocybin microdosing, such as heightened focus, creativity, and sensorimotor performance. These effects have potential to refine the cognitive and physical prowess of pilots and astronauts, offering augmented training outcomes, expedited reactions, and superior aircraft handling. **APPLICATION:** If psychedelic medicines receive

regulatory approval, stringent protocols and guidelines must be crafted to safeguard against any detrimental impacts on aviation operations and safety. Determining the effects of psychedelic treatments on aviation-specific cognitive and sensorimotor skills necessitates rigorous exploration. Judicious microdosing may benefit aerospace and military performance. Psychedelic treatments may refine cognitive and physical prowess of pilots and astronauts, offering augmented training outcomes, expedited reactions, and superior piloting. The rapid re-emergence of psychedelic treatments warrants the attention and involvement of the aerospace medicine community. Additional safety and efficacy research is imperative to navigate the complexities of integrating psychedelics within aviation, and the applicability to pilots and military personnel.

Learning Objectives

1. Identify the clinical research indications for the use of psychedelic medications.
2. Discuss the potential performance enhancement properties of psychedelic medications and their application in aviation medicine.
3. Discuss the risks of psychedelic medication use in pilots.

[336] EMERGING NONPHARMACOLOGIC BEHAVIORAL HEALTH AND COGNITIVE TREATMENT MODALITIES

Brian Schiefer¹, Cheryl Lowry²

¹U.S. Air Force, Retired, Santa Rosa Beach, FL, United States; ²Kinetic Medical Consultants, St. Petersburg, FL, United States

(Education - Tutorial/Review)

INTRODUCTION: Depression, PTSD, addiction, and traumatic brain injury (TBI) continue to represent significant treatment challenges for pilots, as well as the general population. Traditional therapies have shown varying degrees of effectiveness, and there is growing interest in innovative interventions. "Technodelics" is a term that blends technology such as virtual reality, light, sound and immersive digital experiences. These are used alone or in combination with breathwork or psychedelic substances to induce states of consciousness. Technodelics provide users with a novel and often immersive sensory experience that can alter perception, enhance creativity, or lead to a heightened sense of connectedness. Some proponents argue technodelics can have therapeutic or consciousness-expanding effects similar to traditional psychedelics, without ingesting any substances. These new therapeutic modalities may represent viable treatment adjuncts or alternatives for pilots and other safety-sensitive occupations. **This presentation is based on a review of recent studies involving the use of technodelics for treatment of behavioral health diagnoses.** **TOPIC:** Recent scientific literature suggests that technodelics, when administered in controlled settings, have shown promising results in the treatment of behavioral health diagnoses, addiction and TBI. Research has shown statistically significant improvements in mood and cognitive function, as well as overall well-being. Technodelics appear to modulate neural activity and facilitate introspection, potentially aiding in the resolution of trauma and addiction-related issues. Light and sound therapy may influence circadian rhythms and neuroplasticity, which can positively impact mood disorders and therapy, and sound therapy presents a novel approach to addressing depression, PTSD, addiction, and TBI. Pilots seeking treatment for behavioral health conditions and TBI may benefit from these emerging non-pharmacological treatments. The effectiveness of these treatments can vary among individuals. While preliminary results are promising, more extensive and controlled research is required to establish the safety and efficacy of these treatments and to determine their long-term impact on patients. Additional studies are needed to determine the safety and efficacy of these treatments in pilots and personnel in safety-sensitive occupations.

Learning Objectives

1. Define and describe the term "technodelic" clinical treatment modalities and their indications.
2. Understand various types of immersive "technodelic" methodologies including light, sound and virtual reality.

[337] VAGUS NERVE STIMULATION FOR ENHANCEMENT OF HUMAN PERFORMANCE IN AVIATION

William Tyler

IST, LLC, Birmingham, AL, United States

(Education - Tutorial/Review)

INTRODUCTION: The potential of auricular vagus nerve stimulation (aVNS) to improve health and performance in aviation and military professionals is gaining attention. This non-invasive neuromodulation technique uses electrical impulses delivered to the outer ear to stimulate auricular branches of the vagus nerve. AVNS has been shown to reduce fatigue, anxiety and depression through neuromodulation. This presentation is based on a literature review regarding the use of aVNS for fatigue mitigation, stress reduction and performance enhancement. **TOPIC:** Recent research has demonstrated aVNS may offer solutions to some of the pressing challenges faced by pilots and other personnel in aviation and military occupations. Irregular sleep schedules and circadian disruption can severely impact performance through fatigue and impaired alertness. By modulating key neurotransmitters and brain activity starting in the ascending reticular activating system, aVNS can improve sleep quality and restore natural circadian rhythms. Utilizing aVNS in this capacity can lead to more rested and vigilant pilots and crew, enhancing aviation safety. Additionally, high levels of occupational stress in aviation can contribute to mental health disorders, including anxiety and depression. It has been shown that aVNS can provide therapeutic effects for those suffering from depression and anxiety leading to an improved quality of life. Chronic stress also raises systemic inflammation, increasing future health risks. It has been shown that aVNS can reduce inflammation by reducing cytokines through modulation of the cholinergic anti-inflammatory pathway. **APPLICATION:** AVNS could be a useful non-pharmacological intervention in the aviation industry and special duty personnel, given the high-pressure environment. Inflammation reduction by aVNS could not only improve quality of life, but also boost operational readiness by reducing stress and illness-related absences. In summary, through its versatile effects on sleep, mental health, and inflammation, aVNS is an appealing new avenue for optimizing the performance and safety of aviation and special duty professionals. Further research on this non-pharmacological neuromodulation technique may uncover approaches to enhance aerospace medicine through both treatment and prevention.

Learning Objectives

1. Describe the potential indications for the use of auricular vagus nerve stimulation.
2. Understand the mechanism of action for vagus nerve stimulation treatments.

Wednesday, 05/08/2024
Grand Hall J

10:30 AM

[S-59]: SLIDES: HEALTH AND WELLNESS EVALUATIONS

Chair: Paul Young

Co-Chair: Sandy Salzman

[338] MOVED TO [S-65]: AEROSPACE MEDICINE IN GERMANY AND SWITZERLAND

[339] CURRENT RESEARCH AND FUTURE DIRECTIONS IN FEDERAL AVIATION ADMINISTRATION COGNITIVE SCREENING TESTS FOR PILOT MEDICAL CERTIFICATION

Kelene Fercho

FAA, Oklahoma City, OK, United States

(Original Research)

INTRODUCTION: Pilots work in a cognitively demanding environment, making decisions under conditions of operational stress not experienced by most workers. The outcome of a pilot's decisions has the potential to impact hundreds of lives; thus, it is critical that only those who are medically fit to fly do so. As part of the medical certification process, the Federal Aviation Administration (FAA) may require cognitive screening if a pilot has a medical history associated with a potential aeromedically significant cognitive impairment (e.g., stroke, head injury). In these cases, a computer-based neuropsychological test provides an objective measure of cognitive status. Computer-based neuropsychological testing has evolved over the past decades, and now many computerized screening tests and comprehensive test batteries are widely available for both clinical and research use. This current FAA research seeks to:

1) determine reliable and valid, commercially available computer-based tests that could be used for cognitive screening as part of the FAA's medical certification process; and 2) develop pilot normative data for these tests. **METHOD:** Candidate computer-based neuropsychological test batteries were identified through literature searches, market surveys, and in consultation with subject matter experts. Test inclusion and exclusion criteria were applied, and a scoring rubric was used to select the tests for data collection. Normative datasets are being developed for two pilot reference groups: 1) pilots with a FAA first-class or second-class medical certificate; and 2) pilots with a FAA third-class medical certificate.

RESULTS: Sixty-two computer-based neuropsychological test batteries were identified. Test inclusion and exclusion criteria reduced the number of candidate tests to eight. Subject matter experts used an objective scoring rubric to select the three tests used in normative data collection. Normative data collection is in progress with a target total sample size of 960 pilot participants across two reference groups (i.e., FAA medical class) and six age bands. **DISCUSSION:** This research will ensure that FAA aeromedical guidelines for cognitive screening in the FAA medical certification process are consistent with the best current scientific knowledge, and will increase cognitive screening test options with pilot normative data for use by aeromedical health care providers.

Learning Objectives

1. Understand the FAA's research effort to identify computer-based cognitive screening tests in the FAA medical certification process, including the FAA's test selection criteria and methods.
2. Describe the FAA's ongoing normative data collection effort with a large pilot sample following an Institutional Review Board (IRB)-approved protocol.

[340] LONG TERM OUTCOMES OF REFRACTIVE SURGERY IN AVIATORS

Oded Ben-Ari¹, Liora Levian Moadim¹, Aya Ekshtein¹, Maya Avni¹, Dana Berger¹, Yuval Kozlov²

¹Aeromedical Center, Israeli Air Force, Ramat-Gan, Israel; ²Hebrew University of Jerusalem, Jerusalem, Israel

(Original Research)

INTRODUCTION: Photorefractive Keratectomy (PRK) and Laser-Assisted in Situ Keratomileusis (LASIK) are widely applied procedures designed to correct refractive errors in adults. Despite the evidence on the safety and effectiveness of these surgeries, long-term visual and refractive outcomes in combat pilots are not thoroughly investigated. This study aimed to investigate long-term effects of PRK and LASIK on Israeli Air Force (IAF) aviators. **METHODS:** Medical records of aviators who underwent refractive surgery during their service were extracted. Preoperative and annual- postoperative data were analyzed. Key metrics included visual acuity (VA) and spherical equivalent (SE). This study was approved by the Institutional Review Board. **RESULTS:** 87 records were analyzed. Mean age at the time of surgery was 31.8±9.8

years, 95.4% male. Pre surgery myopia severity (SE) was -2.060±1.158. LASIK and PRK procedures were performed in 62.1% and 33.3% of the surgeries, respectively. Both PRK and LASIK demonstrated significant, sustained improvements in VA for 11 years (p=0.035) and SE for 12 years (p<0.001). Myopia severity pre-surgery was identified as a crucial determinant for postoperative outcomes for VA (p=0.029) and SE (p=0.008). Age, astigmatism, and procedure type did not significantly influence long-term outcomes. **DISCUSSION:** This retrospective study of IAF aviators provides vital understanding into the enduring effectiveness of PRK and LASIK procedures. Notably, the study demonstrated substantial and sustained enhancements in different visual parameters for up to 12 years post-surgery. Both PRK and LASIK yielded substantial improvements, with no procedure showing superior results, allaying some prior concerns regarding potential corneal instability from LASIK's corneal flap.

Learning Objectives

1. This study shows that LASIK's corneal flap stability is preserved even under extreme altitudes, hypoxia, and high acceleration over a long period of time.
2. This study demonstrated that PRK and LASIK both led to significant enhancements, and neither procedure demonstrated superior outcomes over the other.

[341] MENTAL HEALTH AND WELLNESS FRAMEWORK FOR PILOTS AND AIR TRAFFIC CONTROLLERS: A SINGAPORE APPROACH

Benjamin Tan, Chun Hon Chong

Civil Aviation Authority Singapore, Singapore, Republic of Singapore

(Education - Program/Process Review)

BACKGROUND: There has been a rapidly growing global burden of mental health disorders, and the COVID-19 pandemic has acutely highlighted its importance not only at workplaces but also across societies and varied populations. Aviation professionals around the world are not spared and may have occupation related stressors including high workload, inconsistent work schedule, time zone shifts, fatigue and sleep disturbances. The impact of aviation professionals' mental health on aviation safety is wide-ranging; from lapses and errors to intentional pilot actions. There is a need to address mental health related risks toward aviation safety. **OVERVIEW:** To effectively mitigate the associated aviation safety risks, a salutogenic approach and comprehensive framework for mental health were assessed to be critical. In Singapore, a unique tripartite framework on mental health and wellness for pilots and air traffic controllers was jointly developed by the Civil Aviation Authority Singapore, the airlines and unions. Also known as the EPIC framework, several initiatives along the four pillars of Education, Peer Support, Intervention and Collaborative Programs were pursued collaboratively to strengthen mental health and wellness for our aviation professionals. **DISCUSSION:** In this presentation, the philosophy and conceptualization of the EPIC framework will be expounded. The various efforts to strengthen the mental health support structures and networks, in alignment to the EPIC framework, will also be shared. Upcoming initiatives to anchor sustainable and long term outcomes will be briefly covered.

Learning Objectives

1. Understand the complex nature of mental health and wellness issues and the importance of safeguarding it for Pilots and Air Traffic Controllers, to better manage aeromedical risks and aviation safety.
2. Learn about a novel tripartite approach for mental health and wellness under the EPIC Framework that has been designed to change culture, reduce stigma and grow peer support networks in encouraging aviation professionals to actively seek help and support.

[342] PEER SUPPORT SERVICE UTILISATION AND USER SATISFACTION OVER A FIVE-YEAR PERIOD: CHALLENGES AND OPPORTUNITIES FOR AN EMERGING FIELD.

Aedrian Bekker, Rob Bor

Centre for Aviation Psychology, London, United Kingdom

(Education - Program/Process Review)

BACKGROUND: Peer Support within the aviation sector is gaining increasing prominence and has become a popular mental health intervention for those who work within it. For those employing commercial pilots, it is a mandated requirement across Europe and the UK and is rapidly becoming best practice in North America and other parts of the world.

OVERVIEW: At its heart, Peer Support is primarily a user-led service supported mostly by trained, volunteer colleagues (i.e. peers). It is designed to (a) lower the barriers to help-seeking behaviour within largely reticent professions, such as pilots, (b) de-pathologise stressful and debilitating experiences and feelings of users through the unique support and validation of their peers, (c) where appropriate, encourage and direct users towards more specialist services, and (d) prevent common life stressors and mental health challenges from escalating to potentially career-limiting and costly outcomes for both the user and their employer. While Peer Support programmes and their methodologies vary, most operate within specific terms of reference, including oversight or access to a specialist mental health professional. While frequently referenced in the industry press, at conferences and workshops, there are few published studies looking at the utilisation patterns, satisfaction levels and user demographics of those who use of Peer Support services. **DISCUSSION:** Our primary purpose of this study has been to answer the following questions: 1) Who uses Peer Support? 2) Why do they use it? 3) How debilitating are their current circumstances that led them to this service? 4) Has it made a significant improvement to their situation having used it? Over the past 5 years, we have aggregated utilisation, categorisation and distress-intensity patterns, along with feedback and (limited) outcome data from across a range of AOCs across the commercial aviation sector. This presentation will explore these findings and consider them within the context of existing challenges and opportunities for this burgeoning field of practice and study. 'Lessons learned' will also be shared with those considering this intervention for other safety-critical professions.

Learning Objectives

1. Considering the usage, causes, and user demographics of pilots utilising peer support services.
2. Contextualising these findings within the challenges and opportunities for those operating (and studying) these services as primary mental health interventions.
3. Understanding the similarities and differences when applying peer support services to other safety-critical, aviation professions.

[343] A REGULATORY SAFE HAVEN

Tim Sprott, Claude Preitner, Sarita Dara

Civil Aviation Authority New Zealand, Wellington, New Zealand

(Education - Program/Process Review)

AUSTRALASIA AND A REGULATORY SAFE HAVEN

BACKGROUND: Estimates for healthcare avoidance for fear of aeromedical certificate loss vary between 46% to 56% with up to 72% of pilots feeling concerned about the possible impacts of seeking medical care on their career or recreation. Rates of withholding or misrepresenting information on a written questionnaire, such as routine medical examinations, may be in the order of 26-27%. There are also tensions faced by aviation and other health professionals working with pilots, even where defined practical pathways for disclosure exist. Healthcare avoidance in combination with the absence of recognised pathways for disclosure to regulators can lead to major risks to safety of the aviation system. The most publicised example is the Germanwings accident but this is far from an isolated example. **OVERVIEW:** Confidential safe zones external to formal regulatory processes are integral to peer support

programmes such as HIMS and PAN. This project expands this concept further for a system that applies to all health conditions that may affect the safety and well being of pilots. **DISCUSSION:** This presentation outlines the concept of a confidential reporting system incorporating a safe zone to encourage pilot disclosure of medical conditions outside the formal regulatory framework, but with some oversight. The management of reported conditions and the potential liability, safety risks and "safety drift" are discussed.

Learning Objectives

1. The current magnitude of healthcare avoidance and non-disclosure of medical conditions by pilots concerned about potential consequences on their aeromedical certification status and careers.
2. The potential aviation system risks associated with pilot healthcare avoidance and non-disclosure of medical conditions.
3. A potential confidential system incorporating a safe zone to encourage pilot disclosure of medical conditions outside the formal regulatory framework, but with some oversight. The management of reported conditions and the potential liability, safety risks and "safety drift" are discussed.

Wednesday, 05/08/2024

10:30 AM

Grand Hall K

[S-60]: PANEL: USAFSAM AAMIMO 2024 CLINICAL CASE PRESENTATIONS: A MULTI-NATIONAL MILIEU OF MALADIES

Chair: Jeffrey Harris

PANEL OVERVIEW: The Advanced Aerospace Medicine for International Medical Officers (AAMIMO) program is a 6-month workshop hosted by the US Air Force School of Aerospace Medicine (USAFSAM). Experienced Aerospace Medicine physicians from militaries around the world complete educational rotations with each US Dept of Defense Agency, as well as with the FAA and NASA. The workshop is meant to increase understanding and interoperability between Aerospace Medicine practitioners from all over the world. Each participant will prepare and present an educational clinical case, either from their country or from their experiences at USAFSAM, that will highlight similarities and differences in international medical standards and how we care for our patient populations. The panel will be a grand rounds style collection of clinical cases in aviation medicine.

[344] FLIGHT OF THE GIRAFFE: MUSCLE TENSION DYSPHONIA IN A FEMALE OFFICER CADET PILOT

Sampath Hewawasam¹; Liu Yutong²

¹Sri Lankan Air Force, Trimcomalee, Sri Lanka; ²Flight Training Command, Gangshan AFB, Kaohsiung, Taiwan

(Education - Case Study)

INTRODUCTION: This case report describes a female officer cadet pilot with poor quality of communication with the Air Traffic Control (ATC) tower, causing significant problems for safety of flight. **BACKGROUND:** Radio communications are a critical link in the ATC system. If this communication is not established properly, misunderstandings can arise leading to the potential for fatal accidents or violation of flight safety rules. Hence, the clarity of communication between pilots and ATC is a critical factor in the field of aviation. **CASE PRESENTATION:** The subject pilot was a 22-year-old in the Sri Lankan Air Force. The ATC tower crew recognized that the communications from the pilot while in the air were not clear enough during her solo flight. She had no problems with communication, including no hoarseness of voice in normal day-to-day life. She was grounded from flying due to unclear communication with ATC crew. She underwent an extensive physical and psychological workup to determine the cause of her speech difficulties. She was found to be suffering from a fear of flying and training stress. A video stroboscope also found that

she had abnormal function of her left vocal cord. She was diagnosed as secondary muscle tension dysphonia by an ENT surgeon. Her vocal cord was surgically repaired. Her fear of flying was successfully treated with cognitive behavioral therapy and a short course of Fluoxetine. She completed speech therapy with good results and was ultimately allowed to return to flying. At present, she is performing her duties as a clever pilot in SLAF. **DISCUSSION:** Training pilots requires a significant investment of resources, and flight surgeons should be capable of managing this type of complex case to meet the operational needs of the military and to assist a young pilot achieve their professional aspirations. We will discuss the differential diagnosis for speech difficulties as well as the treatment for MTD. We will also compare aviation medical standards both military and civilian in Sri Lanka, Taiwan, and the United States.

Learning Objectives

1. The audience will learn about the presentation, diagnosis, and/or treatment of an interesting Aerospace Medicine case.
2. The audience will learn about the similarities and differences in medical standards and pilot medical clearances for civilian, US and foreign military aviation professionals.

[345] WPW SYNDROME IN A JAPAN SMALL JET PILOT

Shotaro Yamamoto¹; Liwaa Alaa Al-Hamami²

¹Air Staff Office, Tokyo, Japan; ²Iraqi Air Force Aeromedical Facility, Tikreet, Iraq

(Education - Case Study)

INTRODUCTION: In this case report we will describe a Japanese military U-125 Pilot who was found to have WPW syndrome during his annual aviation medical examination and returned to flight duties through catheter ablation. **BACKGROUND:** Wolff-Parkinson-White syndrome, or WPW syndrome, is a cardiac arrhythmia characterized by an abnormal electrical pathway in the heart. Normally, the heart's contractions are regulated by a specific pathway, but in WPW syndrome, an abnormal pathway known as an "accessory pathway" exists. This can lead to rapid and irregular heartbeats. One specific arrhythmia associated with WPW syndrome is called "pseudo ventricular tachycardia." In this condition, the abnormal pathway allows the ventricles to be excited prematurely, resulting in a faster heartbeat than usual. This pseudo ventricular tachycardia is distinct from regular ventricular tachycardia. When pseudo ventricular tachycardia occurs, the heart rate becomes very fast, and the rhythm becomes irregular. Symptoms may include dizziness, shortness of breath, and chest discomfort. In severe cases, loss of consciousness can occur. **CASE PRESENTATION:** The pilot was 46 years old when an electrocardiogram during an aviation medical examination showed ventricular tachycardia-like waveforms, and he was suspended from flight duties. He underwent cardiac electrophysiology testing, was diagnosed with WPW syndrome, and underwent catheter ablation. One month after the ablation, he underwent echocardiography, Holter ECG, and exercise stress ECG, none of which showed arrhythmia. Aeromedical Evaluation Board allowed him to return to flight duties on conditions. No further problematic arrhythmias were found. Another Aeromedical Evaluation Board was conducted, with arrhythmia mitigated, he was returned to fly. **DISCUSSION:** At JASDF, the Aeromedical Evaluation Board determines whether a pilot who fails an aviation medical examination is allowed to return to flight duties. Ablation for WPW syndrome generally has a high success rate. However, in some patients with multiple abnormal conduction pathways, other conduction pathways may cause recurrence, so it is necessary to define appropriate evaluation criteria for each patient with WPW syndrome. This presentation will discuss the flight conditions imposed on pilots and the measures used by Japan, Iraq, and the US military for various arrhythmias.

Learning Objectives

1. The audience will learn about the presentation, diagnosis, and/or treatment of an interesting Aerospace Medicine case.
2. The audience will learn about the similarities and differences in medical standards and pilot medical clearances for civilian, US and foreign military aviation professionals.

[346] MISPLACED MALARIA: VIVAX ON ICE

Sneha Dinakar

Department of Acceleration Physiology, Institute of Aerospace Medicine, Indian Air Force, Bengaluru, Karnataka, India

(Education - Case Study)

INTRODUCTION: Malaria continues to pose a problem in endemic countries, due to emergence and spread of drug resistant Plasmodium parasites. Plasmodium (p) falciparum and p. vivax are responsible for the bulk of global morbidity and mortality statistics. India accounts for ~ 80% of cases and ~ 83% of deaths reported in South East Asian (SEA) regions as of 2021. **BACKGROUND:** Malaria is not so much of a diagnostic issue if it occurs in an endemic region. However, with fewer than 2000 cases annually in the US, only a high degree of suspicion can nail the diagnosis. The reported cases of malaria in the US are always imported by people returning from endemic regions or troops returning from deployment. Amongst the four common species of malaria parasite (falciparum, vivax, ovale and malariae), vivax has the longest dormant phase in the liver going from weeks to months. **CASE PRESENTATION:** A 54 yo Indian Air Force (IAF) airman, with no known co-morbidities and not on any medication, was deployed to Alaska for a 4-week flying exercise. He travelled via civil air and was asymptomatic for the first two weeks after arrival. He presented with fever and myalgia in the third week, that was managed with anti-pyretics for 48 hours. After 48 hours of continued symptoms, his bloodwork showed significant thrombocytopenia. He was hospitalised and managed as a case of malaria. **DISCUSSION:** A high degree of suspicion must be exercised in a patient presenting with unexplained fever and thrombocytopenia. History of travel from such areas should raise caution. In aeromedical concerns, once the acute phase is treated, the patient/aircrew will also be treated with pharmacotherapy to eliminate all phases of the parasite. It is imperative to treat a case like a mixed infection (vivax+falciparum) to prevent recurrence after a dormant phase. The duration of extended care and recuperation may take up to 4 weeks, during which time the adverse drug reaction will be looked for and treated. The aircrew can resume flying duties thereafter.

Learning Objectives

1. The audience will learn about the presentation, diagnosis, and/or treatment of an interesting Aerospace Medicine case.
2. The audience will learn about the similarities and differences in medical standards and pilot medical clearances for civilian, US and foreign military aviation professionals.

[347] THE EFFECT OF FLIGHT MANEUVERS ON G-TOLERANCE IN A FIGHTER PILOT

Saja Ameer Hanoon

Iraq Air Force Medical Command, Baghdad, Iraq

(Education - Case Study)

INTRODUCTION: This is a case of a fatal F-16 mishap due to G-induced loss of consciousness (GLOC), that highlights physiologic factors which may decrease a pilot's tolerance of G forces. **BACKGROUND:** G forces continue to be a significant threat in fighter aviation. Safety data shows that 157 G-related mishaps occurred between FY01 and FY11 with five Class As and three fatalities costing \$86.2M. Almost all military pilots, as part of their flight training, will undergo some exposure to the high +G environment. Fast jet operations, however, are where the vast majority of high +G exposure occurs. Fighter pilots are given extensive tools and training to overcome the effects of +G, including centrifuge training, advanced technology anti-G suits (ATAGS), positive pressure breathing for +G, physical conditioning, and refresher training on the anti-G straining maneuver (AGSM) continuously throughout their careers. **CASE PRESENTATION:** The mishap pilot was a physically fit 34-yr-old man. He had over 600 total flying hours. He was a pilot instructor on T-6A and completed training the T-38 prior to entering training in the F-16. On a regular training sortie, the pilot executed a maneuver that caused him to experience negative G followed immediately

by + 9G at which point he experienced GLOC. The pilot regained some level of consciousness prior to crashing and tried to eject, however, it was unsuccessful. The aircraft was destroyed and the pilot dead. He was current on all Aerospace Physiology training. Prior to the mishap sortie. After the crash, a postmortem tissue examination detected the consumption of a nutritional supplements. No carbon monoxide, ethanol, or illegal substances. The mishap aircraft was an F-16CM built in 1991.

DISCUSSION: This tragic accident is one of many that have occurred in military fighter pilots. As flight surgeons, we should be aware of all factors that may negatively contribute to a pilot's abilities in the jet, and be ready to educate air crew about how to stay healthy. In this presentation we will discuss some specific factors that affect G tolerance, including the push-pull effect, the effect of lifestyle on physiologic compensation and decision making under stress, as well as potential effects of common nutritional supplements.

Learning Objectives

1. The audience will learn about the presentation, diagnosis, and/or treatment of an interesting Aerospace Medicine case.
2. The audience will learn about the similarities and differences in medical standards and pilot medical clearances for civilian, US and foreign military aviation professionals.

[348] PERSISTENT TUBERCULOSIS IN A MILITARY TRANSPORT PILOT: A CASE REPORT

Nurunnabi Ibn Hossain¹; Haseena Syazwani Hassan²

¹Banabandhu AFB, Bangladesh; ²Institute of Aviation Medicine, Malaysia

(Education - Case Study)

INTRODUCTION: This case report describes a Royal Malaysian Air Force (RMAF) transport pilot with recurrence of pulmonary tuberculosis (PTB) despite completion of 2 courses of anti-TB treatment. The recurrent PTB was found incidentally during workup for a positive home COVID-19 test. **BACKGROUND:** Tuberculosis is a public health concern in many countries including Malaysia and Bangladesh. It is usually a subacute respiratory infection with prominent constitutional symptoms. The most frequent symptoms are cough, fever, weight loss, night sweats, malaise, and hemoptysis. PTB is a significant aeromedical concern as the symptoms affect aircrew's ability to perform effectively and the treatments may adversely affect concentration and coordination. Additionally, airborne transmission results in significant hazards for flight safety in transport operations. **CASE PRESENTATION:** The pilot was a 33-yr old RMAF C-130 pilot with 210 flying hours. He experienced a 4 kg weight loss and episodic hemoptysis over 4 weeks. PTB workup including sputum AFB smears were positive. He was treated with for 8 months. His sputum AFB smears were negative after the first month. Although asymptomatic at the end of the treatment, a HRCT showed pulmonary fibrosis and tree-in-bud pattern, and his bronchioalveolar lavage contained TB DNA. He was diagnosed with smear negative PTB and started a second round of antibiotics. He was not permitted to fly for a year following treatment completion. His return was delayed by another positive AFB smear discovered during workup for a mild COVID-19 infection. He required a third course of antibiotics. His return to fly assessment included two spirometry tests (3-month interval) and hypobaric chamber training which he completed without difficulty. He was allowed to fly with limitations to fly as, or with, co-pilot and with yearly spirometry. **DISCUSSION:** PTB represents a danger to flying environment during due to its effects on the infected pilot, the potentially incapacitating side effects of treatment, and the risk of spread in a confined aircraft. Aviators with active disease and undergoing long term treatment must be grounded. Careful, thorough follow up evaluation must be completed prior to resuming flying duties.

Learning Objectives

1. The audience will learn about the presentation, diagnosis, and/or treatment of an interesting Aerospace Medicine case.
2. The audience will learn about the similarities and differences in medical standards and pilot medical clearances for civilian, US and foreign military aviation professionals.

[349] IN-FLIGHT EMERGENCY DUE TO UNRECOGNIZED THALASSEMIA TRAIT CAUSING HYPOXIA: A FIGHTER PILOT CASE STUDY

Shiran Rajakaruna¹; Mariyam Bano Khan²

¹Sri Lankan Air Force, Colombo, Sri Lanka; ²Logistics 5 Corps, Pakistan Army, Karachi, Pakistan

(Education - Case Study)

INTRODUCTION: This case study explores the impact of unrecognized thalassemia trait on a fighter pilot, emphasizing the importance of early detection. **BACKGROUND:** Beta thalassemia minor, an autosomal recessive disorder, is characterized by less severe anemia than thalassemia major. Approximately 1.5% of the global population are carriers, with a prevalence of 1 in 2,600 births in Southeast Asians. Mildly anemic patients may be asymptomatic on the ground but will have problems when exposed to the stressors of flight. **CASE PRESENTATION:** A 30-year-old Pakistani JF-17 Thunder Fighter Pilot, previously healthy, experienced signs of hypoxia during a routine mission. Blurring of vision began at 14,000–15,000 ft, escalating to complete blackout at 18,000 ft. The pilot descended to 10,000 ft with assistance, regained normal vision at 9,000 ft, and landed safely. Medical evaluation revealed low hemoglobin (Hb) levels (10.3mg/dl), prompting further investigation. Diagnosed with anemia, subsequent tests revealed mild hypochromic and microcytic features. Hb electrophoresis confirmed beta thalassemia trait. The pilot was referred for comprehensive evaluation and fitness determination. The pilot remained grounded from flying for over a year. Inspired by similar instances in the Turkish and German Air Forces, together with a sudden increase in operational requirements for the Pakistan military, the pilot was granted a waiver for continued single cockpit fighter flying, contingent upon strict compliance and surveillance. Following this case all aircrew were screened for thalassemia, and two new cases were discovered. They underwent the same waiver process. **DISCUSSION:** Aviators in unique environments face inherent hypoxia risks. Thalassemia trait individuals may remain asymptomatic until hypoxia symptoms emerge. Hemoglobin electrophoresis, not standard in induction processes, is vital for early identification. Regular monitoring, counseling, and adherence to flight safety protocols are crucial for managing thalassemia trait cases among aircrew. This case underscores the need for proactive monitoring of hemoglobin levels, especially in asymptomatic individuals, to ensure early identification, appropriate counseling, and sustained flight safety.

Learning Objectives

1. The audience will learn about the presentation, diagnosis, and/or treatment of an interesting Aerospace Medicine case.
2. The audience will learn about the similarities and differences in medical standards and pilot medical clearances for civilian, US and foreign military aviation professionals.

Wednesday, 05/08/2024

10:30 AM

Grand Hall GH

[S-61]: PANEL: AEROSPACE FOR ALL. DISABILITY IN AVIATION AND SPACE EXPLORATION

Chair: Irene Di Giulio

Co-Chairs: Ryan Anderston, Sheyna Gifford

PANEL OVERVIEW: BACKGROUND. This panel explores the topic of accessibility in aerospace, examining different perspectives spanning professional and recreational aviation, parabolic flights, and long-term space travel. The focus is on medical requirements, physiological considerations, solutions and adjustments to ensure inclusivity in the aerospace sector, accommodating all individuals with disabilities. **OVERVIEW.** The first presentation, from R Anderton (Civil Aviation Authority, UK), describes the medical requirements in the aerospace field and the considerations for people with disabilities. The second presentation, from S Gifford (St. Louis University in St Louis, USA and UPenn in Philadelphia, USA), focuses on the

experience of AstroAccess and the lessons learned from a series of parabolic flights with people with disabilities as test subjects. The third presentation, from C Ramsburg (NASA, USA), provides the perspective of the team working on astronauts with physical disabilities, illustrating the needs of people with sensorimotor impairments. The fourth presentation, from I Di Giulio (King's College London, UK), describes the physiological considerations underpinning the European Space Agency accessibility project, and the lesson learned from aviation and people with disabilities. **DISCUSSION:** The presentations in this proposed panel will stimulate a productive discussion about the necessary changes in the aerospace industry to foster inclusivity for all participants. Moreover, the panel discussions will challenge the assumption that physical impairments invariably hinder performance, encouraging the audience to contemplate situations where these impairments do not hinder success in aerospace. Quoting astronauts Samantha Cristoforetti and Tim Peake 'We did not evolve to go to space. So, when it comes to space travel, we are all disabled' and 'Actually, it's about ability. It's not about disability'.

[350] REGULATORY MEDICAL CONSIDERATIONS FOR PILOTS WITH A DISABILITY

Ryan Anderton

Civil Aviation Authority UK, London, United Kingdom

(Education - Program/Process Review)

BACKGROUND: The UK Civil Aviation Authority (CAA) regulates and implements medical requirements for professional flight crew and private pilots. One in 5 people globally, and 24% of the UK population, report having a disability. This presentation will discuss the importance of encouraging access to aviation for all through the development of medical policy and guidance material for pilots with a disability, whilst considering the potential implications for safety critical roles. In particular, the aeromedical assessment of applicants for a medical certificate with a prosthetic limb will be discussed. **OVERVIEW:** The aeromedical assessment of pilots considers both the functional ability (e.g., musculoskeletal, hearing, vision) and the risk of incapacitation. The most common types of disability which prospective pilots present with are spinal cord injuries and amputations. In the aviation environment, impairment of the musculoskeletal system may cause difficulty in ingress/egress of an aircraft and the safe operation of controls. Restricted mobility may adversely affect the ability to read instruments or keep a satisfactory lookout. Applicants for medical certification with musculoskeletal disabilities require assessment to ensure they have the strength and range of movement necessary to operate an aircraft safely, with aids or modifications to controls as appropriate. Recently updated UK CAA guidance for the aeromedical assessment of pilots with a prosthetic limb demonstrates the regulatory approach to consideration of certification and the various means by which this may be achieved. This includes the use of Medical Flight Tests and a specialised limb prosthesis assessment form, incorporating an engineering and integration assessment alongside medical considerations. **DISCUSSION:** The development and update of medical policy to provide a clear and transparent assessment process for pilots with a physical disability is an important part of aviation regulatory work. We must also consider that as both aircraft and medical/engineering capabilities evolve, the risk assessment for a particular disability may also need to evolve. This is reflected in current endeavours to support spaceflight for astronauts with a physical disability. As we begin to define regulations for suborbital spaceflight participation, the application of collective experience and knowledge of disability in aviation will be important.

Learning Objectives

1. The audience will learn about the aeromedical considerations for the certification of pilots with a disability.
2. The audience will learn about the UK CAA's regulatory approach to the assessment of pilots with a prosthetic limb.

[351] HUMAN SYSTEMS INTEGRATION (HSI) CONSIDERATIONS FOR PARASTRONAUTS WITH SENSORIMOTOR IMPAIRMENT

Constance Ramsburg¹, Karina Marshall-Goebel², Scott Wood²

¹U.S. Navy/NASA JSC, Houston, TX, United States; ²NASA JSC, Houston, TX, United States

(Education - Program/Process Review)

BACKGROUND: As the era of the parastronaut begins, there must be a paradigm shift in how the space community approaches its criteria for future parastronaut mission considerations. This analysis reviews the existing body of knowledge on parastronaut considerations and provides a baseline of Human Systems Integration (HSI) considerations that the space industry and HSI experts can apply to enable safe and effective spaceflight missions with parastronauts. **DESCRIPTION:** To date, parastronaut feasibility studies have focused solely on lower limb and stature deficiencies, leaving room for additional impairments to be assessed such as sensorimotor. Notably, parastronauts with sensorimotor impairment may bring potential benefits in enhanced safety through design redundancy and hyperabilities like reduced likelihood of motion-sickness and adaptability during contingency scenarios. In addition, many physiological knowledge gaps on the risk of sensorimotor dysfunction during spaceflight could be researched in flying unique individuals with existing sensorimotor impairment. However, additional assessment and design modifications may also be required in areas such as the space vehicles, space suits, the space station, as well as future considerations for surface and/or microgravity extravehicular activity. Analysis shows all seven HSI Domains (Personnel, Manpower, Training, Safety and Occupational Health, Human Factors Engineering, Habitability, and Survivability) should be considered when selecting, designing for, and assigning parastronauts with sensorimotor impairment to human spaceflight missions. **DISCUSSION:** Recommendations for future research include the use of higher fidelity parastronaut analogs, in-flight exercise hardware assessment, and defining parastronaut selection criteria and feasibility based on the HSI Domains. We recommend strategically optimizing the research benefits of flying unique populations by including both parastronauts and HSI experts in the design and analysis processes. These findings will support the 'Aerospace for All. Disability in Aviation and Space Exploration' panel by stimulating constructive discussion on the inclusion of sensorimotor impairment in human space flight research and missions.

Learning Objectives

1. The audience will be able to understand the considerations for flying parastronauts with sensorimotor impairment in space, using seven Human Systems Integration Domains.
2. The audience will learn about the potential benefits, knowledge gaps, design modifications, and recommendations for flying parastronauts with sensorimotor impairment.

[352] ELEVATING PERFORMANCE ABILITY: OBSERVATIONS FROM ACCESSIBLE PARABOLIC FLIGHT OPERATIONS

Sheyna Gifford¹, Lucas Brane², Carlos Archilla-Cady³

¹St. Louis University Hospital, St. Louis, MO, United States;

²Mission AstroAccess, Houston, TX, United States; ³Florida State University, Orlando, FL, United States

(Education - Program/Process Review)

BACKGROUND: Since 2021, AstroAccess (AA) Medical Operations has treated operational capacity, not standard physiology, as the key consideration in crew selection. This elevation of ability over all over metrics, save for safety, has taken place in the context of an aerospace community committed to re-examining and redefining acceptable risk profiles; at a time when commercial aerospace has opened seats on sub-orbital flights to a wide range of human morphologies; when the word "parastronaut" has entered the vernacular of government aerospace and

the larger industry; and when civilian aerospace agencies are reshaping standards to emphasize performance metrics over age-based cutoffs.

OVERVIEW: In support of parabolic flights for crew of varied disabilities, AA Medical Operations adapted risk assessment and management standards and procedures used by past and current civilian, military and private spaceflight, expanding them to allow for the inclusion of flyers with physical limitations who are psychologically, cognitively, technically, and professionally qualified. The results have been overwhelmingly positive, with 76 potential flyers with disabilities screened and 23 supported to become parabolic flight crew aka "ambassadors." This ambassador cohort includes 5 individuals who are deaf or hard of hearing, 7 individuals who are blind or have low vision, and 11 individuals with mobility disabilities. Each flight or mission entailed 15-18 lunar, martian, or microgravity parabolas of between 20-30 seconds duration. Over the course of 33 parabolas, the only ambassador injury reported was a minor abrasion on the anterior thigh of one flyer, which went unnoticed until the flight suit was removed. In terms of illness, after parabola 10 on each flight, a few cases of nausea were reported and effectively managed with medication. No ambassador experienced vomiting. **DISCUSSION:** The lessons learned from these flights are many. They apply to space medicine operations more broadly and include shifting the onus of "right stuff" from the solitary domain flyers to the shared purview flight surgeons, who must now have the courage and creativity to lead aerospace into an era of judicious experimentation, open collaboration, and evolving consensus about prioritizing function over form in spaceflight while achieving the highest level of safety.

Learning Objectives

1. The participant will be able to discuss current barriers for integration of disabled SFP including hardware modifications, lack of standardized medical screening, risk stratification, risk mitigation and address industry culture.
2. The audience will learn about disabled flyers' experience with parabolic flights and simulated microgravity. Their publicly-known demographics and medical team's implementation of COE CST recommendations and observed learnings.

[353] LESSONS LEARNED FROM AVIATION TO INFORM ACCESSIBILITY IN SPACE EXPLORATION

Irene Di Giulio¹, Mike Miller-Smith², Neil Tucker², Ryan Anderton³, Nicol Caplin⁴, Stephen Harridge¹, Peter Hodgkinson¹, Marco Narici⁵, Ross Pollock¹, Carmen Possnig⁶, Joern Rittweger⁷

¹King's College London, London, United Kingdom; ²Aerobility, Camberley, United Kingdom; ³Civil Aviation Authority UK, Crawley, United Kingdom; ⁴ESA, Noordwijk, Netherlands; ⁵University of Padova, Padova, Italy; ⁶University of Innsbruck, Innsbruck, Austria; ⁷German Aerospace Center (DLR), Cologne, Germany

(Education - Program/Process Review)

BACKGROUND: One in 5 people worldwide lives with a disability, frequently facing challenges in aviation. This makes accessible space flight seem like a distant dream. Recently, ESA selected the first astronaut with a physical disability. Our ESA Topical Team supports this opportunity by reviewing the existing literature and lived experience in the field, to investigate the physical and physiological challenges and also the potential advantages of astronauts with disabilities.

OVERVIEW: Given the overlap between the medical standards required for pilot medical certification and those for astronaut selection, we started by examining the experience of a disabled flying charity, Aerobility. Three key lessons were learned from this review which will support the collaboration between stakeholders when working with astronauts with physical impairments. The first lesson was to recognise that not everyone will meet the standards for aeromedical certification. Astronauts face similar requirements and a transparent approach to assessment is required. However, these criteria can evolve over time, as advancements in both medical and technological fields may mitigate the impact of physical impairments on an individual's ability to participate

in space missions. The second lesson was that people with disabilities can meet the requirements for flying with adapted training and technical modifications. In this context, flexibility and open discussions are needed to understand individual needs and find optimal solutions. Likewise, considering astronauts, dedicated efforts are required to adapt systems and procedures, ensuring accessibility. The third lesson highlighted the significance of involving different stakeholders when reviewing recruitment, training, adaptations, and operations. Unconscious bias remains a challenge in the field. Without scientific evidence demonstrating the suitability of candidates with physical disabilities, space accessibility would remain partial. **DISCUSSION:** We reviewed the experience of a leading flying charity to define key lessons from aviation that could be translated and adapted for space flight. Our overarching goal is to evaluate the physiological considerations for people with physical disabilities in order to support ESA's team and space missions. This work will become even more relevant with the emergence of space tourism, and the need for accommodating a diverse array of candidates for both short-term and extended space flights.

Learning Objectives

1. To discuss the requirements and adjustments for people with disabilities in aviation and how they can inform space missions.
2. To identify the needs and adjustments for astronauts with a physical disability.

Wednesday, 05/08/2024
Grand Hall I

10:30 AM

[S-62]: SLIDES: DIAGNOSIS AND TREATMENT IN SPACE

Chair: David Kim
Co-Chair: Craig Kutz

[354] NEBULIZED INTRANASAL SCOPOLAMINE MAY PROVIDE RAPID RELIEF FOR SPACE MOTION SICKNESS.

Mimi Lan¹, Darin Knaus², Shireen Geimer³, Samantha Leigh³, Lionel Lewis³, Jay Buckley³

¹Thayer School of Engineering at Dartmouth, Hanover, NH, United States; ²Creare LLC, Hanover, NH, United States; ³Geisel School of Medicine at Dartmouth, Lebanon, NH, United States

(Original Research)

Motion sickness is common with approximately two-thirds of all crew members on Space Shuttle flights having reported motion sickness. About half of the cases are classified as moderate or severe. To avoid sedative effects of motion sickness medications there is an incentive to minimize the dose administered or avoid using motion sickness medication all together. This is especially important during demanding high-performance situations such as take-off, landing, and EVA. Rapid-onset motion sickness remedies are important in the space program when crew members need immediate relief and injections are not an option (i.e., when suited in a capsule or when motion sickness symptoms have begun and oral options are ineffective). A fast-acting formulation can be used as a rescue treatment to provide rapid relief when symptoms begin to occur. Scopolamine is an effective motion sickness treatment which is amenable to alternate (such as intranasal) routes of administration. Intranasal gel formulations of scopolamine have been investigated as a potential fast acting motion sickness treatment option. In studies, however, it has been shown to have a slow T_{max} (time to reach maximum concentration) of approximately 1 hour.

To explore a different formulation with a more rapid onset, a pilot study was conducted at Dartmouth Hitchcock Medical Center using nebulized intranasal administration of an aqueous scopolamine formulation. A nebulizer produces fine particles that can penetrate deeper

into the nasal airway and access the upper nasal mucosa. A nebulizer can be packaged in a low-volume, low-mass, and low-power form factor that can be hand-held and pocket stowable. It has the potential to offer an easy, accessible, non-invasive method that can be self-administered even while suited. A pilot test using the nebulized approach has been promising, with rapid onset in both subjects tested ($T_{max} = 5$ min), and with one person having plasma concentration levels comparable to IV administration. This pilot study has now been expanded to enroll 14 people to further study the pharmacokinetics of this approach. This study is currently underway.

Learning Objectives

1. The audience will learn about the therapeutic potential of intranasally administered nebulized scopolamine to provide rapid relief for motion sickness.
2. The audience will learn about current challenges in providing motion sickness relief in spaceflight activities.

[355] SPACEFLIGHT CRITICAL CARE: CEREBRAL PERFUSION IN HYPOTENSIVE PATIENTS DURING REENTRY

Michael Boyle

Self-employed, San Francisco, CA, United States

(Original Research)

INTRODUCTION: The advent of non-governmental crewed commercial spaceflight and efforts to send astronauts beyond low earth orbit introduce new medical risks that must be considered in the design of future vehicles. Shock is a significant risk which is more likely to develop in commercial crew with more comorbidities, and in any astronaut on a longer-duration mission further from definitive care. Atmospheric reentry is a particularly hazardous phase of flight for a patient in shock due to the deleterious effects of reentry acceleration on cerebral perfusion. G-induced loss of consciousness (GLOC) occurs when arterial pressure at the brain becomes so low that cerebral perfusion ceases, which, when prolonged, could cause permanent neurologic injury. For this reason it is important to understand the implications of crew positioning during high-G maneuvers. This work establishes limitations on G tolerance and seatback angles for crew members in shock. **METHODS:** Using validated models, max G tolerances were determined for hypotensive patients with varying heart-level mean arterial pressures (MAPs) and seatback angles. Seatback angles from 0 to 75 degrees from vertical were assessed for the 1st percentile to 99th percentile of the US male and female population. **RESULTS:** For patients with a MAP of 65 at the heart, maximum tolerable Gz at 75 degrees seatback angle was 10.6 and 7.8 for the 1st percentile female and the 99th percentile male respectively, which decreased to 2.8 and 2.0 at 0 degrees (vertical). For a MAP of 50, maximum tolerable Gz at 75 degrees seatback angle was 8.2 and 6 for the 1st percentile female and the 99th percentile male, which decreased to 2.1 and 1.6 at 0 degrees. **DISCUSSION:** These results demonstrate that hypotensive patients are particularly vulnerable to neurological injury during reentry. The degree of mitigation depends both on the acceleration vector relative to the vehicle, as well as crew member orientation within the vehicle. This has significant implications for future vehicle design, as return trajectories from the Moon and Mars will experience significant acceleration forces on reentry. For SpaceX's Starship design, reentry accelerations are near-perpendicular to launch accelerations, potentially precluding a single optimized seat orientation. As commercial and exploration-class spaceflight expands, the increased probability of adverse medical events means that engineers must consider these limitations in vehicle design.

Learning Objectives

1. The audience will learn about the physiology of G-LOC and the influence of spaceflight on crew susceptibility to GLOC.
2. The audience will learn about the physical modeling methods used to determine G-LOC.
3. The audience will learn about the implications of hypotension and reentry G-forces for commercial spaceflight.

[356] AN OPHTHALMOLOGY PROCESS FOR AN EARTH-INDEPENDENT, REAL-TIME DIAGNOSIS OF SPACEFLIGHT ASSOCIATED NEURO-OCULAR SYNDROME (SANS) FOR DEEP SPACE MISSIONS

Scott Ritter¹, Claudia Stern¹, Juergen Drescher¹, Franco Terranova⁴, Oriol Milian², Eleonora Zanus¹, Gauravam Majmudar¹, Aidan Cowley², Robert Siggel³, Ommar Ahmad³, Raphael Sznitman⁴
¹German Aerospace Center (DLR), Cologne, Germany; ²European Astronaut Center (EAC), Cologne, Germany; ³Helios University Clinic Wuppertal, Wuppertal, Germany; ⁴University of Bern, Bern, Switzerland

(Education - Program/Process Review)

BACKGROUND: Aerospace medical professionals may be familiar with the process of performing funduscopy examinations for astronauts, and the level training and experience required to correctly diagnose retinal abnormalities. The same procedures can be used by astronauts themselves during spaceflight missions, but with mobile devices and artificial intelligence support, to aid in real-time diagnosis. This presentation will prepare space medicine practitioners, astronaut trainers, and astronauts to use mobile devices and artificial intelligence applications for detection of Spaceflight Associated Neuro-ocular Syndrome (SANS) for potential use during upcoming Artemis missions to deep space.

OVERVIEW: Operational space medicine practitioners perform regular eye examinations of crew members during their missions to assess symptoms of SANS. These eye examinations may benefit from an Earth-independent, real-time process for SANS diagnosis in-flight with fewer ground support dependencies. To assess the feasibility of using mobile devices for this purpose, a technology demonstration was conducted aboard the International Space Station (ISS). Results from this technology demonstration were evaluated and used to develop an artificial intelligence process for SANS detection with no Internet connection or ground communication required. This process and its development will be presented with special reference to deep space applications, SANS countermeasure support, and where this process could be improved in the future. **DISCUSSION:** Mobile diagnostics and artificial intelligence applications have significance for their potential to save crew time and reduce schedule constraints during operational space medicine examinations. This process serves to support next steps for space medicine during LEO commercialization and the planned Artemis deep space missions. This work also has applications for remote medicine on Earth for professionals in emergency, military, or remote medicine without access to ophthalmology or neurology clinical specialists.

Learning Objectives

1. The participant will be able to understand the process for AI-enabled funduscopy for potential use during deep space missions.
2. The audience will learn about the capability gaps that may be filled with further development and integration of this technology for deep space missions.

[357] QUANTIFYING THE IMPACT OF SUSTAINED ACCELERATION ON CRITICAL CARE TRANSPORT MEDICAL EQUIPMENT

Craig Nowadly¹, David Freeman², Zachary Kerns², Romana Valladares², Joseph Hegedus³, Jeremy Beer²
¹59th Medical Wing/Brooke Army Medical Center, San Antonio, TX, United States; ²KBR Aerospace Environment Protection Laboratory, Inc., San Antonio, TX, United States; ³Brooke Army Medical Center, San Antonio, TX, United States

(Original Research)

INTRODUCTION: Military and commercial stakeholders are investing to explore the use of hypersonic aircraft and orbital spacecraft

to transport cargo, medical supplies, passengers, and casualties. These vehicle platforms require periods of sustained acceleration and deceleration, but to date, these dynamic forces have not been comprehensively considered in the environment of critical care patient movement because injured patients and advanced aeromedical equipment (AE) are rarely subjected to sustained acceleration. While military AE does undergo Crash Hazard Acceleration Testing, this does not test equipment function during or after sustained acceleration. This study was performed to fill that knowledge gap. **METHODS:** AE currently used by the US Air Force AE and Critical Care Air Transport Teams (ZOLL EMV+® 731 ventilator, ZOLL Propaq® MD cardiac monitor, B Braun Infusomat® Intravenous Pump) was subjected to low (2.5g), moderate (4.5g), and variable acceleration for 3-minute periods at the KBR Brooks Centrifuge. AE was tested for function in three different orientations (gX, gY, gZ). Pre-determined variations were made in equipment input settings to ensure each equipment item would function across mission relevant conditions (differing ventilator tidal volumes, differing cardiac monitor arterial pressure inputs, etc.). AE was evaluated for accuracy compared to controlled inputs, alarm conditions, and equipment failure. **RESULTS:** The EMV+® 731 ventilator and Propaq® MD cardiac monitor had no equipment failures during testing. The ventilator had clinically negligible variations in tidal volume, peak pressure, and fraction of inspired oxygen during acceleration. At the highest tidal volume (480 mL) tested, the ventilator had peak pressure alarms at both 2.5g and 4.5g. However, this was due to limitations in test-lung resistance and was not related to a ventilator fault. Mild effects of sensor orientation were recorded in the Propaq® MD blood pressure results; for example, average differences of $+4.9 \pm 0.3$ mmHg (75 mmHg input) were recorded in 4.5gX, compared to -0.9 ± 2.6 mmHg (75 mmHg input) recorded in 4.5gZ. **DISCUSSION:** US Air Force AE critical care equipment had detectable impacts from sustained acceleration. This knowledge will facilitate immediate follow-on experimentation with advanced models of combat injury during simulated medical evacuation in sustained acceleration environments.

Learning Objectives

1. Understand the impacts of sustained acceleration on a US Air Force Critical Care Air transport team ventilator's function.
2. Understand the impacts of sustained acceleration on a US Air Force Critical Care Air transport team cardiac monitor's function.
3. Understand the impacts of sustained acceleration on a US Air Force Critical Care Air transport team intravenous pump's function.

[358] CONSIDERATIONS IN THE EMERGENCY TREATMENT OF ASTRONAUTS: A PRIMER FOR EMERGENCY PHYSICIANS

Christina Mackaill¹, James D. Polk²

¹NHS, Glasgow, United Kingdom; ²NASA, Washington, DC, United States

(Education - Tutorial/Review)

INTRODUCTION: The steep rise of private and commercial human spaceflight as well as the simultaneous development of the multinational Artemis lunar program has increased the potential need to educate physicians around the world on the potential emergency care of an astronaut, should a contingency occur. Human-rated spacecraft may abort on launch, de-orbit due to spacecraft emergencies, or have anomalies that cause them to land or splashdown down range from the launch site, or outside their intended areas. **TOPIC:** The operational, physical, and environmental elements of a human-rated spacecraft contain potential threats to astronauts and rescuers, such as volatile chemicals, radiation, heat, and pyrotechnics. The potential for decompression sickness in an emergency, excessive impact loads on landing, high G loads from ballistic re-entry as well as untoward sea states, winds, and other hazards may cause potential harm to astronauts. The physiologic changes of spaceflight, especially long duration spaceflight, may have a significant impact on resuscitation and trauma treatment protocols that could impart harm to an astronaut if not correctly recognized. For example, the papilledema of SANS may be mistaken for head trauma, or conversely may make the astronaut more susceptible to ischemic changes in more minor head trauma as they already have mild

elevations in intracranial pressure. Preload deficits in long duration astronauts may place them at a higher class of shock if they incur trauma due to their inability to compensate. **APPLICATION:** The astute receiving physician must know the phase of spaceflight in which the anomaly occurred (launch, orbital flight, re-entry, landing), the type of vehicle (capsule versus winged, G loads, water versus land landing) and the duration of astronaut exposure to microgravity in order to correctly anticipate the physiologic changes and potential hazards imparted, and thus the appropriate care. This is especially true if a contingency has placed the responding rescue crews and flight surgeons (who are well versed in aerospace/space medicine) at a geographical disadvantage far from the response or landing site. **RESOURCES:** Provided at presentation.

Learning Objectives

1. Understand the potential emergencies an astronaut may face during different phases of spaceflight (e.g. launch, de-orbit due to spacecraft emergencies, landing).
2. Understand the potential emergencies an astronaut may face during spaceflight due to the operational, physical and environmental elements of spaceflight (eg. volatile chemicals, radiation, heat, pyrotechnics).
3. Understand the salient differences that changes in astronaut physiology or exposures may impact or change resuscitation protocols.

[359] A PROGRAM FOR DIAGNOSIS, PREVENTION AND TREATMENT OF PERIODONTITIS FOR ASTRONAUTS DURING LONG-TERM SPACE TRAVEL

Andreas Pfützner¹, Victoria Sampson², Dirk Neefs³

¹University for Digital Technologies in Medicine & Dentistry, Luxembourg, Luxembourg; ²Dentistry, London, United Kingdom; ³Universita degli Studi di Milano, Milano, Italy

(Original Research)

INTRODUCTION: Long-term space travel exposes participating astronauts to development of periodontal problems, such as gingivitis or periodontitis. **METHOD:** The aim of this prevention, monitoring and treatment program is to maintain oral health and prevent loss of teeth during long-term space travel. The program is based on a diagnostic technology, which can be conducted under non-gravity conditions: a diagnostic device for assessment of active matrix-metalloproteinase 8 (aMMP-8). It shall be used in combination with effective anti-bacterial treatment methods. aMMP8 is a collagenolytic enzyme involved in the pathophysiology of periodontitis. It cleaves the tight junctions in the periodontal tissues enabling bacteria and viruses to penetrate and destroy the periodontal connective tissue. **RESULTS:** Elevated aMMP-8 assessed in saliva is an indicator for the destructive processes leading to periodontitis. This biomarker and risk factor can easily be measured by means of a lateral-flow-based home use test. Preventive and treatment measures should target to lower the aMMP8-concentrations in saliva to normal levels. Prevention includes normal measures of oral health, such as regular cleaning of the teeth and use of disinfecting liquids. Treatment of stable chronic periodontitis can be conducted by several methods, including but not limited to antibacterial treatments, regular application of chlorohexidine, photodynamic therapies, and combinations thereof, e.g. a combination of antibacterial photodynamic therapy (aPDT) and antibacterial blue light (aBL), which has already shown substantial efficacy in home use trials. The suggested diagnostic method, measurement of aMMP-8 in saliva, has been selected as it is fully representative for the ongoing destructive collagenolytic process and can be used to monitor treatment success, only requires minor and small sized equipment, and does not involve gravity for successful operation. The most suitable treatment options need to be identified based on similar criteria. **CONCLUSION:** Results from clinical trials suggest that measurement of aMMP8 may significantly help to maintain oral health even during planned long-term space trips to Mars or other planets of our solar system.

Learning Objectives

1. To understand the active role of aMMP-8 in the pathophysiology of periodontitis and the functionality of measurement of elevated aMMP-8 in saliva to serve as diagnostic (risk indicator and treatment monitoring biomarker).
2. To understand the predictive value of aMMP-8 for periodontitis development.
3. To understand the importance of implementing assessment measures of oral health during long-term space trips.

Wednesday, 05/08/2024
Grand Suites 2 & 3

10:30 AM

[S-63]: POSTERS: HUMAN FACTORS AND AEROMEDICAL CONSIDERATIONS

Chair: Karen Ong

Co-Chairs: Joanna Nelms, Jonathan Elliot

[360] AEROMEDICAL CONSIDERATIONS FOR WINGSUIT HIGH ALTITUDE WORLD RECORD ATTEMPTS

Veronika Puisa¹, Matt Wilkes², Peter D Hodkinson¹

¹King's College London, London, United Kingdom; ²University of Portsmouth, Portsmouth, United Kingdom

(Education - Tutorial/Review)

INTRODUCTION: July 2023 saw a new wingsuit altitude world record of 13,184 m (43,253 ft). With technological developments, altitudes, flight duration and speeds will continue to increase. While environmental challenges posed in such attempts are not new, they need to be considered in new ways in this context. **TOPIC:** Major physiological concerns include hypoxia, decompression sickness (DCS), cold injury, and physical or cognitive limitation leading to pilot error. The altitudes reached are close to the performance limits of traditional aircrew oxygen delivery systems. It is uncertain how much higher a wingsuit pilot could fly, while avoiding significant hypoxia and DCS, without a full pressure suit. The thermal challenges are significant due to the combination of speed, temperature, and duration of exposure, with limited insulation. Oxygen must be reliably delivered in temperatures of -56°C with additional wind-chill. Cold injury has been reported during wingsuit descents without adequate protection. Wingsuiting requires physical effort, particularly shoulder abduction, extension and external rotation, to hold the optimum body position for stable, efficient flight. This physical exertion may exacerbate hypoxia, even with pressure breathing and 100% oxygen at these extreme altitudes. In developing mitigation measures, we must be mindful of total weight, weight distribution, aerodynamics, impact on vision and spatial awareness, human factors, and musculoskeletal injury risk. There must be no impediment to key activities including aircraft exit, navigation and communication, canopy deployment, cutaway, steering, or flaring. Operational considerations include flight planning, oxygen pre-breathing protocol and minimization of altitude exposure, which may vary significantly between different platforms (fixed wing aircraft, helicopters, and balloons are most common). Appropriate pilot training is fundamental to record attempts. The rapid evolution and development of equipment, such as aerodynamic helmet designs, pose challenges for systems integration and testing, which can be facilitated by the new generation of wingsuit wind tunnels. **APPLICATION:** We have identified multiple areas for potential further research to support future wingsuit record attempts from the literature. Many require technological development. Our work offers a framework for medical teams supporting pilots pushing wingsuit (and aeromedical) boundaries higher and faster than ever before.

Learning Objectives

1. The audience will learn about differences involved in wingsuiting compared with other air sports and the associated aeromedical considerations.
2. The audience will learn about some of the human system integration and test challenges associated with these boundary pushing wingsuit altitude world record attempts.

[361] PROFESSIONAL PILOTS REPORT SIGNIFICANTLY HIGHER FATIGUE LEVELS THAN THE WORKING POPULATION

Marion Venus

Venus-Aviation Research, Training & Pilot Support, Zurich, Switzerland

WITHDRAWN

[362] ROYAL NORWEGIAN AIR FORCE (RNOAF) CREW RESOURCE MANAGEMENT (CRM) PROGRAM: DEVELOPMENT AND LEARNINGS

Bobbie Ray-Sannerud¹, Frode Wegger²

¹Royal Norwegian Air Force, Oslo, Norway; ²Royal Norwegian Air Force, Rygge, Norway

WITHDRAWN

[363] THE EFFECT OF A DAYTIME NAP ON LEARNING A NOVEL AVIATION TASK

Nicole Beasley¹, Kara Blacker¹, Sara Alger², Lynn Caldwell¹

¹Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States; ²Walter Reed Army Institute of Research, Silver Spring, MD, United States

(Original Research)

INTRODUCTION: Research has shown the positive effects of sleep on learning and memory. While most work focuses on the effects of a full night of sleep, evidence suggests that a daytime nap has similar effects on improving learning. This notion could be capitalized on when training aircrew. Here we examined the effects of a nap on 3 learning tasks. **METHOD:** Participants (N=75) were randomly assigned to a nap or rest group. The study protocol was approved by the NAMRU-D IRB. Both groups completed: a) a paired associates task (PAT), used to measure declarative memory, b) a finger tapping task (FTT), used to assess procedural memory, and c) an aerial flight maneuvering (AFM) task, used to measure participants' ability to learn to fly a simulated aircraft through a series of targets (e.g., hoops). All tasks were performed in the morning (i.e., test), followed by a 2 hr nap or rest opportunity and then tasks were performed again 30 min after the nap/rest (i.e., retest). EEG was recorded throughout, including polysomnography during the nap. Outcome variables were analyzed using a 2 (time) x 2 (group) repeated-measures ANOVA. **RESULTS:** For the AFM task, we found a significant time x group interaction for both mean distance from the target, $p=.01$, and percentage of targets hit, $p=.002$. The nap group demonstrated improved performance at retest compared to the rest group. Within the nap group, we also found that amount of stage 2 sleep was significantly associated with better learning, $p=.025$. The EEG data during the AFM task demonstrated an opposite effect in beta power changes, whereby the rest group saw a significant increase at retest compared to test, $p=.012$, and the nap group saw a significant decrease, $p=.008$. The PAT and FTT tasks did not elicit any significant behavioral or EEG results. **DISCUSSION:** We found

that a daytime nap significantly improved learning performance on a novel aviation task compared to an equivalent rest period. This improvement was evident in both behavioral performance and EEG results. These results suggest that daytime napping could be incorporated into work/rest guidance as a strategy to improve new aircrew training.

Learning Objectives

1. Understand the effects of sleep on different forms of learning and memory.
2. This study showed that a daytime nap can help individuals learn a novel task faster than rest alone.

[364] DEVELOPMENT OF A QUICK SUITABLE SCREENING TEST TO ASSESS POST-COVID-19 COGNITIVE DYSFUNCTION IN THE SETTING OF ROUTINE PILOT AEROMEDICAL EXAMINATIONS.

Solomon Gurmu Beka, Rob Griffiths, Julie Myers, Paul Skirrow
University of Otago, Wellington, Wellington, New Zealand

(Original Research)

INTRODUCTION: Post-COVID-19 impairments can occur following acute infections that are mild or asymptomatic. While flight deck personnel are generally young, fit, healthy, well educated, and largely vaccinated, (and therefore at lower risk of being severely ill in the acute phase or developing Post COVID-19 Condition), nonetheless, there will be pilots who develop prolonged impairment. A sufficiently sensitive and valid screen of cognitive function is likely to be highly beneficial to identify individuals who may require more extensive neuropsychological evaluation. Hence, this study aims to develop quick suitable screening tests for post-COVID-19 cognitive dysfunction with validation via a modified Delphi survey. **METHODS:** Preliminary to this study was a systematic literature search and narrative review of neurocognitive impairments in post-COVID-19 conditions and its screening tests likely relevant to pilot performance. After a thorough review, screening tests that were revealed to be effective in screening difficulties with very demanding skills for airline pilots' performance were identified and sent to panellists for evaluation and validation with a modified Delphi method. The panel was multidisciplinary and mainly contained aerospace medicine specialists and aviation psychologists. **RESULTS:** A total of 18 experts were involved with a response rate of 88.88%. Initially, we identified thirteen screening tools based on their ability to detect COVID-19-related impairment. From this group, we have shortlisted the Trail Making Test parts A/B, Symbol Digit Modalities Test, and Stroop Colour-Word Test as potentially effective tools for assessing skills, such as attention and executive functioning, that are both affected by COVID-19 and predictive of pilot performance. We also included The Paced Auditory Serial Addition Test and Psychomotor Vigilance Test in the development process due to their wide utilisation and suitability of applications in the aerospace sectors. **CONCLUSION:** The Trail Making Test parts A & B and Symbol Digit Modalities Test were selected as suitable screening tools to detect post-COVID-19 cognitive dysfunction for airline pilots in routine aeromedical examinations. These tests were selected due to their sensitivity, effectiveness, utility, availability in multiple versions, and economical tests for Aviation Medical Examiners. Moreover, they were utilized to assess cognitive impairment in Long COVID and demonstrated good predictive values.

Learning Objectives

1. The participants will learn about the importance of identifying individuals with post-COVID-19 neurocognitive dysfunction for further investigation.
2. The audience will be able to understand quick and suitable clinical neurocognitive screening tests for post-COVID-19 conditions.
3. The participants will discuss the appropriateness of screening tests for neurocognitive impairment in post-COVID-19 conditions focusing on attention and executive functioning, particularly for airline pilots.

[365] DYNAMIC CARDIAC PERFORMANCE APPLIED TO ESTIMATE THE G TOLERANCE: A PRELIMINARY STUDY

Chung-Yu Lai¹, Wun-Wei Huang², Min-Yu Tu³, Kwo-Tsao Chiang⁴, Kuo-Kuang Jen⁵, Shang-Ju Wu⁵, Nian-Shen Chen⁵, Ching-Chun Chang⁶, Fang-Ling Li⁷

¹National Defense Medical Center, Taipei City, Taiwan, Greater China;

²Kaohsiung Armed Forces General Hospital Gangshan Branch, Kaohsiung City, Taiwan, Greater China;

³Medical Affairs Bureau, Ministry of National Defense, Taipei City, Taiwan, Greater China;

⁴Taipei Veterans General Hospital Fonglin Branch, Hualien County, Taiwan, Greater China;

⁵National Chung-Shan Institute of Science and Technology, Taoyuan City, Taiwan, Greater China;

⁶Kaohsiung Armed Forces General Hospital Gangshan Branch, Taipei City, Taiwan, Greater China;

⁷Tri-Service General Hospital Beitou Branch, National Defense Medical Center, Taipei City, Taiwan, Greater China

(Original Research)

(Original Research)

INTRODUCTION: High G training is a part of strenuous and high-intensity sports. Recently, a novel parameter, being the cardiac force index (CFI), was introduced to investigate the relationship with the G tolerance during the centrifuge. Walking CFI on the ground could be applied to predict the level of G tolerance under the gradual onset rate among military flight cadets. The aim of this study was set to reconfirm the potential model between the walking CFI and G tolerance.

METHODS: We organized this cross-sectional study in August 2023; 24 subjects were recruited from the aeromedical personnel training program in Taiwan. Before the centrifuge training, they wore the non-invasive BioHarness 3.0 devices (Zephyr Technology Corporation, Annapolis, MD, USA) to collect the heart rate (HR) and activity data during the 200-meter walk. Walking CFI was generated from the formula: $CFI = \text{weight} \times \text{activity}/HR$. Relaxed G tolerance (RGT) and straining G tolerance (SGT) were examined during the gradual onset run of initial high G training (Onset rate: 0.1G/sec). A regression model between the walking CFI and G tolerance was established by the SPSS 24.0 software. **RESULTS:** Of these subjects, the average data of age, height, and weight were 31.25 years, 170.75 cm, and 72.75 kg. The mean of the RGT and SGT were 5.42G and 8.27G. There were between four and 13 subjects at the $RGT \geq 6.0G$ and $SGT \geq 8.0G$, respectively. Subjects with the RGT more than 6.0G, and the SGT more than 8.0G, had a significantly higher walking CFI than the others. We also found that each increment of the 10 walking-CFI unit increased the RGT by 1.65G and the SGT by 0.70G. **DISCUSSION:** In this small study, it appeared that walking CFI could assist in the estimation of the G tolerance before the training began again. However, some reports revealed that the G tolerance became various and different every day. It is necessary to collect more data to assess the validity and stability of this algorithm used to predict the G tolerance. We also hope that this finding will further be used to monitor the G performance before the flight mission.

Learning Objectives

1. To understand the physiological challenges and responses during the G load.
2. To develop the model of G tolerance estimation before the training by using the new cardiac parameter.

[366] CHANGES IN FATIGUE RISK MANAGEMENT PHYSIOLOGICAL PARAMETERS DURING A SEMESTER IN A UNIVERSITY PILOT TRAINING PROGRAM

Botond Szűcs

Pharmaflight, Vál, Hungary

WITHDRAWN

[367] BIOETHICAL CONSIDERATIONS FOR FUTURE MICROGRAVITY-BASED HUMAN RESEARCH

Karl Mueller¹, Wiaam Elkhatab², Teo Dagi¹, Michael Harrison¹, Leigh Speicher¹, Dana Herrigel¹

¹Mayo Clinic, Jacksonville, FL, United States; ²Mayo Clinic, Rochester, MN, United States

(Education - Tutorial/Review)

INTRODUCTION: The rapid growth of the commercial space sector has promoted expansion of biomedical research focused on improving longevity on Earth. When would ethical considerations eclipse the deployment of such innovations aimed to benefit human health? The 4 fundamental principles of bioethics: beneficence, non-maleficence, autonomy, and justice, along with their potential conflicts, are important concepts to consider as aerospace medicine researchers explore medical therapies in microgravity. **TOPIC:** We will describe a hypothetical dilemma to illustrate the principles of bioethics in microgravity research. It is not out of the realm of possibility that we will witness development of microgravity-based medical therapeutics in the not-too-distant future. We will discuss the implications of this hypothetical scenario to explore the topic and to provide education regarding medical bioethical principles, citing historical precedents in human research, such as pioneer Col. John Paul Stapp. The apparent beneficence of offering such unique therapeutics to individuals and humankind is apparent, but other ethical principles must be considered, and guidelines should be developed accordingly. Historically, human research in the United States has been governed by institution-specific IRBs. What research-focused regulatory body will oversee such investigations? Just as any terrestrial procedure, the patient's current state of health and ability to undergo the procedure must be considered. In this hypothetical case, the rigors of space travel must be thoroughly assessed, and the risks and benefits of space travel must be carefully considered for each patient. To respect patient autonomy, risks and benefits must be provided to an individual with capacity to consent. How will these risks and benefits be determined if they are truly unknown? Microgravity-based therapeutics would provide unique justice concerns. Travel to LEO is prohibitively expensive. This poses an ethical dilemma: will patients with greater medical fitness for space travel (minimizing non-maleficence) be overlooked in favor of patients with enhanced financial ability to cover costs? This brings us to another justice concern – availability, posing potential for health rationing.

APPLICATION: Creating guidelines on how to conduct human research in microgravity is a complex field that will require advanced discussion and application of bioethics.

Learning Objectives

1. To learn the 4 principles of bioethics and how to apply the to aerospace medicine cases.
2. To define an ethical framework to develop guidelines for on how to conduct human research in microgravity.

[368] CAN WE PREDICT WHICH AIRCREW WILL DEVELOP NECK PAIN DURING MILITARY FLYING TRAINING?

Ellen Slungaard¹, Cliona McRobert²

¹RAF/DMRC Stanford Hall, Loughborough, United Kingdom; ²University of Liverpool, Liverpool, United Kingdom

(Original Research)

INTRODUCTION: Neck pain within military pilots is recognised as a challenging problem in modern air forces with an estimated one-year prevalence approaching 50%. The Aircrew Conditioning Programme (ACP) is a preventative strategy and has been shown to enhance physiological performance under conditions of high +Gz, however its effect on reducing flight-related neck pain has not been fully investigated. This study aimed to investigate the incidence of neck pain during the first 5 years of UK military flying training in aircrew who had undertaken ACP

during this period and have physiological performance metrics recorded as part of a previous PhD project investigating the impact of ACP on +Gz tolerance. **METHODS:** All 36 aircrew enrolled in the previous research project were invited to participate. Data was collected through the Aircrew Neck Pain and Lifestyle Questionnaire and analysis of physiological measures recorded during initial study recruitment at the start of military flying training. **RESULTS:** At the 5 year follow-up, 19 aircrew responded (52.7% response rate), mean age 28 years old. Fourteen aircrew were currently flying in high +Gz capable aircraft, with 443 mean total flying hours and 7.8 mean total Night Vision Goggle hours. A total of 36.8% aircrew (n=7) reported neck pain during flight in the last 12 months, with high +Gz (+4-5.9Gz) reported by 55.5% (n=5) of those aircrew as the cause of neck pain. When asked what preventative activities were used, 47.4% (n=9) reported using ACP. Physiological measures recorded at the start of flying training were reviewed against incidence of flight-related neck pain in responders, there was a tendency for aircrew with a smaller neck circumference, lower isometric neck strength and lower +Gz tolerance to report neck pain at the 5-year time point. **DISCUSSION:** At the start of military flying training, those aircrew identified as having a lower isometric neck strength and lower +Gz tolerance may benefit from targeted training to enhance performance and reduce the incidence of flight-related neck pain. Whilst these are not statistically significant findings, with a larger sample size, a more robust estimate could have been drawn.

Learning Objectives

1. This 5-year follow up review aids in identifying possible predictors of neck pain in military aircrew.
2. The audience will learn about the potential targeting of preventative strategies for neck pain.

[369] THE MEDICAL COLLEGE OF WISCONSIN MILITARY AIRCREW NECK AND BACK PAIN STUDY: BASELINE FIGHTER PILOT PAIN AND FUNCTIONAL ASSESSMENT DATA

Rachel Cutlan¹, Keri Hainsworth¹, Cory Everts², Alok Shah³, Amy Nader¹, Narayan Yoganandan¹, L. Tugan Muftuler¹, Timothy Meier¹, Hershel Raff¹, Peter Le⁴, Chris Dooley⁵
¹Medical College of Wisconsin, Milwaukee, WI, United States; ²Wisconsin Air National Guard, Madison, WI, United States; ³Zablocki Veterans Affairs Medical Center, Milwaukee, WI, United States; ⁴Air Force Research Laboratory, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Up to 97% of fighter pilots report neck pain from high +Gz forces, but the etiology has not been clearly defined (PMID: 21614872). This study will explore the etiology of chronic neck pain and acute activity-related flare-ups using pain and functional assessments, structural and advanced MRI scans, and inflammatory and stress biomarkers using annual baseline assessments and intermittent assessments linked to flight exposures. Correlations of baseline pain and functional data with flight history are presented here.

METHODS: Wisconsin Air National Guard (WIANG) fighter pilots participated in demographic and flight history surveys, anthropometric measurements, and pain and functional assessments. Pain assessments included eight validated questionnaires focused on the intensity, characteristics, and interference of neck and back pain. Functional assessments included cervical range of motion (CROM) and neck strength movements to assess neck functionality. **RESULTS:** Twelve males and one female participated with a mean age of 39 (range: 28-46) years, 2268 (500-3500) total military flight hours and a Neck Disability Index (NDI) of 7 (1-18). Most flight hours (69.0%) were flown in the F-16, with 5.8% in the F-35 that WIANG pilots began flying in Spring 2023. NDI was negatively correlated with all six bending CROM movements ($r > 0.62$, $p < 0.04$) and positively correlated with F-16 flight hours ($r = 0.43$, $p = 0.14$). The number of flight hours in the past year was negatively correlated with all eight

neck strength assessments except flexion ($r > 0.7$, $p < 0.007$). **DISCUSSION:** These baseline results highlight the complex relationships between total and recent military flight time, neck and back pain, and functional disability. Pilots with increased flight time tended to have reduced neck strength and CROM, along with increased pain scores. These functional deficits may interfere with a pilot's effectiveness during flight. Pilots report avoiding neck rotation movements like aerial combat maneuvers and checking six due to anticipation of pain (PMID: 18717118). This study will focus on multiple flight exposures per year to understand the etiology of this pain and differentiate between pain profiles linked to chronic versus acute flight exposures. This information can guide further research in finding methods to reduce the burden of neck and back pain in military aircrew.

Learning Objectives

1. The audience will understand the type of pain experienced by fighter pilots due to their exposure to +Gz forces using results from pain assessments.
2. The audience will understand the functional effects experienced by fighter pilots due to this pain and repeated exposure to +Gz forces.

[370] MODIFICATION OF COBURN-FORSTER-KANE EQUATION TO ACCOUNT FOR HUMAN SEQUESTRATION OF CARBON MONOXIDE IN A CLOSED SYSTEM

Michael Loesche¹, Amran Asadi¹, Brandon Trapp¹, Diana Dayal², Esther Putman³, Jaime Mateus¹

¹SpaceX, Hawthorne, CA, United States; ²UCLA, Los Angeles, CA, United States; ³University of Colorado Boulder, Boulder, CO, United States

(Original Research)

INTRODUCTION: Mitigating the threat of carbon monoxide (CO) to crewmembers in space involves balancing toxicity with the risks imposed by venting a contaminated atmosphere or early mission termination. The current Spacecraft Maximum Allowable Concentration (SMAC) of CO was derived from the Coburn-Forster-Kane (CFK) equation, which relates inhaled CO levels with carboxyhemoglobin (COHb%), a proxy for toxicity, in an open system. Here we propose a modification to the CFK equation to track the net transfer of CO between the crew and spacecraft in the Dragon capsule, which was generalized to multiple environments. **METHODS:** The CFK equation was numerically solved for a crew of four in a Dragon capsule. The net exchange of CO between Dragon and the crew was tracked. The environmental and COHb% levels were calculated for various exposures and atmospheres. To account for hypobaric atmospheres, the sum of percent deoxyhemoglobin and COHb% was used as a toxic threshold. **RESULTS:** Each crew member sequesters approximately 9.2 mL STPD of CO per COHb%. The modified CFK estimated a 20%-25% reduction in environmental levels at 24 hours dependent on atmosphere. When targeting a CO-Hb of 13.55% as in the NASA SMAC, the modified CFK suggested raising the CO exposure limit to 125 ppm from 100 ppm at sea level. We provide estimated COHb% at CO levels ranging from 50 to 1,000 ppm and in atmospheres ranging from 14.7 psi to as low as 8 psi over a mission duration of 5 days. **DISCUSSION:** Crews may sequester meaningful amounts of CO in a Dragon-like environment. The modified CFK needs to be tested with in-vivo experiments before being utilized for in-flight decision. If verified, these results may lead to raising currently accepted SMAC thresholds in small spacecraft.

Learning Objectives

1. The CFK equation traditionally relates environmental CO to carboxyhemoglobin levels in an open system where CO levels do not change.
2. The CFK equation can be modified to estimate net CO movement between a closed environment and the crew.
3. Crew sequestration of CO may remove meaningful amounts of CO in Dragon-like environments.

[371] EFFECTS OF MILD HYPOBARIC HYPOXIA ON BEHAVIORAL HEALTH AND PERFORMANCE OUTCOMES IN NASA EXPLORATION ATMOSPHERE MISSION 2

Steven Anderson¹, Sheena Dev¹, Bruce Keller¹, Alaa Khader¹, Suzanne Bell²

¹KBR/NASA Behavioral Health & Performance Laboratory, Houston, TX, United States; ²NASA Behavioral Health & Performance Laboratory, Houston, TX, United States

(Original Research)

INTRODUCTION: Decompression Sickness (DCS) is a risk during spaceflight extravehicular activities (EVAs). The NASA Exploration Atmosphere (EA) study aims to validate modeling efforts for a novel pre-breathe protocol while adequately mitigating risk of DCS. We examined effects of exposure to the mild hypobaric hypoxic chamber environment on behavioral health and performance outcomes in Exploration Atmosphere Mission 2 (EA-2). **METHODS:** Eight participants spent 11 days in NASA's 20-foot chamber at Johnson Space Center (May–June 2023) where they were exposed to an atmosphere consisting of lower pressure (8.2 psia) and higher O₂ (34%), controlling physiologic levels of N₂. One participant left the study at Test Day 3. Participants completed five simulated EVAs during the 11-day test phase. Cognitive performance was measured using the Cognition test battery comprising 10 subtests. Cognitive performance results were examined during pre-test, 11-day test, and post-test phases to identify whether the mild hypobaric hypoxic environment substantially impacted participants' cognitive performance. Cognition test battery outcomes were corrected for practice and battery effects, and then z-transformed based on the average and standard deviation of baseline (pre-test) performance scores across study subjects. Summary scores for accuracy and speed were calculated by averaging across z-transformed scores within the accuracy and speed domain. **RESULTS:** Examining z-scores for outcomes in each of the 10 cognitive subtests indicated that participants' cognitive performance did not substantially change from baseline during the 11-day test or post-test phases in EA-2. Computed z-scores indicated that performance outcomes during 11-day test and post-test phases were all within one standard deviation of the group baseline mean. **DISCUSSION:** The small changes in cognitive performance observed from pre-test to 11-day test, and pre-test to post-test phases suggest that the mild hypobaric hypoxic environment did not substantially impact participants' cognitive performance. Future directions include combining results from multiple EA missions to increase sample size and conducting linear mixed effects models to compare performance across test phases.

Learning Objectives

1. The audience will learn about the NASA Exploration Atmosphere study aims and objectives.
2. The audience will learn about the cognitive and behavioral impacts of mild hypoxia.
3. The audience will learn about the cognitive and behavioral impacts of mild hypoxia as studied in NASA Exploration Atmosphere.

Wednesday, 05/08/2024

2:00 PM

Grand Ballroom A

[S-64]: PANEL: INFLUENTIAL WOMEN ON THE FRONTIERS OF SPACE MEDICINE EXPLORATION: LESSONS ON LEADERSHIP

Sponsored by ANAHPs

Chair: Marian Sides

Co-Chairs: Mary Cimrmanic, Allen Parmet

PANEL OVERVIEW: This panel is the fourth annual event of the Mary F Foley Endowment, established in her honor, to perpetuate her passion

and career long work profiling women in aviation and space medicine. As we build momentum in the era of space travel, this panel will portray the dynamics of influential women on the frontiers of space medicine exploration. Speakers will describe the qualities and virtues that shaped their leadership, and how they distinguished themselves through persistence, courage, and determination. **TOPIC:** The first presentation will portray the distinguished Thais Russomano, a Brazilian doctor, biomedical engineer, research scientist, and international lecturer in space medicine. She is founder of the Microgravity Center, the first educational and research center in Space Life Sciences in Latin America. She is followed by the presentation of NASA astronaut Nicole Stott, whose book, "Back to Earth: What Life in Space Taught me about our Home Planet," imparts hard won lessons on how a response to crisis in space can be applied to life on Earth. The panel will highlight the contributions and influence of former NASA Chief astronaut Peggy Whitson, recipient of the medal for Merit in Space Exploration, who holds the longest record, of an American woman in space of 675 days. She is the first woman to command the International Space Station, twice. Ilaria Cinelli, a biomedical engineer, commander on numerous space analog missions in extreme environments, will be portrayed as a next generation leader in space travel. Presenters will convey how Cinelli's energy in action, inspires others and has cascading influence on the evolution of space exploration. Barbara M Barrett's leadership will be described, as former United States Secretary of the Air Force, and the United States Space Force. Her diversified business and diplomatic career, including instrument rated pilot, trained astronaut, and Ambassador to Finland will be highlighted. **APPLICATION:** Leadership styles of these influential women will be described. How they navigated challenges that shaped industry operations will be discussed. This event will offer illuminating and inspirational mentoring lessons in leadership development for AsMA members.

[372] ASTRONAUT NICOLE STOTT: HEALING EARTH AND HUMANITY THROUGH SCIENCE AND ART

Aubrey Florom-Smith¹, Cathy DiBiase²

¹Stanford University, Menlo Park, CA, United States; ²Kennedy Space Center, Titusville, FL, United States

(Education - Tutorial/Review)

INTRODUCTION: Leaders adept at balancing space exploration and art are unique. Nicole Stott, NASA astronaut, artist, author and advocate for humanity as crewmates on Planet Earth, exemplifies this ability by applying lessons learned in space to preserving our shared planet and inspiring the next generation of explorers and artists. **TOPIC:** Ms. Stott inspires and empowers others to embrace the marvels of space exploration and the restorative aspects of art. As the 10th woman to spacewalk, Ms. Stott experienced physical separation from Earth while viewing the planet as a single entity, which underscores her belief in peaceful cooperation for the betterment of all. As a NASA astronaut and aquanaut, Ms. Stott lived this objective: she spent 18 days in an underwater lunar analog mission, trained with astronauts and cosmonauts around the globe, and spent 104 days in space on the Space Shuttle and the International Space Station conducting science experiments targeting terrestrial benefits. She was also on the final flight of the Space Shuttle Discovery. In 2009, while on the International Space Station, Ms. Stott was the first person to paint a watercolor in space. Her paintings and 2021 book illustrate how urgently Earth requires humanity's care. Healing Earth is not Ms. Stott's only mission: she founded the Space for Earth Foundation, which provides opportunities for children to become "Aronauts" and dream of a future for themselves through space, art, and healing. **APPLICATION:** Ms. Stott's example of connecting science and art to heal the Earth and its inhabitants – including its children – is inspiring. Human beings need to explore and create. Lessons learned from Ms. Stott's career as a NASA astronaut and artist provide guidance for aerospace nurses and other healthcare providers seeking to link these important activities to promote healing.

Learning Objectives

1. Learners will identify two significant leadership characteristics of Nicole Stott.
2. Learners will describe two examples of science and art that promote greater understanding of the need to protect Earth.

[373] PEGGY WHITSON: FROM BIOCHEMIST TO NASA CHIEF ASTRONAUT TO PRIVATE MISSION COMMANDER

Kathleen Samoil

ANAHPS, Calgary, AB, Canada

(Education - Tutorial/Review)

INTRODUCTION: From a background in biochemistry, progressing from NASA scientist to the greatest number of days in space by a woman, commander of multiple space missions, these are only a few demonstrations by our AstroPeggy as a strong contributor to space exploration and aerospace medicine. **Topic:** Following a Bachelor of Science from Iowa Wesleyan College, Dr. Whitson completed her doctorate in biochemistry at Rice University. Continuing at Rice University as an awarded post-doctoral scholar she then moved to the National Aeronautics and Space Administration's Johnson Space Center as the supervisor of the biochemistry research group. This was the beginning of a groundbreaking career in space. Progressing from, the project scientist for the Shuttle-Mir program to astronaut candidacy in 1996, record breaking for the longest time in space by a NASA astronaut, first non-pilot Chief Astronaut, twice commander of the International Space Station, and now mission commander with private space directorate Axiom. **Application:** This presentation will be a discussion of how Dr. Whitson's knowledge is architected through formalized education within a university to career, development within agency responsibilities, and transitioning from the public to private sector within the context of a humble and dedicated explorer. As a biomedical scientist Dr. Whitson's career arc has contributed greatly to the advancement of aerospace medicine as both a scientist and astronaut contributor. Dr. Whitson's pioneering is not limited to a career trajectory rather it is the mechanisms for gleaning knowledge, mentorship, role modelling, and dedication as an experimentologist that distinguish her.

Learning Objectives

1. Recognize the contribution of a biochemist non-medical doctor to the advancement of aerospace medicine.
2. Describe possible role conflict that may arise when an individual is both a scientist and a study participant. May include strategies and protective mechanisms as guided by the Declaration of Helsinki.

[374] SECURING THE SPACE ENVIRONMENT: LESSONS IN LEADERSHIP

Karen Klingenberg

U.S. Air Force, Williamsburg, VA, United States

(Education - Tutorial/Review)

INTRODUCTION: Ambassador Barbara Barrett, the 25th Secretary of the Air Force, has noted how dependent people are "in our day-to-day lives on space...our information, our navigation and our communications are all space-dependent. It's ubiquitous, but it's invisible." She was the civilian leader of the Air Force and the inaugural head of the United States Space Force. Earlier, she was Deputy Administrator of the Federal Aviation Administration, Vice Chairman of the U.S. Civil Aeronautics Board, and U.S. Ambassador to Finland. Among other roles, she was a Senior Advisor to the U.S. Mission to the United Nations and worked to open economic opportunities for women in Afghanistan and many other countries. In addition to being a lawyer and accomplished business woman, Ambassador Barrett has been on the leading edge of military and commercial space. **TOPIC:** Ambassador Barrett was active in furthering the peaceful utilization of space by finalizing the

creation of the US Space Force, during her tenure as Air Force Secretary. Ambassador Barrett publicly advocated for an independent branch of the American military dedicated to meeting and protecting the nation's needs in space. She brought her unique credibility to her position as Secretary of the Air Force while championing the inauguration of US Space Force. An instrument rated pilot with experience in flying US and Finnish fighter aircraft, she also trained, in her 50s, at Star City (Russia), culminating in a certification for commercial space travel to the International Space Station. Ambassador Barrett serves as an exceptional example of the powerful contribution that women have made and will continue to make to the future of military and commercial space exploration. **APPLICATION:** Today's space missions operate at the same time that space becomes a larger factor in international power politics. Ambassador Barrett's contributions ensure that American economic reliance on and continued exploration of space occur in an environment secure from future threats. "We have to be first and best in space for the world's safety and especially the defense of America."

Learning Objectives

1. Describe Ambassador Barrett's philosophy regarding worldwide daily dependence on space capabilities.
2. Identify two leadership qualities of Barbara Barrett that apparent in her work to secure our space domain.

[375] FOCUS ON THAIS RUSSOMANO: A VISIONARY LEADER IN INTERNATIONAL SPACE RESEARCH

Annette Sobel

International Academy of Aviation and Space Medicine, Corpus Christi, TX, United States

(Education - Tutorial/Review)

INTRODUCTION: This presentation will describe the life's work, passion, and entrepreneurial activities of Dr. Thais Russomano to advance the field of international space medicine research. Dr. Russomano's development of advanced research models and interdisciplinary educational programs were well ahead of their time and served as a mechanism to attract young biomedical researchers and students to the field and push the envelope of rapidly advancing databases, advanced analytics and translational medicine applications. **TOPIC:** New technical approaches and methodologies will be described that validated research modeling applicable to the unknowns of space and initiated a bold approach to seeking new knowledge and opportunities for extreme environment research. Through founding the Microgravity Centre (MicroG) at PUCRS university, Porto Alegre, Brazil, Dr. Russomano distinguished herself through boldness and scientific grounding. MicroG is the first Latin American Space Life Sciences research and educational center. Additionally, PUCRS is known for its entrepreneurial, innovative spirit, and as such is consistent with the establishment of MicroG/. **APPLICATION:** The field of space medicine physiology, biomedical engineering, telemedicine, and telehealth has been particularly challenging due to the necessity to develop new models and baseline data readily translatable to extreme environments. This presentation will describe specific examples of successful translation and pathfinding research as well as the highly innovative efforts of the Space Network (Rede Espaço), coordinated by Dr. Russomano, and other synergistic activities such as the Mars One Advisory Board;¹ International Relations Director for the UK-based HuSCO, Human Spaceflight Capitalization Office; and director of two private companies linked to space life sciences and telehealth – InnovaSpace² Consultancy (UK) and International Space Medicine Consortium (USA).

Learning Objectives

1. The attendee will understand the significance of the research and educational efforts of women leaders such as Dr. Thais Russomano in advancing the field of space medicine.
2. The attendee will learn about emerging technical and modeling approaches to understand the extreme environment of space.

3. The attendee will appreciate the new scientific and leadership opportunities to participate in international space medicine research.

[376] ILARIA CINELLI: INTERSECTING HEALTHCARE AND SPACE

Amelia Garner Shrader

ANAHPS, Hazel Green, AL, United States

(Education - Tutorial/Review)

INTRODUCTION: Technological advances achieved in space can have applications here on Earth. Ilaria Cinelli is a bioengineer focused on improving healthcare globally and advancing space exploration. The exploration of space offers boundless opportunities for human health advancement. **TOPIC:** Dr. Cinelli is an influential leader in healthcare and space technology on an international scale. Ilaria Cinelli holds a bachelor's and a master's degree in biomedical engineering from the University of Pisa in Italy. She earned a structured doctorate in neural engineering from the National University of Ireland, Galway. She completed the International Space Studies program at TU Delft, Netherlands, and completed a postdoc in neuromodulation at Tufts University in the US. Ms. Cinelli has served as crew commander on eight analogue missions for the European Space Agency. The European Patent Office commended Ms. Cinelli as one of the 50 Top Voices in Tech for her expertise in space and healthcare. Ilaria's work has spanned many regions of the globe including the UK, USA, Republic of Ireland, the Netherlands, Spain, and Italy. She was recognized by The United Nations Office for Outer Space Affairs as a role model and has invited her to speak about space medicine, engineering and gender equality. Ms. Cinelli has served as a mentor and role model for the Space4Women network of the United Nations Office for Outer Space Affairs since 2020. Ilaria was the youngest President of the Aerospace Human Factors Association from 2013-2021 and also the youngest member of the Mars Society Steering Committee, serving since 2018. Ms. Cinelli was inducted as an AsMA fellow in 2020 and a fellow of the Aerospace Human Factors Association in 2021. **APPLICATION:** As more humans reach space, innovative leaders like Ilaria Cinelli are integral in translating space advances to ground-based applications and vice versa. Applying space technology to advance healthcare is integral in advancing wellness for humankind on planet Earth and beyond. Ilaria's work is a groundbreaking inspiration to female scientists as well as young, emerging leaders in the aerospace field.

Learning Objectives

1. Learners will be able to identify two leadership characteristics of Ilaria Cinelli.
2. Learners will describe how healthcare can be advanced on Earth with application from space technology.

Wednesday, 05/08/2024

Grand Ballroom B

2:00 PM

[S-65]: PANEL: AEROSPACE MEDICINE IN GERMANY AND SWITZERLAND

Sponsored by German Society of Aerospace Medicine

Chair: Oliver Ullrich

Co-Chair: Jochen Hinkelbein

PANEL OVERVIEW: This traditional panel is sponsored by the German Society of Aerospace Medicine, DGLRM. It covers recent research topics of aerospace medicine in both Germany and Switzerland. The panel consists of five different research papers by different German and Swiss presenters.

[377] This abstract was moved to the end of the panel.

[378] EXPLORING ALTERNATIVE CPR TECHNIQUES FOR HELICOPTER RESCUE OPERATIONS: HONOURING THE PAST AND PREPARING FOR THE FUTURE OF AEROSPACE EMERGENCY MEDICINE

Lydia Johnson Kolaparambil Varghese¹, Remco Overbeek², Felix Liebold³, Niels Benjamin Adams², Jan Schmitz², Michael Sebastian Neumann¹, Wolfgang A. Wetsch², Jochen Hinkelbein¹

¹Johannes-Wesling-Universitätsklinikum Minden, Ruhr-Universität Bochum, Minden, Germany; ²Faculty of Medicine and University Hospital Cologne, University of Cologne, Cologne, Germany; ³University Hospital of Leipzig, Leipzig, Germany

(Original Research)

INTRODUCTION: The confined and dynamic environment of helicopter rescue operations presents unique challenges for traditional cardiopulmonary resuscitation (CPR) techniques. To explore alternative CPR approaches specifically tailored to this context, we conducted a comprehensive scoping review with the aim of providing a high-quality overview of the existing literature. Our objective was to identify and evaluate the potential applicability and effectiveness of alternative CPR techniques in helicopter operations. **METHODOLOGY:** Two independent reviewers performed a rigorous search across five renowned databases, including PubMed, EMBASE, CINAHL, Cochrane, and Web of Science. A search string was designed using specific keywords related to helicopters, non-traditional CPR methods, and chest compression techniques. In order to ensure adherence to the PRISMA guidelines and detect duplicates reliably, we utilized Rayyann, a screening software, as an auxiliary tool during the manual screening process. Rayyann proved invaluable in efficiently identifying and managing duplicate content, while still maintaining a human-driven approach to the screening process. Data extraction was conducted using Excel, while bibliography management was handled using Zotero. **RESULTS:** The initial screening yielded 884 results, which were subsequently narrowed down to 25 relevant publications after removing duplicates and conducting abstract screening. Among the identified papers, only one method, the Koch method, met the inclusion criteria. The Koch compressions demonstrated a higher overall quality score (79%) compared to conventional compressions (63%), showing improved compression depths and reduced exhaustion. The remaining publications focused on comparing manual CPR with mechanical CPR (mCPR). Due to the limited number of papers available, a meta-analysis could not be conducted. **CONCLUSION:** This study highlights the scarcity of evidence concerning alternative CPR techniques in helicopter rescue operations. While the Koch method shows promise as a potential alternative, further research is imperative to develop tailored approaches that address the unique challenges encountered in these scenarios. Advancing our understanding of effective CPR techniques specific to helicopter operations will ultimately enhance resuscitation outcomes and improve emergency medical assistance in these critical situations.

Learning Objectives

1. Understand the unique challenges faced in performing cardiopulmonary resuscitation (CPR) in the confined and dynamic environment of helicopter rescue operations.
2. Recognize the limitations and gaps in current evidence regarding alternative CPR techniques in helicopter rescue operations and identify the need for further research to develop tailored approaches that address the specific challenges encountered in these scenarios.

[379] ANALYSIS OF FIXED-WING MOTORIZED AIRCRAFT ACCIDENTS: INJURY SEVERITY AND CONCOMITANT FACTORS IN THE YEAR 2000–2019

Jochen Hinkelbein¹, Felix Liebold², Catherina Hippler³, Jan Schmitz³

¹Ruhr University Bochum, Minden, Germany; ²University Leipzig, Leipzig, Germany; ³Uniklinik Koeln, Koeln, Germany

(Original Research)

BACKGROUND: There is a paucity of research on general aviation accidents in Germany. The authorities investigate only a fraction of all national accidents. The current study analyzes existing accident reports and aims to identify injury severity in regard to concomitant risk factors. **METHODS:** Data of flight accidents was analyzed for aircraft of, 5700 kg maximum takeoff weight (MTOW) over a 20-yr period. Besides descriptive data, concomitant factors (type and category of aircraft, date, occupants and outcome, flight phase, etc.) were analyzed. Statistical analysis was performed using the Chi-squared test. **RESULTS:** The authorities list 1595 aircraft accidents between 2000 and 2019, but only 17.9% of these were analyzed in detail. Accidents of aircraft of, 2000 kg MTOW were over-represented between May and September and between Friday and Sunday. The fraction of fatal accidents was highest during cruise. During landing, significantly more mishaps of larger aircraft occurred. The number of seriously injured or deceased occupants was significantly higher for accidents involving private pilots. An occupancy rate of more than three persons on board correlated significantly with fewer number of deaths. **CONCLUSIONS:** The annual count of aircraft accidents has almost halved during the previous 20 yr. Unfortunately, only a small number of mishaps were further investigated by authorities, which leads to a lack of evaluable data needed for in-depth investigations. The accumulation of larger aircraft mishaps in winter and the superior outcome of professional pilots in terms of safety, as well as the fewer number of mishaps in larger aircraft, should be further investigated.

Learning Objectives

1. The audience will learn about the relevant factors contributing to an GA accident.
2. The audience will learn how to perform a statistical analysis of factors relevant for an accident.

[380] PROINFLAMMATORY MARKERS AND FLIGHT HOURS: PRELIMINARY FINDINGS

Denis Bron¹, Andres Kunz¹, Sibylle Grad², Kenneth Kinzel³, Elizabeth Damato³, Michael Decker³

¹Aeromedical institute Swiss Air Force, Duebendorf, Switzerland; ²AO Research Institute, Davos, Switzerland; ³Case Western Reserve University School of Medicine, Cleveland, OH, United States

(Original Research)

INTRODUCTION: A higher prevalence of back complaints in flying personnel compared to the general population is well documented. Various causes have previously been described. While standard analysis approaches including clinical testing, imaging-based evaluation and electrophysiological testing are well established, the role of laboratory analyses are less known. As part of a larger study intended to explore the relationship between musculoskeletal pain and blood serum analytes, this study sought to evaluate the relationship between flight hours and relevant laboratory parameters. **METHODS:** Eighty military pilots and aircrew members were evaluated over a three-year period during their routine health check-ups. The sample was divided into 2 groups based on the median flight hours (150 hours/year). Independent samples T-tests and Mann-Whitney U-tests were used to assess differences in blood serum analytes between

groups. **RESULTS:** The group of aviators showed different mean values for Interleukin-12 (IL-12), Macrophage Derived Chemokine (MDC), Monocyte Inflammatory Protein-1 α , (MIP1- α), Vascular Endothelial Growth Factor-A (VEGF-A), and Placental Growth Factor (PIGF).

CONCLUSION: These results, supported by past literature, suggest that increased flight hours correspond with elevated levels of proinflammatory serum analytes. Additional research is needed to determine whether the changes in serum analytes correspond with severity of musculoskeletal pain/injury.

Learning Objectives

1. The participant will learn that a relationship may exist between amount of flight hours and changes in proinflammatory serum analytes.
2. The participant will discuss the function of the serum analytes that differed based on flight hours.

[381] RAPID CHANGES OF THE NUCLEAR ARCHITECTURE AND GENE REGULATION IN T LYMPHOCYTES IN HYPERGRAVITY

Oliver Ullrich, Cora Thiel

University of Zurich, Zurich, Switzerland

(Original Research)

Earth's constant gravitational pull, various acceleration forces affect human cells and tissues, both physiologically, as in the bloodstream, and through advanced technology, like high-performance aircrafts. Notably, the lymphatic system, a significant component of the human body, responds swiftly to gravity changes, playing a pivotal role in systemic messaging and regulation. This study explored the impact of hypergravity on the three-dimensional structure of chromatin, gene expression, histone modifications, and nuclear morphology. We conducted experiments using human Jurkat T cells exposed to hypergravity at 1.8g and 9g for different durations. Our findings revealed a dynamic gene expression response to hypergravity between 20 seconds and 60 minutes, which was followed by a rapid adaptation. Up-regulated genes tend to centralize within the nucleus, while down-regulated genes move toward the nuclear periphery. The hypergravity-induced up-regulated genes are primarily located on chromosomes 16-22. Notably, this gene expression pattern differed from responses to oxidative stress, heat shock, or inflammation. Our fluorescence microscopy analysis showed rapid cellular responses and epigenetic adaptations, even within 75 seconds of hypergravity. These effects normalized after 60 minutes. Additionally, cytoskeletal analyses indicated a temporary re-organization in hypergravity, which returned to normal levels after 60 minutes. In conclusion, our study demonstrated a robust and dynamic response to altered gravity, surpassing the responses observed with other stressors like inflammation, heat shock, and oxidative stress. We also unveil the influence of hypergravity on the three-dimensional chromatin structure and associated cellular epigenetic regulation through histone methylation. These findings shed light on the profound impact of hyper-gravity on cellular functions and gene expression.

Learning Objectives

1. Recognize the significance of the lymphatic system in responding to gravity changes and its role in systemic regulation.
2. Understand the effects of hypergravity on the three-dimensional structure of chromatin, gene expression, histone modifications, and nuclear morphology.

[338] AEROMEDICAL FITNESS AFTER A SEVERE SPINAL TRAUMA? THE LONG WAY BACK TO THE COCKPIT.

Torsten Pippig

Center of Aerospace Medicine of the German Air Force, Koeln, Germany

(Education - Case Study)

Military fighter aircraft are equipped with rescue systems (ejection seat, parachute) that can save lives and protect against serious injuries, not always. Small civilian aircraft do not have these systems. I report on a 29-year-old fighter pilot and flight instructor of the German Air Force who crashed in a private small plane in the USA in December 2021 and suffered severe spinal trauma: Cover plate fracture of Th12 (A3) and L1 burst fracture (A4) with conus medullaris-type-Syndrome. The initial surgical treatment took place in a special clinic in the USA: L1 laminectomy, T11-L3 segmental pedicle screw fixation using K2M and posterolateral fusion L3-T11). No fracture healing could be seen during the X-ray and CT examination of L1 one year after surgery and a third operation was carried out in November 2022: Reduction and shortening of the previous spinal fusion (this was not loosened!) from Th12 to L2, removal and replacement of L1 body and an autologous spongiosoplasty. 9 months later, the military and civilian specialist orthopedic aeromedical examination and assessment took place at the Centre of Aerospace Medicine of the GAF in Cologne. **DISCUSSION:** The indication for spinal fusion is instability of the spine. This can occur due to wear of the intervertebral discs, vertebral fractures and tumors, spondylolisthesis or osteoarthritis of the vertebral joints. e.g., after trauma, inflammation, degeneration, tumor or osteoporosis, there is an indication for a corporectomy and vertebral body replacement. If the load-capacity of the vertebral body is no longer present e.g., after trauma, inflammation, degeneration, tumor or osteoporosis, there is an indication for a corporectomy and vertebral body replacement. **Aeromedical Decision:** The fighter pilot was assessed as "unfit for all military flying duties". In a subsequent waiver process, the airworthiness was reassessed, which speaks for and against military flying duty. It was approved to fly fixed wing aircraft but use as a jet pilot (ejection seat!) and helicopter pilot was excluded. The reasons for this decision will be explained in the following lecture: Pilot/injury/surgery/ consequences, workplace and stress, special features of military flight service, prognosis. Civil aeromedical fitness was granted without restrictions 22 months after the aircraft accident. This is not an isolated case; between 2012 and 2022, 9 pilots were examined and assessed in my department after spinal fusion.

Learning Objectives

1. Severe spinal trauma, diagnosis, surgical treatment and rehabilitation. Outcome and prognosis.
2. Aeromedical fitness. Waiver conditions and waiver process. Which speaks for and against military flying duty.
3. Risk of spinal injuries and spinal fracture when using an ejection seat.

[377] ALTERNATIVE CPR TECHNIQUES IN CONFINED SPACE AND AIRPLANE ENVIRONMENTS: COMPREHENSIVE REVIEW AND RECOMMENDATION FOR PRACTICE

Felix Liebold¹, Remco Overbeek², Niels Benjamin Adams², Jan Schmitz², Lydia Kolaparambil Varghese³, Michael Sebastian Neumann³, Wolfgang Wetsch², Jochen Hinkelbein², Manuel Michno⁴

¹University Hospital Leipzig, Leipzig, Germany; ²Faculty of Medicine and University Hospital Cologne, University of Cologne Department of Anesthesiology and Intensive Care Medicine, Cologne, Germany; ³Johannes-Wesling-Universitätsklinikum Minden, Ruhr-Universität Bochum Department of Anaesthesiology, Intensive Care Medicine and Emergency Medicine, Minden, Germany; ⁴Research Centre Jülich/University of Zürich, Zürich, Switzerland

(Original Research)

INTRODUCTIONS: Confined environments can be found in several settings relevant to emergency medical care such as helicopters, pressure chambers, airplanes or road vehicles. The challenges associated with respective rescue operations are distinct and require a variety of adaptations

to the conventional guidelines. This scoping review provides an overview of the existing literature regarding Cardiopulmonary Resuscitation (CPR) in Confined Spaces with special interest in airplane environments and derives concrete recommendations of applicable approaches for practice. **METHODOLOGY:** A systemic literature search was conducted across five renowned databases, including PubMed, EMBASE, CINAHL, Cochrane and Web of Science by two independent reviewers. The following search string was designed including specific key words representing for confined space and air travel: (CPR OR resuscitation OR ALS OR BLS OR chest compression) AND (confined space OR airplane OR straddling position OR over the head OR adapted technique). **RESULTS:** An initial screening yielded 788 results. After duplicates removal, full-text screening and application of all inclusion and exclusion criteria, there were 14 publications to be included into the final review. Among these articles describing alternative CPR techniques, there was one found relevant for airplane travel and 13 articles for confined space. Additionally, nine publications provided useful information pertaining to CPR during air travel or in spatially demanding environments. Different approaches in terms of CPR-quality in a confined space were discussed. The only airplane travel related publication investigated a new mechanical resuscitation device which led to significantly less absolute hands-off time but at the same time less effective ventilation. The other publications included showed that both the Over-the-Head technique and the Straddle Technique offering comparable CPR quality compared with standard lateral CPR. **CONCLUSION:** This work summarizes the current state of research on alternative CPR techniques in aircraft and confined environments. It highlights the critical need for research, particularly in relation to airplane travel, to generate evidence-based recommendations for best practice CPR in the air.

Learning Objectives

1. The participants will gain knowledge about the difficulties regarding CPR in confined space and during airplane travel.
2. The audience will get to know alternative CPR techniques that are applicable in confined space and in aircraft environments.

Wednesday, 05/08/2024

2:00 PM

Grand Hall J

[S-66]: SLIDES: NEUROPHYSIOLOGY- PHYSICAL AND COGNITIVE IMPAIRMENT

Chair: James Devoll

Co-Chair: Benisse Lester

[382] EFFECT OF ACUTE HYPOXIA EXPOSURE ON THE AVAILABILITY OF A1 ADENOSINE RECEPTORS IN THE HUMAN BRAIN MEASURED WITH [F18]CPFPX PET

Manuel Michno¹, Henning Weis², Jan Schmitz³, Anna Foerges⁴, Simone Beer⁴, Jens Jordan⁵, Bernd Neumaier⁴, Alexander Drzezga⁶, Daniel Aeschbach⁵, Andreas Bauer⁴, Jens Tank⁵

¹Research Centre Julich/University of Zurich, Zurich, Switzerland;

²University Hospital of Cologne, Nuclear Medicine, Cologne, Germany;

³University Hospital of Cologne, Anesthesia, Cologne, Germany; ⁴Research Centre Julich, Julich, Germany; ⁵German Aerospace Centre, Cologne, Germany; ⁶University Hospital of Cologne, Nuclear Medicine, Cologne, Germany

(Original Research)

INTRODUCTION: Animal studies suggest that adenosine actions on A1 adenosine receptors (A1AR) protect the brain from oxygen deprivation through adjustments in cerebral blood flow, metabolism, and electrical activity. Given the relevance of cerebral hypoxia tolerance for aerospace medicine, we translated these findings from animals to human beings. Using [F-18]CPFPX, a PET tracer for A1AR, we tested the hypothesis that hypoxia-induced adenosine release reduces A1AR

availability in the human brain. Furthermore, we tested the hypotheses that this response is associated with altered psychomotor vigilance and cerebral blood flow. **METHODS:** Ten healthy volunteers (31 ± 8 years, 3f) completed an 110-min bolus plus constant infusion [F-18]CPFPX PET-MRI hybrid experiment: Subjects spent the first 60 minutes of the scan in normoxia followed by 30 minutes of individually adapted normobaric hypoxia to achieve a peripheral oxygen saturation of 70 - 75% (mean gas mixture corresponds to an altitude of 5500m/18000ft), followed by 20 minutes of normoxia. We obtained blood samples to calculate metabolite-corrected steady-state A1AR distribution volumes (VT). We measured brain perfusion via arterial spin labelling in high temporal resolution. We conducted a 3-minutes psychomotor vigilance test (PVT) every 10 minutes. We continuously measured heart rate and peripheral blood oxygen saturation. **RESULTS:** Mean peripheral oxygen saturation was 97% during normoxia and 73% during hypoxia exposure (p < 0.0001). Hypoxia reduced A1AR availability in the cerebral cortex by 14% (p = 0.03). Compared to normoxia, brain perfusion increased during hypoxia by 34% in cortical gray matter (p < 0.0001). Heart rate increased by 20% (p < 0.001). PVT mean reaction time was longer by 12 ms (p = 0.002). **DISCUSSION:** Our study is the first to show that acute oxygen deprivation corresponding to 5500 m altitude reduces A1AR availability in the human brain. The finding is consistent with hypoxia-induced cerebral adenosine release leading to increased A1AR occupancy. Given adenosine's known actions on the brain, A1AR could contribute to variability in hypoxia tolerance and serve as target for countermeasures.

LEARNING OBJECTIVE

1. The availability of A1AR in the human brain consistent with increased adenosine release.
2. Adenosine actions on A1AR may protect the brain from oxygen deprivation.

Learning Objectives

1. Acute Hypoxia reduces the availability of A1AR in the human brain consistent with increased adenosine release.
2. Adenosine actions on A1AR may protect the brain from oxygen deprivation.

[383] PERCEPTUAL AND COGNITIVE SKILLS AFFECTING PILOTS' ASSESSMENT OF THE ROLL-ANGULAR DISPLACEMENT DURING SIMULATED COORDINATED FLIGHT TURNS

Andreas Brink¹, Michailis Keramidis¹, Arne Tribukait², Ola Eiken¹

¹Royal Institute of Technology, Stockholm, Sweden; ²Karolinska Institutet, Solna, Sweden

(Original Research)

BACKGROUND: Pilots undergoing coordinated flight turns or centrifugation, whilst devoid of visual cues, exhibit substantial interindividual variation in their perception of roll tilt. The objectives of this study were to investigate whether, and to what extent, specific perceptual and cognitive abilities can account for this inter-individual variability. **METHODS:** Twelve experienced fixed-wing pilots were subjected to centrifuge tests on two separate occasions, with a six-month interval between them. The subjective visual horizon (SVH) was measured in darkness using an adjustable luminous line during three 6-minute centrifuge runs, each involving different roll tilts: 25° (1.1 G), 56° (1.8 G), and 66° (2.5 G). Initial and final SVH settings were recorded for each G plateau. During the second occasion, the SVH settings were temporarily interrupted at each plateau (visual distraction task). In addition, verbal estimations of experienced G loads were provided by the pilots. After the centrifuge tests, 1-g environment, the pilots were questioned about the relationship between G load and roll tilt, and they were asked to adjust the luminous line so that its slope corresponded with specified angles. **RESULTS:** The pilots underestimated their roll tilt throughout each G plateau, average SVH being 4° to 28° less than the actual roll angle at the different G loads. The visual distraction task did not affect the SVH settings. A multiple

regression analysis indicated that the chain of tested capacities - perception of G load, knowledge of relation between G load and bank angle, accuracy when indicating angles in 1 g - significantly contributed to the SVH. **DISCUSSION:** Thus, the tested chain of skills appears to influence the pilots' ability to assess the degree of roll tilt during simulated coordinated flight turns. Notwithstanding, SVH was typically markedly smaller than predictions based on the specific abilities. Presumably, SVH is also dependent on subconscious processing, linking the sensation of bodily weight to a visually imagined horizon.

Learning Objectives

1. Participants will gain insight into the role of the vestibular system in pilots' perception of roll tilt during coordinated flight turns and centrifugation, and how it interfaces with cognitive processes, shedding light on the complexities of pilot perception.
2. Participants will understand the challenges posed by the nonlinear relationship between G load and bank angle perception, and how the brain's reliance on otolith information for spatial orientation can affect pilots' ability to accurately estimate roll tilt, highlighting the need for potential training regimens to improve this capability.

[384] A COMPARATIVE STUDY OF UTRICULAR FUNCTION BETWEEN HEALTHY AIRCREW AND GROUND CREW USING SUBJECTIVE VISUAL VERTICAL TEST

Karthikeyan Sankaran, Rahul Pipraiya

Institute of Aerospace Medicine, Bengaluru, India

(Original Research)

INTRODUCTION: The perception of gravitational vertical is crucial for maintaining an upright posture, gait, and majority of motor functions. Multimodal integration of visual and vestibular information plays a major role in the way that verticality is represented. The direction of gravito-inertial vectors can be ascertained via otoliths (utricle & saccule), which are also useful for navigation. Objective of the study was to determine and compare utricular function between aircrew and ground crew using Subjective Visual Vertical (SVV) test. **METHODS:** SVV tests, including Vertical Static Tilt, Dynamic Clockwise and Dynamic Anticlockwise, Vertical Static Tilt Right & left were performed on 100 volunteer subjects comprising of 50 healthy aircrew and ground crew each. Degree of tilt was assessed by measuring the angle between perceived and true verticals. The difference in the degree of perceived tilt between aircrew and ground crew was analysed using Student's unpaired T-test. **RESULTS:** The obtained mean values of Static SVV, Dynamic Clockwise, Dynamic Anticlockwise, vertical static tilt right & left SVV in ground crew were $+0.99 \pm 0.41^\circ$, $+4.35 \pm 1.85^\circ$, $-5.81 \pm 3.24^\circ$, $-0.75 \pm 1.45^\circ$ & $-0.33 \pm 2.30^\circ$ respectively and were $+0.70 \pm 0.35^\circ$, $+3.6 \pm 1.83^\circ$, $-4.46 \pm 3.46^\circ$, $-0.66 \pm 0.92^\circ$ & $+0.21 \pm 1.09^\circ$ respectively in aircrew. The perceived degree of tilt was significantly lesser in aircrew as compared to groundcrew ($p < 0.05$) in Static SVV, Dynamic Clockwise & Dynamic Anticlockwise SVV test. The difference between the two groups was not statistically significant ($p > 0.05$) for the Vertical static tilt right & left SVV tests. **DISCUSSION:** Due to frequent and continuous exposure to the aviation environment, aircrew exhibit a better perception of verticality than ground crew, as evidenced by the degree of tilt in the vertical static, dynamic clockwise and anticlockwise SVV tests. The firing rates of the utricular hair cells may be proportionally dependent on membrane displacements that change depending on the angles of head tilts due to their mechanical characteristics. In other words, head tilts less than 30° would primarily stimulate the lateral region of the utricle and cause a mild deviation of the hair cells in the opposite direction of head motion. Scant scientific literature on the subject is available, thereby limiting comparative analyses with other studies.

Learning Objectives

1. The use of SVV test battery as an invaluable tool for a better understanding of utricular function.
2. This knowledge may be applied in early recognition and treatment of utricular dysfunction in aircrew and space crew.

[385] VIBROTACTILE FEEDBACK AS A COUNTERMEASURE FOR SPATIAL DISORIENTATION IN EARTH-G, MARTIAN-G, LUNAR-G, AND 0-G ANALOGS

Vivekanand Vimal, Paul DiZio, James Lackner

Brandeis University, Waltham, MA, United States

WITHDRAWN

[386] DOES FLIGHT RELATED NECK PAIN EFFECT COGNITIVE AND PSYCHOMOTOR PERFORMANCE IN MILITARY ROTARY-WING REAR CREW?

Richard Vail¹, Stephen D.R. Harridge¹, Nicholas Green², Marousa Pavlou¹, Peter Hodkinson¹

¹King's College London, London, United Kingdom; ²RAF, London, United Kingdom

(Original Research)

INTRODUCTION: Military rotary-wing operations require sustained levels of cognitive and psychomotor performance from aircrew to ensure safety and operational effectiveness. Significant flight-related neck pain (SFRNP) is common amongst rotary-wing aircrew, potentially affecting their performance. This study aimed to examine the effect of SFRNP on psychomotor and cognitive performance in a cohort of military rotary-wing aircrew in the operational flight environment. **METHODOLOGY:** A field study was conducted using a dual-task paradigm with 40 military operational CH-47 rear crew (39 male, 1 female). The primary outcome variable was the Dual Task Effect (DTE) (% change between single and dual task conditions) for cognitive and psychomotor performance on a novel simulated flight-task test battery. These data were stratified post-hoc for those with or without SFRNP. This study received favourable opinion from the UK Ministry of Defence Research Ethics Committee (MODREC). **RESULTS:** 65% (n=26) of participants reported SFRNP during the test flights. Mean intensity of SFRNP was 2.5 on the Numerical Pain Rating Scale. Pre-flight, there was a significantly greater deterioration in psychomotor performance under dual task conditions for the SFRNP group (DTE -15.8), compared to the non-neck pain group (DTE 1.5) ($p = .01$). Deterioration in dual-task performance (DTE) for both the cognitive and psychomotor conditions was slightly worse following the operational flight sortie; however, no significant differences were observed after the operational flight sortie in either the SFRNP or non-neck pain group ($p = > .05$). **DISCUSSION:** SFRNP was found to be present amongst this sample of military rotary-wing aircrew. There was a detectable change in the cognitive and psychomotor performance of the aircrew using the dual-task paradigm. Whilst there was evidence that SFRNP was associated with reduced psychomotor dual-task performance, operational flight exposure did not affect aircrew performance in this study. Future research could consider the relationship between the pain intensity and its effect on performance.

Learning Objectives

1. Psychomotor dual-task performance was reduced in military rotary-wing rear crew with significant flight-related neck pain.
2. Operational flight exposure was not associated with reduced dual-task performance in aircrew with or without significant flight-related neck pain in this study.

[387] QUANTIFYING OVERESTIMATION OF HEAD TILT DURING SUSTAINED AND REPEATED EXPOSURE TO HYPER-GRAVITY

Victoria Kravets, Aadhit Gopinath, Torin Clark

University of Colorado, Boulder, Boulder, CO, United States

(Original Research)

INTRODUCTION: Dynamic changes in gravity experienced during space travel present immediate challenges for astronauts, and the

associated neurovestibular impairment during the first crucial hours in a new environment poses increased risk of spacecraft mishaps when manual control is required or the possibility of injuries during emergency egress or Extravehicular Activities. This research seeks to address a significant knowledge gap by characterizing the extent and temporal dynamics of neurovestibular impairment within the initial hour following a gravity transition, offering valuable insights into the timeline and severity of impairment during the adaptation period. **METHODS:** We utilized a human centrifuge to generate a net force of 1.5g along the longitudinal body axis of our subjects for 1 hour. The amount of over/underestimation of head tilt was used to provide an indirect inference of the time course of neurovestibular adaptation to the change in gravity and was monitored by passively tilting the head to a random roll angle every 3 minutes while collecting subject visual vertical (SVV) measures through a head-mounted display. Pre- and post- centrifugation SVV measures were also collected to establish a baseline perceptual response and to monitor readaptation to 1g. Testing was repeated on two consecutive days to explore the effect of memory of recent gravity transitions on adaptation trajectories. This protocol was approved by the University of Colorado-Boulder Institutional Review Board. **RESULTS:** Thirteen subjects (7 males and 6 females; ages 26.8±6.1 years) completed the study. During the hour of centrifugation, subjects consistently overestimated head tilt (by an average of 41±22% of actual head tilt angle on day 1 of testing and 45±28% on day 2 of testing). The subsequent readaptation phase demonstrated a rapid readjustment back to baseline perceptual measures. Notably, significant inter-individual differences were observed throughout the study. **DISCUSSION:** Despite the potential ramifications related to vestibular impairment following a gravity transition, minimal data has been collected to systematically examine adaptation over the crucial first hours following a gravity transition. The results of this study offer insight into the diverse range of adaptation trajectories that may occur and can be used to inform computational models further exploring the adaptation process.

Learning Objectives

1. The audience will learn about how tilt estimation changes in altered gravity.
2. The audience will learn about the effect of repeated exposure to altered gravity on tilt estimation in novel environments.

Wednesday, 05/08/2024
Grand Hall K

2:00 PM

[S-67]: PANEL: MEDICAL AND HUMAN PERFORMANCE CONSIDERATIONS FOR COMMERCIAL LOW EARTH ORBIT

Sponsored by Aerospace Human Factors Association

Chair: Anna Clebone Ruskin

Co-Chair: Brian Musselman

PANEL OVERVIEW: *INTRODUCTION:* Astronauts have historically been selected on the basis of mission requirements and strict medical and physical guidelines. The advent of commercial space travel offers an opportunity for non-astronaut passengers to experience spaceflight. *TOPIC:* As the commercial space industry expands to include commercial space travel and possible future colonization of the Moon and Mars, future space travelers may require accommodation for a wide variety of physical and medical conditions. These accommodations may include the need for physical prehabilitation, management of stress and noise, limiting discomfort such as nausea and vomiting, and overall integration of a new class of space travelers into a space vehicle. *APPLICATION:* Physical prehabilitation is currently used by anesthesiologists and surgeons, and seeks to optimize a patient's physical status before the planned surgery and anesthesia. The goal is to ensure the best possible outcome after surgery. Concepts from pre-operative clinic 'prehabilitation' could be applied to potential spaceflight passengers, and could

in the future even launch a new medical subspecialty of the 'space tourist physician.' Similarly, commercial space passengers may not expect stressors that commonly occur during launch, orbit, and re-entry. They will experience these stressors in a cramped environment without an immediate exit. Contributors to this stress include noise, space sickness, and claustrophobia. Current data and future directions on describing and evaluating the acoustic environment of space flight vehicles will be reviewed. Non-pharmaceutical and pharmaceutical strategies for managing nausea from space sickness will also be explored. Finally, an effective human system integration approach needs to be applied to space vehicle design to ensure it is optimized for all potential space travelers. As more people travel in space, the need for medical accommodations will increase. Current science, as well as future research can be leveraged to meet this need.

[388] PHYSIOLOGICAL STRESSOR OPTIMIZATION

Jaclyn Edelson

University of Chicago, Chicago, IL, United States

(Education - Tutorial/Review)

INTRODUCTION: As technology advances and space accessibility becomes more financially inclusive, space tourism for lay-people may become a budding industry. Similar to optimizing lay-people for the physiological stressors of surgery, physicians may have a role in optimizing space tourists for the physiological stressors of the journey. **TOPIC:** Historically, physicians have played a close role in monitoring astronaut health and safety in previous missions to space. This role will likely change as space exploration expands beyond the elite fitness of historic astronauts to lay-people that desire a tourist experience in space. **APPLICATION:** Physicians can use principles learned from patient optimization on Earth in the setting of a pre-operative clinic and 'prehabilitation', and apply them to preparing space tourists for their time beyond Earth's atmosphere. These principles include how to assess risk for individual passengers, and what minimal standards of health may be needed to enjoy the journey. It is also important to hypothesize and outline what responsibilities, expectations, and consequences may be for a "space tourist physician" before the role exists in widespread practice. **RESOURCES:** Tew GA, Ayyash R, Durrand J, Danjoux GR. Clinical guideline and recommendations on pre-operative exercise training in patients awaiting major non-cardiac surgery. *Anaesthesia*. 2018;73(6):750-768. DOI: 10.1111/anae.14177. Committee on Standards and Practice Parameters; Apfelbaum JL, Connis RT, Nickinovich DG; American Society of Anesthesiologists Task Force on Preanesthesia Evaluation; Pasternak LR, Arens JF, Caplan RA, Connis RT, Fleisher LA, Flowerdew R, Gold BS, Mayhew JF, Nickinovich DG, Rice LJ, Roizen MF, Twersky RS. Practice advisory for preanesthesia evaluation: an updated report by the American Society of Anesthesiologists Task Force on Preanesthesia Evaluation. *Anesthesiology*. 2012 Mar;116(3):522-38. doi: 10.1097/ALN.0b013e31823c1067. PMID: 22273990

Learning Objectives

1. Express how principles of pre-operative evaluation and prehabilitation are relevant to pre-flight evaluation for potential space tourists.
2. Discuss what responsibilities and expectations exist for a physician in the budding space tourism industry.

[389] ASSESSING THE IMPACT OF ACOUSTIC ENVIRONMENTS ON COMMUNICATION AND AUDITORY HEALTH

Abby Silbaugh

University of Chicago, Chicago, IL, United States

(Education - Program/Process Review)

BACKGROUND: The acoustic environment in space flight vehicles and habitats remains a major operational concern. Risks associated with noise, radiation, and ototoxin exposure include reduced speech intelligibility and permanent shifts in hearing thresholds. This presentation

assesses key elements of the NASA Hearing Conservation Program (HCP), reviews data availability in critical areas, and provides a prioritized list of recommendations for future study. **OVERVIEW:** Data collected in terrestrial environments primarily inform auditory damage risk criteria and recommendations on the use of hearing protective devices. A comprehensive understanding of short- and long-term changes in hearing sensitivity in spacecraft environments is required to mitigate unique habitability concerns and safety risks. Noise level monitoring and periodic audiometric testing are critical components of the HCP, but whether existing approaches can sufficiently characterize changes in hearing sensitivity and its impact on communication must be rigorously evaluated. This presentation discusses 1) the extent to which pure-tone audiometry can detect changes in hearing sensitivity affecting speech discrimination; 2) the limitations of existing retrospective studies investigating transient and permanent shifts in hearing thresholds; and 3) NASA Johnson Space Center (JSC) data availability and reporting. A workshop composed of relevant specialties across military and civilian spheres assembled primary peer-reviewed papers and JSC data in the following areas: pre- and post-flight audiograms, On-Orbit Hearing Assessments, Sound Level Meter measurements, and Acoustic Dosimeter measurements. Data quality and accessibility were evaluated, and reviewers generated a prioritized list of recommendations for further research. **DISCUSSION:** NASA's Hearing Conservation Program and effective programs in other professional disciplines use accurate, scientifically-based standards and countermeasures. Increasing interest in commercial and long-term space flight expands the variety of astronaut medical and physical conditions requiring accommodation, establishing the need to rigorously characterize the impact of the acoustic environment on auditory health and safety. This work is of broad interest to professionals who may be in a position to contribute to the scientific knowledge base, increase data accessibility, or implement additional testing and countermeasures in this area.

Learning Objectives

1. Recognize the impact of acoustic conditions in space flight vehicles on auditory health and communication and review current approaches to hearing conservation.
2. Understand current methodologies and data utilized in monitoring auditory health in space environments, recognizing areas of potential improvement and further research needs.

[390] SPACE MOTION SICKNESS - NON-PHARMACOLOGIC AND PHARMACOLOGIC INTERVENTIONS

Anna Clebone Ruskin

University of Chicago, Chicago, IL, United States

(Education - Tutorial/Review)

INTRODUCTION: Being selected as an astronaut comes with an understanding that one is willing to undergo physical discomfort. As commercial orbital and suborbital flights increase, the range of individuals who become space flight participants, and thus experience the physically unpleasant circumstances of space flight will increase. **TOPIC:** 'Space motion sickness,' is caused by modification of signals, due to microgravity, in the neuro-vestibular and visual systems. A multi-modal approach to this neurogenic problem incorporates multiple interventions, each of which may have a weak effect but when combined may potentiate each other. **APPLICATION:** This presentation will review various non-pharmacologic and pharmacologic interventions to space motion sickness. Non-pharmacologic interventions are ideal due to the decreased potential for side-effects and can be started weeks prior to the anticipated flight. One of the simplest approaches is avoidance of recreational alcohol. A more complex intervention is motion exposure. This could be as basic as spinning for a few minutes daily in a roller-chair, or as intense as using a spatial disorientation trainer (which spins a person in multiple axes but at low speed) for several hours a day in the weeks leading up to the flight. Eating ginger candy, and wearing bracelets that apply pressure to the P6 acupressure point are also useful during the actual motion. Pharmacologic interventions all have potential side effects, but

could be used under the supervision of a physician or other medical officer. Famotidine works on the H1 receptor to decrease stomach acid, and a single dose has relatively few side effects. Other drugs may be more efficacious, but have the potential for sedation, which precludes use in pilots and other crew members who are essential for flight safety. Ondansetron is a serotonin receptor antagonist used for peri-operative nausea treatment and prophylaxis, however it can cause some sedation, headache, and constipation and is contraindicated in patients with long QT syndrome. Diphenhydramine and other H2 blockers, as well as scopolamine, an anticholinergic, cause significant sedation along with a dry mouth and dizziness. Dextroamphetamine is a stimulant, but should be avoided when possible due to the potential for addiction and sudden cardiac death. A risk for polypharmacy and unanticipated side-effects also exists if multiple drugs are used.

Learning Objectives

1. Similar to other neurogenic problems, space motion sickness benefits from a multimodal approach, in which several interventions may potentiate each other.
2. Non-pharmacologic modalities to prevent and treat space motion sickness have fewer side effects. In the weeks before the flight, these may include avoidance of recreational alcohol and motion exposure. During the flight, eating ginger candy, and wearing bracelets that apply pressure to the P6 acupressure point are also useful.
3. Pharmacologic interventions for space motion sickness require medical supervision, and may be contraindicated in some travelers. Famotidine, ondansetron, scopolamine, and diphenhydramine will be discussed.

[391] EVALUATING STRESS IN FUTURE SPACE PASSENGER OPERATIONS

Elizabeth Combs, Josephy Tierney

U.S. Air Force, San Antonio, TX, United States

(Education - Tutorial/Review)

INTRODUCTION: Suborbital commercial space flights became a reality in July 2021. Commercial companies are currently design low earth orbit destinations, which can support commercial space passengers. While the medical evaluations and standards are continuing to be addressed, one facet of space flight that may benefit from further evaluation is passenger stress. Stress is well understood in modern literature as a nonspecific response to demands or response to a stimulus that disrupts homeostasis. In commercial aviation, these demands range from emergencies to negative passenger interactions. Passengers may experience additional stress from delays, external personal interactions, or from the novelty of the experience. **TOPIC:** Increased stress can manifest in both cognitive and physiological changes which present in a variety of different ways. As space flight operations increase; passenger stress has the potential to negatively impact operations. **APPLICATION:** This presentation will address current methods of evaluating stress in passengers. It will detail non-invasive use of biomarkers in current stress research and potential future applications to space flight passengers. The presentation will also detail current stress survey methods and best practices. It will evaluate the usefulness and limitations of the different stress measures for space passengers.

Learning Objectives

1. The audience will learn about common ways to currently assess stress in aviation and their use in space passenger operations.
2. The audience will learn about limitations of evaluating stress in space passenger operations.

[392] HUMAN SYSTEMS INTEGRATION IN SPACE SYSTEMS DESIGN

Brian Musselman¹

¹*Star Harbor, Denver, CO, United States*

WITHDRAWN

Wednesday, 05/08/2024
Grand Hall GH

2:00 PM

[S-68]: SLIDES: ACCIDENT ANALYSIS AND SURVIVAL

Chair: Douglas Boyd
Co-Chair: Charles DeJohn

[393] ANALYSIS OF HUMAN FACTORS IN AIRCRAFT ACCIDENTS/INCIDENTS IN CIVIL AVIATION IN INDIA FROM YEAR 2000 - 2023 USING HFACS AND FAHP

Srihari Enakal

Directorate General Of Civil Aviation, New Delhi, India

(Original Research)

INTRODUCTION: Despite the advent of technology and various safety measures in place Human Error still remain to be the leading cause of Aircraft Accidents/Incidents across the world. This study is intended to find the various causative factors of these Accidents/Incidents from the published AAIB/COI reports in the last 24 years in India and analyze the human errors in these accidents, also suggest measures to reduce Human Error related Accidents/Incidents thus improving overall Aerospace Safety. **METHODOLOGY:** All the Aircraft Accidents/Incidents occurred between Jan 2000 - Oct 2023 in Civil Aviation in India have been considered for this study. Each of these Accidents/Incidents have been analyzed in detail in order to identify the role of Human Errors in these accidents by using the Human Factors Analysis and Classification System (HFACS) and Fuzzy Analytical Hierarchy Process (FAHP) for ensuring the quantitative and qualitative assessment of aircraft accidents/incidents. **RESULTS & DISCUSSION:** There were a total of 276 Aircraft Accidents/Serious Incidents in the last 24 years i.e, from January 2000 – 30 October 2023 in Civil Aviation in India out of which 133 were major Aircraft Accidents & 143 were Serious Incidents. A total of 453 people including Crew & passengers lost their life and 190 were seriously injured in these Aircraft Accidents/Serious Incidents. This study has reiterated that Human Error remain to be the leading cause of aircraft accidents (58%). The study also had made analytical assessment of HFACS using the Fuzzy Analytical Hierarchy Process (FAHP). The statistical analysis was carried out using SPSS. This study also gives an insight into the capabilities of integration of analytical tools into the HFACS framework in comprehensive assessment of aircraft accidents and thus implementing safety measures for Aerospace Safety.

Learning Objectives

1. The participants will understand the impact and trend of Human Errors in the Aircraft Accidents/Incidents in Civil Aviation in India in the last 24 years.
2. The participants will get to know the full potential of integrating analytical framework with HFACS in assessment of dynamic factors of aircraft accident investigations.
3. This study will enable the participants to utilize the data and to the compare with the data from around the world.

[394] DIRECT COMBAT-RELATED U.S. ARMY AVIATION INJURIES 2003-2014

Frederick Brozoski, Sandra Conti, Jennifer Dudek, Valeta Chancey, John Crowley

U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: The U.S. Army Aeromedical Research Laboratory, a partner in the Joint Trauma Analysis and Prevention of Injury in Combat (JTAPIC) partnership, conducted retrospective reviews to investigate injuries sustained by occupants of Army rotary-wing (RW) aircraft involved in combat damage incidents (CDIs) (i.e., incidents in which enemy weapon systems damaged an Army RW aircraft). Previous

reviews provided an overview of injuries sustained during direct and indirect events (DEs and IDEs). This review analyzed occupant injuries occurring during DEs to identify potential improvements in aircraft- and personnel-borne protective equipment. **METHODS:** A retrospective review was conducted on injuries sustained by occupants of Army RW aircraft involved in CDIs between 2003 and 2014. All Black Hawk, Apache, and Chinook CDIs were reviewed. Personnel casualty information was linked to CDI information by matching the airframe, incident date, and circumstantial information. Information on aircraft- and personnel-borne protective equipment was gathered for each occupant when available. Injuries sustained during DEs (CDIs in which the enemy weapon directly caused occupant injuries) were coded using the Abbreviated Injury Scale (AIS). Descriptive statistics were used to describe the frequency and distribution of injuries and injury mechanisms. **RESULTS:** Within the study period, 45 direct injury events were suffered by 75 of 264 individuals exposed to CDIs. The extremities were the most injured body regions, with the lower extremities suffering more injuries than the upper extremities. Penetrating injury was the primary injury mechanism for all body regions except the head. Blunt force trauma caused all reported head injuries. Injuries to each AIS body region were predominantly minor (AIS 1) and moderate (AIS 2). **DISCUSSION:** Injuries to U.S. Army aircraft occupants (pilots, crew, and passengers) by direct contact with enemy weapon effects during the study period were relatively infrequent and minor, considering the intensity of operations during the study period. Second, of the injuries that did occur, penetrating trauma was the most frequent mechanism, but these were mostly minor. Third, the lack of event data, especially regarding the use of, or performance of, aircraft- or personnel-borne protective equipment, prevents any detailed analysis leading to recommendations, specifically regarding personal protective equipment performance.

Learning Objectives

1. The audience will understand the frequency and severity of injuries sustained by occupants of U.S. Army aircraft exposed to direct contact with enemy weapon systems.
2. The audience will understand the need for improved data collection, particularly regarding personal protective equipment, from in-theater combat damage events to allow retrospective review and guide potential improvements in occupant protection.

[395] MISHAP EXERCISE DESIGN THROUGH THE LENS OF A GAMER

Liam Milburn

Flight Operational Medicine Clinic, APO AE, United States

(Education - Program/Process Review)

BACKGROUND: Aerospace medicine clinics are responsible for performing initial mishap investigations when an event occurs. Training for aerospace medicine technicians and physicians explains the "how" of the process. Providers and technicians often lack the experience with initiating mishap protocols. The missing component is actual implementation, the complexity and the time it takes to process the initial stages of the investigation. This presentation will demonstrate how to design and implement a mishap investigation into military exercises. **OVERVIEW:** Modern tabletop game design has had twenty-five years of continuous process refinement. Current adventure modules account for difficulty tiers, narrative flow, immersion, and consequences of player actions; this exists through the entire module and can be expanded to large campaigns. Prior to this, early modules consisted of disconnect encounters which fit a theme of the overall adventure. Individual encounters inconsequential to any overarching narrative. Current military exercise design is based on the latter design philosophy. Individual scenarios which fit the theme of the overall exercise, designed to test a specific team's response. Teams are tested whether they are capable of performing a single set of tasks, but not the sustained operations which would realistically occur. This presentation approaches exercise design from a modern gaming design perspective. **DISCUSSION:** Familiarity at managing the initial stages of a

mishap is best obtained through practical experience and training. A mishap exercise which utilizes all facilities within a medical facility, and ideally incorporates line side personnel, will accurately demonstrate unique limitations of each site. Through use of modern game design techniques, mishap investigation exercises can be created regardless of scale, and addition or exclusion of non-line side personnel. This approach is less about beating a set time for completion, rather stresses maintaining the integrity of the investigation over a prolonged period of time.

Learning Objectives

1. The audience will better understand the limitations present military exercises pose to mishap investigations.
2. The audience will be able to identify gaps in mishap training at their home stations and how to best to address those limitations.
3. The presenter will demonstrate holistic approach to mishap exercise design and training.

[396] POSTMORTEM CARBON MONOXIDE PRODUCTION IN A FATALLY INJURED HELICOPTER PILOT

Turan Kayagil

NTSB, Washington, DC, United States

(Education - Case Study)

INTRODUCTION: On July 19, 2021, a Robinson Helicopter Company R44 II was destroyed when it impacted the water in Albemarle Sound near Point Harbor, North Carolina. The noncertificated pilot and passenger were fatally injured. Although postmortem toxicology testing of cavity blood from the pilot revealed an elevated carboxyhemoglobin of 19%, the National Transportation Safety Board (NTSB) investigation did not identify any likely source of carbon monoxide exposure. **BACKGROUND:** Carboxyhemoglobin is a marker of carbon monoxide (CO) exposure. Nonsmokers normally have carboxyhemoglobin levels of less than 1-3%, while heavy smokers may have levels as high as 10-15%. Elevated carboxyhemoglobin in postmortem blood after an aviation accident is commonly attributable to smoke inhalation during post-crash fire, and may also be an indication of in-flight CO exposure. Rarely, CO may be formed in cavity blood after death, particularly after water immersion. **CASE PRESENTATION:** The helicopter pilot's body was recovered after prolonged water immersion. His autopsy revealed no evidence of thermal injury or airway soot. Fragments of the helicopter displayed no fire damage. The cabin heating system could not be examined, but would unlikely have been in use given warm weather. The pilot reportedly did not smoke. The Federal Aviation Administration Forensic Sciences Laboratory measured carboxyhemoglobin at 19% in the pilot's cavity blood using spectrophotometry, with confirmation by gas chromatography. No passenger specimen was available. The NTSB investigation found that the pilot likely had experienced spatial disorientation after continuing visual flight into instrument meteorological conditions, and that postmortem CO production likely had increased the carboxyhemoglobin level in the pilot's cavity blood after his death. **DISCUSSION:** Postmortem production of CO rarely is an appropriate forensic interpretation of abnormal carboxyhemoglobin elevation in a crash-involved pilot. This case illustrates circumstances under which such an interpretation should be considered. A confirmed carboxyhemoglobin result was obtained in a cavity blood specimen from a body that had been immersed in water. No likely source of abnormal CO exposure was identified, and the crash could be explained from available evidence without positing CO-related pilot impairment. The case is presented by the investigating NTSB medical officer.

Learning Objectives

1. Understand possible explanations for elevated carboxyhemoglobin levels measured in postmortem blood specimens in aviation accident investigations.
2. Identify circumstances under which postmortem carbon monoxide production should be considered as a potential cause of carboxyhemoglobin elevation.

[397] -PLANE CRASH EXTREME SURVIVAL- 4 CHILDREN, 40 DAYS IN THE AMAZON JUNGLE: SEARCH, RESCUE AND SURVIVABILITY ANALYSIS

Diego M Garcia

National University of Colombia, Bogota, Colombia

(Education - Program/Process Review)

BACKGROUND: The miraculous extended survival of four Indigenous children in the Amazon jungle following a plane crash is a testament to crashworthiness engineering and human resilience. Various factors contribute to the survival of individuals in plane crashes. These factors encompass tolerable levels of G-forces, aircraft crashworthiness, and post-crash considerations. This remarkable event underscores the significance of aircraft cabin dealthalization, survival skills and resources in extreme conditions, and the importance of cross-service efforts in search and rescue missions. **OVERVIEW:** Four Indigenous children endured 40 days of survival in the unforgiving Colombian Amazon rainforest after a plane crash that claimed the lives of three adults, their mother included. The successful search and rescue mission involved a collaborative effort between military teams, Indigenous volunteers, and aerospace medicine professionals, highlighting the operational challenges and interdisciplinary approaches required in complex operations like this. Survival factors constitute a crucial aspect of accident investigations, encompassing various specialties and responsibilities. These include documenting impact forces and injuries, evacuation procedures, survival equipment, wilderness literacy, community emergency planning, and search & rescue efforts. **DISCUSSION:** This extraordinary event holds operational and resilience engineering significance, showcasing the remarkable ability of individuals to survive under extreme conditions. It emphasizes the critical role of aerospace medicine and the necessity for comprehensive training and resources to respond to such challenging emergencies. This incident also underscores the vital importance of cross-service and international cooperation in conducting search and rescue missions, transcending military-civilian boundaries. Empirical case findings often highlight the importance of training crew members and passengers in survival and evacuation procedures, emergency equipment use, and effective emergency responses. Identifying survival factors in aviation accidents is not only essential for learning from past events but also for sharing crucial information with organizations responsible for enhancing occupant survivability.

Learning Objectives

1. Understand the Multifaceted Factors Contributing to Survival in Aviation Accidents: Explore the various factors that influence the survival of individuals in aviation accidents, including tolerable G-forces, aircraft crashworthiness, and post-crash considerations. Gain insights into how these factors are crucial in enhancing occupant survivability and resilience during catastrophic events.
2. Appreciate the Interdisciplinary and Collaborative Nature of Search and Rescue Missions: Recognize the significance of cross-service and international cooperation in conducting search and rescue missions during aviation accidents. Understand how collaborative efforts between military teams, Indigenous volunteers, and aerospace.
3. Emphasize the Role of Aerospace Medicine and Training in Enhancing Survival: Highlight the importance of aerospace medicine and comprehensive training in preparing individuals to respond effectively to challenging emergencies. Learn how empirical case findings contribute to the identification of critical survival factors and how this knowledge can be used to enhance safety measures and occupant survivability in aviation accidents.

[398] OPTIMIZATION OF RNA-ANALYSIS FOR MOLECULAR PATHOLOGY IN AIRCRAFT ACCIDENT INVESTIGATION

Michael Schwerer

German Air Force Centre of Aerospace Medicine, Cologne, Germany

(Original Research)

INTRODUCTION: Modern medico-legal aircraft accident investigation includes the diagnosis of pathological conditions such as hypoxia, cardiocirculatory disease, or cellular stress burden in the victims using RNA-based forensic genetics. Following current guidelines, tissue samples from autopsies are fixed in 4% formalin solution. For histological assessment, the specimens are subsequently embedded in paraffin wax. Such formalin-fixed, paraffin-embedded (FFPE) material is reliably protected from degradation. However, fragmentation and cross-linking of nuclear acid strands impairs RNA extraction and downstream molecular analysis using reverse-transcription based PCR (RT-PCR). This study compared different methods to retrieve RNA from FFPE samples. **METHODS:** FFPE heart tissue specimens obtained in 21 forensic autopsies between the years 1967 and 2019 were investigated. RNA extraction was carried out using automated magnetic bead-based protocols as well as manual silica-column-based procedures. Commercially available chemistries for the extraction process itself as well as for a pre-treatment to remove the paraffin wax from the tissue were used (Promega, Mannheim, and Qiagen, Hilden, Germany). Self-established procedures from our laboratory were co-evaluated. The effectiveness of RNA extraction was assessed with the Quanti-Fluor-System (Promega). The sensitivity for the detection of lowly concentrated RNAs was studied using RT-PCR for spiked-in miRCURY controls (Qiagen) on a Quant-Studio 5 thermal cycler (Thermo-Fisher, Darmstadt, Germany). **RESULTS:** RNA extraction results not applicable for further RT-PCR analysis were observed in a significant subset of magnetic-bead-based experiments, but were rarely seen when silica-column-based techniques were used. Pre-treatment with either commercially available chemistry or self-established protocols was unavoidable to obtain high-level RNA yields. Employing optimized procedures, the detection of RNAs in concentrations as low as 0.00002 femtomol per microliter was possible. **DISCUSSION:** Successful RNA-based molecular pathology depends on a maximum of extraction efficiency. Under optimized conditions, even lowest concentrations of nuclear acids can be demonstrated on the cellular level. Hence, even minimal pathological changes can be detected and interpreted in accident investigation.

Learning Objectives

1. The participant will get to know the possibilities of molecular pathology in modern aircraft accident investigation.
2. The participant will learn about the limitations of molecular pathology depending on the quality of substrate material and how to improve the results with optimized laboratory protocols.

Wednesday, 05/08/2024**2:00 PM****Grand Hall I****[S-69]: SLIDES: IS THE SKY THE LIMIT? MED OPS IN COMMERCIAL SPACE FLIGHT****Chair: Harriet Lester****Co-Chair: Micah Kenney****[399] OPPORTUNITIES IN COMMERCIAL SPACE FOOD SYSTEM**Chuyan Chen*Axiom Space, Houston, TX, United States**(Education - Program/Process Review)*

BACKGROUND: Through decades of National Aeronautics and Space Administration (NASA) experience in human spaceflight, one of the most vital elements to crew wellbeing and performance continues to be the food system. When NASA announced in 2022 the scheduled

retirement of the International Space Station (ISS), the opportunity emerged for commercial space food system development. In support of designing its commercial successor, Axiom Space has been compiling valuable learnings from operations of three Private Astronaut Missions (PAM) and development of Extravehicular Activity Services (xEVAS) space-suit. **DESCRIPTION:** When evaluating a space food system suitability to human crew, a comprehensive and sustainable system should be key design priorities. The development of a food system that is both holistic and sustainable is a formidable goal. The challenges of food safety maintenance, nutritional degradation, and sensory acceptability remain crucial to address. As mission durations extend for longer periods, the sustainability of the food system comes into focus. Technological development to address the limitation of resources has resulted in the proven ability to grow and consume leafy greens aboard the ISS. Further technological advancements should aim to alleviate the upmass cost and stowage resource burdens. **DISCUSSION:** Axiom Space PAM utilized existing food technologies which include thermostabilized, freeze-dried, and commercially off the shelf (COTS) products, produced and packaged on-ground and stowed as flight cargo. Much of the mission food costs came from the severe cost to send upmass. The food procurement process involved key collaboration with NASA and commercial food suppliers. Partnership with commercial food industry has also proved instrumental in the continuous development of xEVAS spacesuit. Leveraging the capabilities of existing food industry infrastructure is essential while technological advancements look to overcome the acknowledged gaps.

Learning Objectives

1. Challenges associated with development of a holistic and sustainable space food system.
2. Considerations and lessons learned to be applied to resolve stated challenges.

[400] COMMERCIAL SPACE – THE FINAL FRONTIERMichael Harrison¹, William Powers¹, Michelle Hong¹, John Marshall¹, Kendall Howie², Chuyan Chen²¹*Axiom Space Inc & Hercules Medical Group, Houston, TX, United States;*²*Axiom Space Inc, Houston, TX, United States**(Education - Program/Process Review)*

BACKGROUND: The “firsts” that have occurred over the past decade of commercial spaceflight have included both anticipated and unanticipated historic events. The pace of operations has increased for multiple commercial space companies during this period and the tempo is only likely to increase over the next decade. This presents both opportunities and challenges that must be addressed to achieve the goal of making space accessible to all and establishing a sustained presence of commercial crews in space. **OVERVIEW:** Several commercial companies are engaged in designing and flying a commercial space station in low Earth orbit (LEO). Achieving this ambitious goal will require transitioning many activities to the commercial sector or engaging in collaborative activities between governmental and commercial space companies – the product of some of these efforts will also provide benefit to those living on Earth or further commercial opportunities for companies that can offset other costs associated with spaceflight. This panel will discuss collaborative efforts with established governmental space agencies as well as the process for helping new countries develop a corps of career astronauts; the intricacies of developing the next generation of spacesuits with larger ranges of anthropometric capacity; and the considerations in providing nutritious, shelf-stable, and culturally important food. **DISCUSSION:** Space is hard. Commercial space endeavors to make space accessible to all and to support a sustained presence of astronauts who do not necessarily fit the traditional government mold. Accomplishing this aim with require deliberate, collaborative, and innovative approaches to selecting and supporting astronauts, designing and maintaining spacesuits for their missions, and establishing a food system that meets both their physical and psychological health needs.

Learning Objectives

1. The audience will learn about the potential for broad collaborative and innovative relationships that are possible in the commercial space industry.
2. The audience will become familiar with the wide-ranging scope of capabilities and assets, such as a food system, that are required to support commercial spaceflight missions.
3. The audience will understand the importance of physical and psychological benefits provided by these support resources, using a comprehensive food system as an illustrative example.

[401] EFFECTS OF MILD HYPOBARIC HYPOXIA ON RESPONSE FROM MILD EXERCISE IN NASA EXPLORATION ATMOSPHERE TESTS

Brett Siders¹, Lori Cooper², Nicole Strock³, Alejandro Garbino⁴, Patrick Estep⁴, Lichar Dillon³, Kadambari Suri³, Monica Hew³, Constance Ramsburg⁵, Karina Marshall-Goebel³, Andrew Abercromby³

¹NASA/Aegis Aerospace Inc., Houston, TX, United States; ²NASA/JES Tech, Houston, TX, United States; ³NASA/KBR, Houston, TX, United States; ⁴NASA/Geocontrol, Houston, TX, United States; ⁵U.S. Navy, Houston, TX, United States

(Original Research)

INTRODUCTION: The NASA Exploration Atmosphere study aims to validate a new prebreathe protocol incorporating an alternate habitat atmosphere of 56.5 kPa (8.2psia), 34% O₂, and 66% N₂ to control and mitigate decompression sickness risk associated with spaceflight extravehicular activities. This alternate atmosphere results in a mild hypoxic environment (PIO₂ of 128 mmHg) that may influence inhabitant physiological responses to exercise. Therefore, the responses to light exercise in relation to the mild hypobaric hypoxic environment were investigated. **METHODS:** Eight participants (4M/4F; age=38.3±9.0 yr; weight=76.0±13.1 kg; peak aerobic capacity [VO₂pk]= 3.1±0.7 L/min) were exposed to a mild hypobaric hypoxic environment for 11 days in NASA's 20-foot hypobaric chamber at Johnson Space Center. Chamber conditions alternated daily between a habitat atmosphere of 56.5 kPa/34% O₂ and simulated 6-hour EVA environment, 29.6 kPa/85% O₂. Participants completed pre-mission graded VO₂pk tests on a LODE cycle ergometer with ParvoMedics metabolic analyzer. Submaximal aerobic tests were performed pre and during the mission (10-minutes of exercise at a workload of 40% VO₂pk). Pre-mission, participants performed submaximal exercise exposed to a breathing air mixture of, 18% O₂ and balance N₂, simulating the mildly hypoxic environment within the 20-foot chamber. Linear mixed models (fixed effect: test day; random effects: subject, age) were performed to determine whether physiological responses (oxygen uptake [VO₂], carbon dioxide production [VCO₂], ventilation [VE], oxygen saturation [SPO₂], heart rate [HR], respiratory exchange ratio [RER]) to submaximal exercise performed within the 20-foot hypobaric chamber every 2 days differed from the pre-mission (18% O₂) testing. Results are presented as estimated marginal means with lower and upper confidence limits, with significance set to 0.05. **RESULTS AND DISCUSSION:** Seven of eight participants completed the chamber study. Mixed models for VO₂, VCO₂, SpO₂, HR, and RER indicated negligible impact of the mild hypoxic chamber environment compared to pre-mission testing (all p>0.05). Results for VE indicated a minor impact of chamber environment compared to pre-mission testing (37.0 L/min [30.8, 43.2]), with increased VE at test day 10 (40.4 L/min [34.2, 46.6]; p= 0.029). The aerobic performance data collected suggests limited physiologic responses to mild exercise when performed at normobaric hypoxia and hypobaric hypoxia.

Learning Objectives

1. The audience will learn about physiologic responses to submaximal exercise identified in a mild hypobaric hypoxic environment.

2. The audience will learn about the methodologies used for metabolic data collection in a mild hypobaric hypoxic environment.

[402] EFFECTS OF MILD HYPOBARIC HYPOXIA ON VISUAL FIELD IMPAIRMENT

Monica Yayu Hew-Yang¹, Alejandro Garbino², Patrick Estep², Brett Siders³, Lichar Dillon⁴, Kadambari Suri¹, Constance Ramsburg⁵, Karina Marshall-Goebel⁶, Andrew Abercromby⁶

¹KBR, Houston, TX, United States; ²GeoControl Systems, Houston, TX, United States; ³Aegis Aerospace, Houston, TX, United States; ⁴University of Houston, Houston, TX, United States; ⁵U.S. Navy, Houston, TX, United States; ⁶NASA JSC, Houston, TX, United States

(Original Research)

INTRODUCTION: The primary objective of the Exploration Atmosphere (EA) study is to validate a new prebreathe protocol necessary before exposure to a suited hypobaric environment during extravehicular activity (EVA) from a habitat 'exploration atmosphere' of 56.5kPa (8.2 psia), 34% O₂, 66% N₂. Prebreathe protocols must be time and resource efficient while also controlling Decompression Sickness (DCS) risk to within acceptable limits. The habitat hypobaric exploration atmosphere also results in a mildly hypoxic environment (piO₂ = 128mmHg). As a secondary objective of the EA study, we characterized the effects of 11-day exposure to a mild hypobaric hypoxic environment on visual performance. **METHODS:** Two, 11-day hypobaric chamber tests were performed (EA-1 and EA-2, n=8 each) in NASA's 20-foot chamber at Johnson Space Center where subjects lived in the exploration atmosphere. Subjects also underwent simulated 6-hour EVAs at 85% O₂ and 29.6 kPa during EVA on days 3, 5, 7, 9, and 11. Visual acuity (VA), a measure of spatial resolution, and contrast sensitivity (CS), a measure of ability to distinguish ever finer increments of brightness, were assessed on non-EVA days by using gapped Landolt C testing. The luminance was controlled by using a booth, a light monitor, and a lighting rheostat. EA-1 data had revealed problems in lighting control impacting consistency of the data. Procedures were subsequently updated for the EA-2 test. **RESULTS:** EA-1 data revealed large variance and data recording errors and was removed from the analysis. One participant left the study at Test Day 3 during EA-2. EA-2 ANOVA results showed CS (mean change=0.010 logCSWeber) and VA (mean change, -0.016 logMAR) between pre-test and 11-day test phases; however, neither VA nor CS changes were statistically significant. There were non-statistically significant declines in VA across test phases. **DISCUSSION:** Overall, visual field performance did not exhibit clinically significant changes (3 lines or greater change in LogMar chart) during exposure to the mild hypoxic exploration atmosphere environment compared to pre-test baseline. The consistency and stability of VA data during EA-2 suggests that the mild hypobaric hypoxic environment did not cause clinically significant negative impacts to participants' visual field performance.

Learning Objectives

1. The audience will learn about the EFFECTS OF MILD HYPOBARIC HYPOXIA ON VISUAL FIELD IMPAIRMENT.
2. The audience will learn about the NASA Exploration Atmosphere's MILD HYPOBARIC HYPOXIA IMPACT ON VISUAL FIELD IMPAIRMENT.

[403] KETAMINE FOR ACUTE SUICIDALITY AND APPLICABILITY IN EXPLORATION SPACEFLIGHT MISSIONS

Charles H. Dukes¹, Amit M. Mistry², Craig J. Kutz³

¹UTMB, Human Health and Performance Contract, NASA, Houston, TX, United States; ²Veterans Affairs, Oklahoma City, OK, United States; ³UTMB, Galveston, TX, United States

(Original Research)

INTRODUCTION: The transition to exploration missions places a heightened risk on behavioral health and performance in spaceflight

crew. Isolation in extreme environments, such as Antarctica or Greenland, have provided key insights into behavioral challenges such as confinement, increased autonomy, distance from family, and psychosocial stressors. Although serious psychiatric emergencies during spaceflight have been rare, long duration missions increase possibility of genetic predisposition to mental illness, grief, isolation, helplessness, loss of child or family member, or catastrophic events. Complicated grief and bereavement are associated with the highest rate of suicidal ideation. In recent years, ketamine is increasingly used as an emergent intervention for acute suicidality, promoting its stability, ease of administration, safety profile, and outcomes for reduction of suicidal intent. The goal of this study was to review current literature and collate the understanding of ketamine as a safe, effective pharmacological adjunct for acute suicidality in spaceflight. **METHODS:** This retrospective review of published literature was conducted to gather data related to ketamine use for acute suicidality. In addition, this review gathered information on stability, limitations and utilization of ketamine within extreme environments. **RESULTS:** 55 publications were reviewed for relevance including at least 18 randomized-control trials for ketamine use in behavioral emergencies. **DISCUSSION:** Ketamine is a diverse pharmacologic agent with multiple advantageous indications, including acute suicidality, pain, and sedation. Terrestrial use of ketamine in emergent acute suicidal ideation suggests a rapidly efficacious medication for reduction in mortality, morbidity, and functional impact. Including a multifaceted pharmaceutical in future long-duration mission formularies offers optimization of vehicle storage and expands indications for use with a favorable safety profile. As behavioral stressors expand related to extreme isolation and extended missions, contingencies for suicidal ideation and serious behavioral emergencies become increasingly important to recognize. Although this review is not intended to re-develop current ISS intervention strategies, it is the first to discuss the benefits of ketamine in spaceflight as a potential safe, effective multifaceted tool for future exploration missions and in particular, as a treatment for acute suicidal ideation.

Learning Objectives

1. The audience will gain an appreciation of the current literature on terrestrial ketamine use in acute suicidality.
2. The audience will gain an understanding for consideration of ketamine as a possible safe, multifaceted pharmaceutical intervention in spaceflight.
3. The audience will gain an understanding of key features of extended duration, exploration missions that increase the possibility of a behavioral emergency, such as acute suicidality.

[404] SPACE SUPPERS AND COSMIC CULTURES: A CULINARY ODYSSEY

Kendall Howie, Melinda Hailey, Lindsey Hieb, Chuyan Chen
Axiom Space, Houston, TX, United States

WITHDRAWN

Wednesday, 05/08/2024
Grand Suites 2 & 3

2:00 PM

[S-70]: POSTERS: HYPO/HYPER/ TRAINING/FATIGUE

Chair: Jaime Harvey
Co-Chair: Rachelle Lang

[405] BUBBLES AND TROUBLES: DECOMPRESSION SICKNESS IN USAF UNDERGRADUATE NAVIGATOR TRAINING

Arran Ponte, Chenoa Gentle
U. S. Air Force, Colorado Springs, CO, United States

(Education - Case Study)

INTRODUCTION: This case study describes a recent Decompression Sickness, DCS, case and investigation following an altitude chamber flight and rapid decompression, RD, at Peterson SFB Aerospace Physiology Training Unit, APTU. **BACKGROUND:** Aerospace Physiology units utilize hypobaric chamber training in accordance with AFMAN 11-403 for hypoxia familiarization and to demonstrate physiological effects of pressure changes during slow and rapid decompressions. Flight profiles contain three main segments: a 30-minute prebreathing period of 100% oxygen, a slow decompression hypoxia exposure at FL250 and a RD meeting 4.5 psi differential in barometric pressure. A subsequent risk of these flights is DCS. **CASE PRESENTATION:** Twenty-two-year-old male Undergraduate Navigator student called Peterson's APTU 15 hours post-hypobaric training, to report difficulty breathing, dry cough, pressure and pain in the lungs, and an air bubble feeling in the throat. The student had no history of poor health and held a current Flight class II physical. Symptom onset began after attending dinner in the Cripple Creek area of Colorado Springs at an altitude of 9,500ft MSL. In accordance with hypobaric training emergency procedures, the student was sent to the closest hypobaric therapy treatment center at the UC Health Memorial Hospital. The hyperbaric physician diagnosed the student with a mild case of pulmonary DCS and treated with a USN Treatment Table 5. Student's symptoms subsided and returned to flight after 72 hours with approval of flight surgeon. **DISCUSSION:** Peterson's APTU has a field elevation of 6,200ft MSL, making it one of the highest hypobaric chambers in the world, putting students and crew at a greater risk for DCS. A thorough investigation of this case found that the RD profile exceeded the required 4.5 psi differential due to miscalculating field elevation in relation to psi differential requirements. Flight profile was corrected so that the 4.5 requirement was met. From 2018-2023 Peterson's APTU observed 13 DCS cases throughout 759 chamber flights and 309 RDs: equating to a 1.71% flight and 4.21% RD rate of DCS. Statistical analysis projects a 20% decrease in DCS cases over the next 5 years to experience under 10 cases in the anticipated 660 flights and 269 RDs.

Learning Objectives

1. Individuals can identify how and why DCS may occur and understand risk associated in hypobaric environments.
2. Audience will understand pressure differentials and the physiological impact in flight.
3. Learn about hypobaric training profiles, risks, and requirements for USAF Undergraduate Navigators.

[406] G-LOC DUE TO THE PUSH-PULL EFFECT ON A MILITARY FIGHTER PILOT DURING AIR COMBAT MANEUVERS

Michael Nehring, Helmut Fleischer

German Air Force Centre of Aerospace Medicine, Koenigsbrueck, Germany

(Original Research)

INTRODUCTION: This case report describes a G-LOC due to a push-pull-effect (PPE) on a Eurofighter pilot performing intercept maneuvers. The thermal burden and dehydration were aggravating factors. **BACKGROUND:** The push-pull-effect (-Gz to +Gz transition) is of great operational relevance. Blood pressure and heart rate respond to sudden changes of gravity. A reduced +Gz-tolerance is the result. Push-pull-manuevers were associated with approximately 30% of the G-LOC events. **CASE PRESENTATION:** Due to a high administrative workload, the pilot (31-year-old male) had no time for lunch and sufficient hydration. The outside temperature was 86° F and the air conditioning of the building was insufficient. On his second flight of the day, the pilot was practicing intercept maneuvers with his wingman. In preparation for the next intercept, he intended to turn the switch for the harness lock into the lock position but inadvertently he turned off the G-protection system. He turned into an inverted flight for 9 seconds with a maximum of -1.5 Gz. The altitude decreased to 21,600 ft. His wingman was flying at 16,000 ft

and the pilot started the intercept maneuvers with a g load of 6.1 Gz. At 17,400 ft, the positive G exposure stopped and the aircraft descended unexpectedly in a nearly vertical flight. In accordance with the investigation report, the stick had been in the center position for 11 seconds without any input. One second after the voice warning "pull up", the pilot tried to recover the situation with maximum stick input (9.1 Gz). The minimum altitude at this maneuver was 3,520 ft. The pilot was able to stabilize the aircraft and declared an in-flight emergency as a "physiological incidence" and returned safely to the air base. The amnesia in combination with the lack of stick activity suggests that the pilot fell into G-LOC. **DISCUSSION:** Military pilots are aware of the risk of +Gz exposure. The risk of the PPE significantly to reducing the pilot's Gz- tolerance is not well known among high-performance aircrew. As a matter of principle, aeromedical training shall include educating pilots about the harmful effects of push-pull-maneuvers. Contributing factors like thermal heat stress and dehydration have a negative impact on Gz tolerance and should be addressed to flight personnel. Aircrew should be reminded not to rely entirely on the G-protection system as it sometimes does not work, like in this case where the G valve was inadvertently turned off.

Learning Objectives

1. The audience will learn about the harmful effects of push pull maneuvers.
2. The audience will learn about the importance of aeromedical training.

[407] ARE ARMY AVIATORS TRULY MORE "PHYSIOLOGICALLY FIT" THAN THE GENERAL POPULATION? A RETROSPECTIVE ANALYSIS.

Matthew D'Alessandro¹, Ryan Mackie¹, Samantha Wolf¹, James McGhee², Ian Curry¹

¹U. S. Army Aeromedical Research Laboratory, Fort Novosel, AL, United States;

²Department of Aviation Medicine, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: Aviators are required to maintain a level of physiological fitness as part of their qualifying process, which suggests that they are generally physically healthy. However, it has not been statistically proven that they are more "physiologically fit" than the general population. Even though Army Regulation (AR) 40-501, chapter 4 and the U.S. Army Aeromedical Policy Letters are based on aeromedical subject matter expertise and research outcomes, to our knowledge, a recent, large-scale evaluation assessing the physiological parameters of aviators has not been performed. This analysis is imperative to keep policy makers informed about the current physiological well-being of our aviators. **METHODS:** Our retrospective study compared the physiological metrics of 24,259 Army aviators from the AERO database to 12,001 individuals from the NHANES database representing the general US population. The aviators and general population were grouped by age (16-25, 26-35, 36-45, 46-55 years) and biological gender (male, female) for analysis. Physiological variables assessed included pulse, blood pressure, hematocrit, hemoglobin, lipids, glucose. **RESULTS:** Male aviators had lower pulse rates than the public (ages 26-55, $p < 0.05$). Females had lower pulses across ages ($p < 0.05$). Aviator blood pressure was higher than the public until age 45 ($p < 0.01$), then lower. Male aviators aged 46-55 had higher hemoglobin/hematocrit ($p < 0.01$). Females aged 16-45 also showed higher levels ($p < 0.01$). Male aviators aged 16-25 exhibited higher total cholesterol ($p = 0.013$) and LDL ($p < 0.001$) than the public. Females aged 16-25 had lower total cholesterol ($p = 0.024$). HDL was higher in aviators across most groups ($p < 0.05$). Cholesterol/HDL ratios were lower in aviators for most groups ($p < 0.01$). Glucose was lower in all aviators ($p < 0.001$). **DISCUSSION:** While aviators displayed physiological superiority in some categories, they did not supersede the general population across the board. This indicates a nuanced link between aviation and overall fitness. Targeted monitoring and maintenance programs based on flight physicals and additional monitoring initiatives could better optimize aviator health. Future research should explore additional factors like mental health, sleep, diet for a comprehensive picture of aviator well-being.

Learning Objectives

1. Compare aviator physiology versus the public to help guide policy.
2. Evaluate the targeted health initiatives for aviators based on assessments.

[408] EFFECTS OF ACUTE NORMOBARIC HYPOXIA ON SENSORY AND COGNITIVE PROCESSING

Kiersten Weatherbie, Julia Milo, Kara Blacker

Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Hypoxia impairs cognition and remains a relevant potential threat in military aviation. Developing non-invasive, in-flight sensors to detect hypoxia is critical in preventing physiological-related occurrences. This study validates the use of whether neural markers, the mismatch negativity (MMN) and P3a, and cognitive performance are sensitive to a mask-off acute normobaric hypoxia exposure. **METHODS:** Thirty-one males participated in a repeated-measures, single-blind study. The protocol was approved by the NAMRU-D IRB. There were two visits: a normoxic exposure (21% O₂) and a hypoxic exposure (10.6% O₂), each lasting up to 45 minutes within a normobaric hypoxia chamber. For each exposure, participants completed five blocks of cognitive tasks (Psychomotor Vigilance Task [PVT], Change Signal Task [CST], and Digit Symbol Substitution Task [DSST]) while EEG and physiological measures were recorded; the MMN/P3a was elicited via an auditory oddball paradigm. All variables were analyzed using a 2 (exposure) × 5 (block) ANOVA. **RESULTS:** For reaction time (RT) on the PVT, a significant main effect of exposure emerged, $p = .002$, whereby RT was slower during hypoxia compared to normoxia. For both the CST and DSST, we saw no significant changes in performance associated with the two exposures. For EEG, there was no difference in MMN amplitude between exposures, but there was a significant reduction in the P3a amplitude during hypoxia compared to normoxia, $p = .005$. For the MMN to P3a peak-to-peak amplitude, the exposure × block interaction was significant, $p = .01$, whereby the reduction in amplitude for hypoxia became more pronounced as the exposure duration increased. **DISCUSSION:** Decreased vigilance performance and impaired underlying sensory processing is strongly evident following a 45 min acute hypoxic exposure. These findings support the need for future developments of non-invasive in-flight O₂ sensors to include neurophysiological monitoring. Furthermore, these results suggest ways to improve hypoxia familiarization training by teaching aircrew about the extent to which different functions are impaired during hypoxia.

Learning Objectives

1. Address the need to develop non-invasive, in-flight sensors for aerospace medical threats.
2. Understand how hypoxia impairs performance on a neural, cognitive, physiological, and behavioral level.

[409] EFFECTS OF BREATHING RESTRICTION, HYPEROXIA, AND HYPOXIA ON NEUROCOGNITIVE FUNCTION

Cammi Borden, Frank Robinson, Stephanie Warner,

Kara Blacker

Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Respiratory challenges continue to be a concern in the military aviation community. The DoD is actively pursuing in-flight monitoring technology to alert aircrew to the presence of dangerous respiratory conditions and to detect impairments. Previous work has demonstrated that cognitive and sensory processing are disrupted during hypoxia. Unfortunately, various causes of breathing restriction are not mutually exclusive, nor are breathing restrictions the only

respiratory threat. This study examined the effects of different types of breathing challenges on neurocognitive functioning. **METHOD:** In this repeated-measures, single-blind design, 29 healthy adults completed four sessions. Each session had 3 phases: baseline, exposure, and recovery. For baseline and recovery, participants always breathed 65% O₂ at standard breathing regulator inlet pressure (25 psi). The exposure phase manipulated either O₂ concentration (9.7%) or inlet pressure (25 psi with added downstream resistance or 4 psi). All breathing conditions were controlled by the hypoxia ventilatory research device and delivered to the participant via a CRU-103 regulator and MBU-20/P flight mask. For each session participants performed a reaction time (RT) task while EEG was recorded in response to auditory stimuli. Participants reported hypoxia symptoms afterwards via questionnaire (HSQ). The study protocol was approved by the NAMRU-D IRB. Data were analyzed using 3 (phase) x 4 (condition) repeated-measures ANOVAs. **RESULTS:** For RT, the condition x phase interaction was significant, $p < 0.05$, whereby RT was slower for the hypoxia compared to hyperoxia conditions during exposure and recovery phases. For the HSQ, the main effect of condition was significant, $p < 0.001$, whereby participants reported more symptoms during hypoxia compared to hyperoxia. Inlet pressure had no detectable effect on HSQ score or RT. Our EEG measures did not show a significant difference with respect to condition. **DISCUSSION:** Our results illustrate a negative impact of hypoxia on RT and the frequency and severity of symptoms compared to hyperoxia. However, we saw no significant effect of inlet pressure on these measures. This suggests that breathing restriction (within the parameters tested here) itself may not have a meaningful effect on neurocognitive function.

Learning Objectives

1. The audience will learn the different effects various breathing restrictions have on physiological, cognitive, behavioral, and sensory performance.
2. The audience will learn about the time course of neural responses from various breathing restrictions in cockpit-like breathing environments.

[410] PRELIMINARY EXAMINATION OF EYE MOVEMENT IN PILOTS DURING DIFFERENT FLIGHT SCENARIOS AND WORKLOAD CONDITIONS

Frank Robinson¹, Nicklaus Fogt², Dain Horning¹, Ryan Everidge³, Gary Ellis³, Nathaniel Spencer³, DeAnne French³

¹Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States; ²Ohio State University/ORISE, Columbus, OH, United States;

³Naval Medical Research Unit - Dayton/Leidos, Wright-Patterson AFB, United States

(Original Research)

INTRODUCTION: Spatial disorientation (SD) is one of the leading causes of serious mishaps in military aviation. Most training to reduce the likelihood of SD is delivered in a lecture-based format with little opportunity for students to practice risk mitigation strategies. We are developing an interactive SD countermeasures training tool to provide students the opportunity for such practice. We intend to identify attention allocation behaviors that predict the risk of becoming disoriented in simulated flight scenarios. We will then develop a training program to encourage students to mimic the attentional strategies of people who successfully avoid SD. We report here on our efforts to identify such strategies.

METHODS: Nine qualified pilots flew four different flight scenarios in a fixed-base flight simulator. Participants experienced scenarios related to the black hole illusion, a sloping cloud deck, and two fixed horizon illusions. Each scenario was conducted under three levels of workload: low (no secondary task), medium (an added working memory task), and high (a more frequent working memory task or a visual search task paired with the "medium" working memory task). All combinations of scenario and workload were repeated three times, for a total of 36 flights. Eye movements were captured using a SmartEye system. **RESULTS:** We observed a significant interaction such that the percentage of time spent

looking at each instrument depended on the type of instrument and the scenario being flown ($F(90, 9602) = 208.57, p < 0.001$). We also observed a significant interaction such that the percentage of time looking at each instrument depended on the type of instrument and the workload imposed ($F(60, 9602) = 29.58, p < 0.001$). Flight path error in the black hole illusion scenario increased at high workload ($t(8) = -2.51, p = 0.02$).

DISCUSSION: These results indicate that our flight scenarios induced different demands on the pilots and that our workload manipulation was effective at altering scanning behaviors and flight performance. We continue to collect new data and conduct analyses to identify eye movement tendencies that predict the occurrence of SD in each scenario at different levels of workload.

Learning Objectives

1. Participants will understand how different flight scenarios lead to different scanning behavior.
2. Participants will learn how various changes in workload can affect scanning behavior.

[411] AID TO THOSE IN NEED: ONLINE-BASED NON-INVASIVE NEUROCOGNITIVE INTERVENTION FOR PILOTS WITH AEROMEDICALLY SIGNIFICANT TEST RESULTS

John Milanovich

MindMatters Neuropsychology & Optimal Aviation, Ann Arbor, MI, United States

(Original Research)

INTRODUCTION: Each year thousands of pilots are required to undergo neuropsychological evaluation, often due to a history of alcoholism (HIMS), CVA, TBI, MCI, SSRI use, or ADHD. Of these pilots, it is estimated 18 to over 30% are found to have some form of impairment that grounds them indefinitely. **METHOD:** An online, coached, fee-based cognitive training (CTr) program was examined in 192 pilots residing across the United States, following identified deficiencies by their HIMS neuropsychologist (NP). The 6 to 8 week CTr program included customized assembly of exercises with weekly management and feedback by a trained instructor via email; no exercises resembled presenting stimuli found in NP tests; no office visits were made. Target Training Levels (TTL's) were developed to identify pilots who were likely to be found normal upon follow-up NP re-evaluation (NPre), using composite z-scores from proprietary training data (PTD) and an online aviator cognitive assessment battery (OA Assess). **RESULTS:** Of 77 pilots reporting NPre results, 74% passed. One-way MANOVA indicated final PTD and OA Assess scores significantly predicted NPre results [$F(1,30)=4.97, p=.014; Wilks \Lambda=.746$]; significance was lost when pre-training baseline OA Assess scores were used ($p=.053$). Post-training PTD and OA Assess cut-off scores to establish TTL's were best fit at $z=.77$ and $z=1.46$ above non-aviator means, respectively. Logistic regression indicated combined PTD and OA Assess scores best predicted whether or not a pilot would pass NPre, with 87% accuracy [$df(30) \Delta\chi^2=5.67, p=.017$]. Chi-square analyses indicated pilots who reached combined TTL's had an 88% chance of passing their NPre, while those that did not reach TTL's had a 33% chance of passing ($\chi^2=7.41, p=.006$); the OA Assess TTL alone was less robust but still acceptable ($p=.024$).

DISCUSSION: Structured, coached CTr is an effective online-based intervention for use in pilots with neurocognitive deficiency. In addition to strengthening abilities important to flight performance and safety, the program reliably and accurately predicted which pilots would likely succeed in passing far more expensive neuropsychological evaluations, which could reduce personal and organizational costs while hastening return to duty or training. Past CTr studies showed lasting effects and in the aviation environment CTr appears far more appropriate than neurofeedback, direct electrical stimulation, and traditional cognitive rehabilitation.

Learning Objectives

1. Participants will become aware of the need for non-invasive, easily accessible neurocognitive interventions in pilots with known or suspected declines in mental sharpness or abilities.

- Participants will identify components of online CTr important to a pilot's success.
- Participants will understand the potential to strengthen cognitive functions in a reliable, long-lasting way that generalizes to neurocognitive testing and daily activities alike.

[412] A NOVEL APPROACH TO SELECTION: ONLINE COGNITIVE ASSESSMENT OUTPERFORMS TRADITIONAL MEANS IN IDENTIFYING THE "BEST OF THE BEST" AND THE "LEAST BEST"

Brian Neff¹, Thomas Schaner², John Milanovich³

¹Kent State University, Stow, OH, United States; ²FlightSafety International, Columbus, OH, United States; ³MindMatters Neuropsychology & Optimal Aviation, Ann Arbor, MI, United States

(Original Research)

INTRODUCTION: Pilots in training, as well as new hires, must not only cope with learning a tremendous amount of novel information on an ongoing basis, but also demonstrate proficiency with applying said information in the cockpit. While traditional means of pilot selection have been of benefit to aviation schools and airlines alike, some pilots predicted to be efficient in moving through programs do not live up to expectations. **METHODS:** This study examined the efficacy of a novel, Online Aviator Cognitive Assessment tool (OA Assess) to predict the number of hours required to complete flight training in 17 aviation student volunteers attending Kent State University, a part 141 program. High school GPA, ACT/SAT scores, academic skill rankings in organization, reading, math, and writing, current college GPA, and years in college were also examined for comparison purposes. **RESULTS:** Correlation matrix analysis indicated significance between the OA Assess and TOTAL number of flight hours required through commercial rating ($r=-.85$, $p=.033$), as well as hours to solo ($r=-.90$, $p=.015$) and obtain a PPL ($r=-.668$, $p=.035$); it also predicted final IFR checkride scores ($r=.74$, $p=.006$) and hours required to complete the final CFI course ($r=-.99$, $p=.036$); it was not correlated with the commercial phase itself ($r=-.37$, $p=.363$). The modified OA Assess z-score was 106 for the top 50% of students, compared to a score of 11 in the bottom 50%. The OA Assess showed significance in 6 out of 7 (85.7%) main comparisons while all other pilot selection variables showed significance in 4 out of 63 (6.3%) combined, with none seen multiple times. **DISCUSSION:** While grades, standardized test scores, and academic skills have been factors used to judge an aspiring pilot's potential, the cognitive assessment tool used here (OA Assess) was far superior to predicting actual time in the cockpit likely required to complete flight training. Directly examining underlying cognitive capacities critical to flight performance and safety, including processing speed, working memory, and executive controls can assist pilots and programs alike with selection-based decision-making in easily accessible, online platforms. Students or new hires with relatively lower "aviator cognition" can be easily identified and may benefit from reliable cognitive training exercises to improve their capacities, before or during training or transitions, thereby potentially reducing both personal and organizational costs.

Learning Objectives

- Participants will become aware of a novel approach to pilot selection that appears more effective than traditional approaches.
- Participants will learn about novel ways to understand pilots' actual performance in the cockpit as related to brain functioning, defining the term "Aviator Cognition".
- Participants will understand the limitations of traditional approaches in lieu of the OA Assess tool (aviator cognition) that readily discriminates between those that are likely to require less hours in the cockpit to complete training or transitions.

[413] EFFECT OF TRANSIENT CEREBRAL HYPOPERFUSION ON EVENT-RELATED POTENTIALS FOR SPATIAL STIMULUS-RESPONSE COMPATIBILITY

Keita Ishibashi

Chiba University, Chiba, Japan

(Original Research)

INTRODUCTION: Adequate cerebral blood flow (CBF) perfusion is crucial to maintaining brain function and performance. This study aimed to determine event-related potentials (ERPs) related to a spatial stimulus-response compatibility (SRC) task under transient cerebral hypoperfusion caused by oscillatory lower body negative pressure (OLBNP). As chronic cerebral hypoperfusion has been associated with decreased ERP amplitude and slower reaction time, we hypothesized that fluctuations in CBF perfusion may also affect ERP amplitude and task performance. **METHODS:** The sinusoidal pattern of an 18-sec period (0.056 Hz) of OLBPN at 0 ~ 40 mmHg was used to induce transient cerebral hypoperfusion. We measured ERPs for the SRC task and CBF velocity (MCAv) during three 10-min OLBPN (33 cycles of 18-sec periods) and two 10-min control (no-OLBNP) sessions in 9 male subjects (average age, 23.3). Changes in cerebrovascular variables, ERP and task performance data during OLBPN were evaluated in three phases (Phase1: 0 ~ 6 sec, Phase2: 6 ~ 12 sec, and Phase3: 12 ~ 18 sec). The study protocol was approved in advance by the Research Ethics Committee of the Chiba University Graduate School of Engineering [R4-15]. **RESULTS:** One-way repeated-measures analysis of variance (ANOVA) and post-hoc comparison revealed that MCAv decreased significantly in Phase1 and 2 compared to the control and Phase3 ($F(3, 24) = 14.48$, $p < 0.001$). ANOVA also revealed that spatially incompatible stimuli caused significantly increased ERP amplitude ($p < 0.001$) and response times ($p < 0.001$) compared with spatially compatible stimuli. However, we found no significant effect of OLBPN on ERPs or task performance. **DISCUSSION:** Our data demonstrate that OLBPN causes CBF perfusion to fluctuate and that spatial stimulus compatibility affects ERPs and task performance. However, the relationship between fluctuations in CBF perfusion and ERPs and task performance remains unclear. The present results may suggest that a certain robustness of brain function to fluctuations in CBF.

Learning Objectives

- This study introduces OLBPN as a method to cause fluctuations in CBF with high reproducibility.
- We also found that changes in brain function during OLBPN are not apparent through task performance.

[414] A VALIDATION OF TASK DEMAND LEVEL TRAINING PROCEDURES IMPLEMENTED IN THE U.S. ARMY AEROMEDICAL RESEARCH LABORATORY MULTI-ATTRIBUTE TASK BATTERY

Jon Vogl, Charles McCurry, Sharon Bommer, Leonard Temme
U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: The Multi-Attribute Task Battery (MATB) is a classic aviation-like multitasking simulation platform that has amassed a rich history in performance assessment literature since its creation in 1992. Recently, the United States Army Aeromedical Research Laboratory (USAARL) has modified the traditional MATB to feature the classic task battery with upgraded features that meet the needs of current research trends in cognitive workload assessment, adaptive automation, and performance modelling. **METHODS:** The four subtasks used within the USAARL MATB were designed to mirror aviation tasks performed by pilots, including system monitoring, communications, compensatory tracking, and resource management. Ten unique task demand levels

were designed to control the event rates of the four subtasks across a spectrum of increasing demand. Twenty-four subjects were trained in the performance of the USAARL MATB using a stepwise approach, increasing demand levels until they were unable to maintain at least a 75% average score across all subtasks during a five-minute simulation. The final demand level reached with a passing score was administered in four sequential ten-minute simulation sessions during a second laboratory visit. **RESULTS:** Multitasking performance was assessed through percentage of time loaded by discrete subtask events (i.e., system monitoring and communications subtask events). Multitasking performance across subjects remained consistent between measurements, showing no significant differences (Task Load (TL)0: $p = 0.783$; TL1: $p = 0.956$; TL2: $p = 0.217$; TL3: $p = 0.627$). Across demand levels, multitasking performance did show significant differences (TL0: $p < 0.001$; TL1: $p < 0.001$; TL2: $p = 0.004$; TL3: $p = 0.033$), indicating a progressively increased multitasking load with higher demand levels. **DISCUSSION:** The USAARL MATB is poised to serve as an adaptable tool to face the challenges put forth by modern research trends in the fields of aerospace medicine and human performance. Offering unique control of dynamic task demand shifts, automation implementation, and data synchronization, the USAARL MATB allows for quick turnaround laboratory studies. The data collected in this study offers support for the training procedure and demand level event rate values included in the USAARL MATB program. The USAARL MATB software is available to be shared with collaborating institutions.

Learning Objectives

1. The audience will understand the historical development of the MATB program and the motivation behind the desired functionality changes.
2. The audience will be able to identify how current research trends can leverage the custom design nature of the USAARL MATB platform in their research.

[415] ANALYSIS OF PHYSIOLOGICAL CHANGES AND HYPOXIA SYMPTOMS DURING THE HYPOBARIC CHAMBER TRAINING

Chung-Yu Lai¹, Kuo-Kuang Jen², Shang-Ju Wu², Nian-Shen Chen², Shih-Yu Lee¹, Hao Su³, Fang-Ling Li⁴, Chung-Yu Liao¹, Shih-En Tang¹, Chien-Lin Kuo⁵

¹National Defense Medical Center, Taipei City, Taiwan, Greater China; ²National Chung-Shan Institute of Science and Technology, Taoyuan City, Taiwan, Greater China; ³The 4th Tactical Fighter Wing of ROCAF, Chiayi City, Taiwan, Greater China; ⁴Tri-Service General Hospital Beitou Branch, National Defense Medical Center, Taipei City, Taiwan, Greater China; ⁵Aviation Physiology Research Laboratory, Kaohsiung City, Taiwan, Greater China

(Original Research)

INTRODUCTION: Military aircrew must familiarize personal hypoxia symptoms before the flight training. Existing research is limited in its description of the dynamic physiological changes and hypoxia symptoms. Therefore, the primary objective of this study is to examine the relationships between the cardiac data, hypoxia symptoms, and tolerance time. **METHODS:** This retrospective study was carried out between July 1, 2022, and August 31, 2023. Subjects were army, navy, and air force aircrews that underwent an initial aviation physiological course in Taiwan. Data on the time of useful consciousness (TUC), blood oxygen saturation levels, and individual hypoxia symptoms every minute at a simulated altitude of 25,000 feet were obtained from the training document. The analysis of the data was conducted using the statistical software SPSS 24.0. **RESULTS:** This study included a total of 102 subjects from the army, navy, and air force. Their average age was 23.8 ± 2.1 years, with an average body mass index of 23.0 ± 2.5 kg/m². The mean TUC at an altitude of 25,000 feet was 3.7 ± 0.9 minutes. The blood oxygen saturation level started at 86.7% in the first minute and noticeably dropped in the second minute (68.0%). By the third minute, it had decreased to 58.3%, followed by a gradual decline from the third to the sixth minute. At the end of the first minute, subjects with a TUC of less than three minutes had an average blood oxygen saturation of

$83.1 \pm 8.6\%$, which was slightly lower when compared to those with a TUC of three minutes or more ($87.4 \pm 7.9\%$). Around 20% of trainees displayed the hypoxia symptoms within the initial minute. Main symptoms during the first minute included hot flushes (10.9%) and dizziness (5.0%). Subjects with TUC less than three minutes had a higher proportion (17.6%) of experiencing dizziness symptoms within the first minute. **DISCUSSION:** In this study, we presented the variations in blood oxygen saturation and the occurrence of hypoxia symptoms at one-minute intervals during the chamber flight. In addition, we conducted a comprehensive analysis to establish the correlations between the physiological responses, prominent symptoms, and hypoxia tolerance. These findings hold significant value in the development of a real-time monitoring system and the improvement of the training safety measures.

Learning Objectives

1. To understand the dominant hypoxia symptoms during the hypobaric chamber training.
2. To compare the changes in oxygen saturation between the different TUC groups.

[416] INDIVIDUAL VULNERABILITY TO HYPOXIA: THE HMOX2 POLYMORPHISM CONTRIBUTES TO THE CAROTID BODY CHEMOREFLEX BY REGULATING HYPOXIC VENTILATORY RESPONSES.

Pierre Fabries¹, Catherine Drogou¹, Danielle Gomez-Merino¹, Fabien Sauvet¹, Olivier Nespoulous¹, Benoit Lepetit¹, Marie-Claire Erkel¹, Anne-Pia Hamm-Hornez², Alexandra Malgoyre¹, Nathalie Koulmann³, Mounir Chennaoui¹

¹French Armed Forces Biomedical Research Institute - IRBA, Brétigny-sur-Orge, France; ²Aeromedical Center - CPEMPN, Clamart, France; ³Military Health Academy - Ecole du Val-de-Grâce, Paris, France

(Original Research)

INTRODUCTION: During flights, pilots and crew are exposed to altitude hypoxia. It causes physiological responses (the first is hyperventilation) and can cause incapacities with flight safety impact. This varies depending on both extrinsic and intrinsic factors. Recently, a functional genetic polymorphism in Heme oxygenase-2 (*HMOX2*, rs4786504_T>C), an essential enzyme in heme catabolism, has been associated with high-altitude adaptation in Tibetans. In carotid body, heme oxygenase-2 is sensitive to oxygen availability and mediates the hypoxic response inducing increased breathing, which is different between individuals and linked to tolerance. We hypothesized that *HMOX2* polymorphism influenced the chemosensitivity related to hypoxic ventilatory response (HVR) in Caucasians. **METHODS:** HVR ($\text{FiO}_2 = 0.115$) was measured at rest and exercise (30% maximal oxygen uptake) (the Richalet's test) in 84 healthy male and female volunteers. Among chemosensitivity parameters, HVR at exercise (HVR_e) is considered the best independent predictor of high altitude hypoxia tolerance. Low chemoresponsiveness is defined when $\text{HVR}_e < 0.78 \text{ L}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$. The LAMP-MC technology was used to determine *HMOX2* polymorphism. To test genotype-phenotype associations with *HMOX2* (two modalities, T/T-C/T vs. C/C genotypes), we used the student's t-test and a Chi-square analysis. This study was approved by CPP SUD MEDITERRANEE III. **RESULTS:** 47.6% homozygous C/C (n=40), 41.7% heterozygous C/T and 10.7% homozygous ancestral T/T (n=44). HVR was significantly higher for C/C subjects than for T allele carriers at rest (0.78 ± 1.16 versus $0.38 \pm 0.405 \text{ L}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$ respectively, $p = 0.043$, $F = 4.22$) and exercise (0.736 ± 0.470 versus $0.534 \pm 0.426 \text{ L}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$, $p = 0.042$, $F = 4.36$). A high HVR_e was more frequent in subjects carrying C/C polymorphism versus T allele ($p = 0.002$, OR = 5.2 [1.69; 16.03]). **DISCUSSION:** In our population, there is a significant association between *HMOX2* polymorphism and chemosensitivity evaluated by HVR. Although significant, this finding must be confirmed in larger samples. This could help to better understand the role of genetic factors in chemosensitivity, the first step in the hypoxia response, in order to provide personalized recommendations and countermeasures.

Learning Objectives

1. Identify vulnerability factors to hypoxia from the first step of detection by carotid body chemoreceptors.
2. Understand the role played by genetic factors involved in chemosensitivity.

[417] THE INFLUENCE OF WORKING MEMORY AND RELAXATION TRAINING ON THE COGNITIVE AND OPERATIONAL EFFICIENCY OF JET PILOTS

Michal Janewicz¹, Hanna Bednarek²

¹Military Institute of Aviation Medicine, Warsaw, Poland; ²SWPS University, Warsaw, Poland

(Original Research)

INTRODUCTION: A useful way to improve jet pilots' efficiency and cognitive functioning was sought. This work attempts to check whether daily, adaptive working memory training or relaxation training using the autogenic method can be effective in improving the cognitive and operational efficiency of pilots. Both high efficiency of working memory and the ability to achieve a state of relaxation are important for the proper performance of military operations and the daily functioning of airmen. Especially during military operations, the tasks performed are extremely cognitively demanding and can cause a lot of stress. **METHODS:** In the main study involving airmen, 44 male and female MiG-29 jet pilots were examined, including 41 men (93%) and 3 women (7%) aged 25–52 ($M = 34,550$; $SD = 7,164$). The average flight time on the MiG-29 aircraft was $M = 513,360$ hours; $SD = 379,060$ hours. The subjects were randomly assigned to three groups: (1) relaxation training group, $n = 15$ people (35.7%); 14 men (93.3%) and 1 woman (6.7%); (2) working memory training group, $n = 13$ people (33.3%); 12 men (92.9%) and 1 woman (7.1%) and (3) inactive control group, $n = 13$ people (31%); 12 men (92.3%) and 1 woman (7.7%). The efficiency of working memory, attention, resistance to +Gz and the level of +Gz were tested twice (in the pretest - posttest formula). Both in the pre-test and in the post-test, the pilots performed a number of aerial maneuvers using a centrifuge with a high +Gz - roll, loop and Immelmann maneuver. The simulator recorded changes in heart rate and +Gz in individual phases of flight. During the flight on the simulator, the scanning of the pilot's field of view was recorded using an eye tracker (SMI GLASSES). Between pre and posttest, subjects in the training groups performed training sessions at home. Pilots in the control group was inactive. **RESULTS:** Autogenic training was found to improve attentional functioning, specifically the speed of regaining attentional control under rapidly changing stimuli. After the WM training, there was an improvement in the concentration of visual attention. **DISCUSSION:** We conclude that both working memory training and autogenic training can be used to improve the cognitive and operational functioning of pilots flying the MiG-29 jet. It seems, however, that both trainings should be used complementarily during the standard training of military pilots. The observed regularities require further, in-depth research.

Learning Objectives

1. The audience will learn about the possibility to use relaxation and cognitive methods during jet pilot training program.
2. The participant will be able to see the scientific process of testing training methods in jet fighter pilot group.

[418] BODY COMPOSITION AS A PREDICTOR OF ISOMETRIC MID-THIGH PULL AND BACK EXTENSION ISOMETRIC HOLD PERFORMANCE IN STUDENT PILOTS

Michelle Jilek¹, Anthony Acevedo², Joshua Dorcheus¹, Zachary Zeigler², Stephanie Chayrez¹, Jared Blake¹, Christopher Parrott², Brittany Nores¹, Carolyn Price Moore¹, Ryan Scott¹

¹U.S. Air Force, Phoenix, AZ, United States; ²U.S. Air Force Contractor, Phoenix, AZ, United States

(Original Research)

INTRODUCTION: Air Force fighter pilots must be prepared for high-G and long-duration operations. Both mission sets demand optimal body composition, endurance, and strength. Unfortunately, lower back issues, such as pain and injury, are prevalent among fighter pilots, potentially compromising mission success, pilot safety, and long-term health. The purpose of this study is to determine if body fat (%BF) can serve as a predictive indicator of isometric mid-thigh pull (IMTP) and back extension isometric hold (BEIH) performance. This study aims to refine the utilization of %BF as an assessment tool and inform the development of more effective training programs. We hypothesize that a higher %BF will be negatively associated with IMTP and BEIH. **METHODS:** Student pilots (SPs) at Luke Air Force Base (males, $n = 195$, females, $n = 13$) completed their Aircrew Conditioning Program Assessment (ACPA) prior to the initiation of their formal B-Course training. %BF was determined through bioelectric impedance analysis (InBody 570), IMTP was assessed using force plates (VALD), and BEIH was measured via a glute ham raise. A linear regression model was employed to investigate the capacity of BF % to predict IMTP and BEIH performance ($p < 0.05$). This retrospective analysis was approved by the Air Force Research Laboratory Institutional Review Board. **RESULTS:** %BF was significantly and negatively correlated to both IMTP ($r = -.435$, $p < .001$) and BEIH ($r = -.886$, $p < .001$). %BF explained 19% ($p < .001$) of the variance on the IMTP scores with a beta coefficient of $-.425$ and 78% ($p < .001$) of the variance on the BEIH scores with a beta coefficient of $-.647$. **DISCUSSION:** These findings highlight the role of %BF as a predictive factor for back and lower body strength assessments, indicating that lower %BF is linked to superior IMTP and BEIH performance. Ultimately, %BF may be used to enhance pilot evaluation and training, therefore aiding in mitigating injury, career longevity, and flight safety. Further research is warranted to delve into the underlying mechanisms of this relationship and explore potential interventions.

Learning Objectives

1. The role body composition plays in assessing pilot's ability to perform performance testes.
2. A lower body fat percentage is a strong predictor of better lower body strength and back endurance.

[419] FATIGUE, CONCENTRATION, AND RESPONSIVENESS OF AIR CREW MEMBERS ON (ULTRA-)LONG-RANGE FLIGHTS

Raphael Kneffel¹, Sandra Dühr², David Cyrol¹, David Gläser¹, Janina Post¹, Stefan Sammito¹

¹German Air Force Centre of Aerospace Medicine, Cologne, Germany;

²Special Air Mission Wing Federal Ministry of Defence, Cologne, Germany

(Original Research)

INTRODUCTION: The scientific literature on the stresses and strains experienced by flight crews during long-range (LR) and ultra-long-range (ULR) operations has mainly focused on the pilots. There are few studies on cabin crews, and even fewer that compare cockpit (COC) and cabin crews (CAB). **METHODS:** Subjective fatigue, concentration, and responsiveness of 11 all-male COC members and 46 CAB (24 female) – the average age was 35.3 ($SD = 8.7$) – were examined at takeoff and landing via visual analogue scales (VAS). Included were 4 outbound flights from Germany to Canberra (AUS), Las Vegas, Dulles (USA), and Hiroshima (JPN), as well as the 4 corresponding return flights from Papeete (PYF), Las Vegas, Los Angeles (USA), and Seoul (KOR). In three flights a connection flight between first destination and second departure airport was conducted but not included in this analysis. Flight durations ranged from 9:50 to 19:43 h. Each itinerary, outbound plus corresponding return flight, was categorized in east and west by outbound direction. **RESULTS:** Overall, highly significant increases in fatigue and decreases in concentration and responsiveness were observed across all flights ($p < 0.001$). For outbound flights, CAB reported a higher reduction in concentration ($p = 0.017$) and responsiveness ($p = 0.131$) than COC, the latter effect being non-significant; the change in fatigue did not differ ($p = 0.998$). For return flights CAB reported greater exhaustion in all three dimensions, the

results were not significant ($p > 0.05$). Further analyses revealed a poorer recovery of fatigue ($p = 0.392$) and concentration ($p = 0.126$) after flying eastward compared to westward. No effect was found for responsiveness ($p = 0.609$), t -tests performed were not significant. **DISCUSSION:** LR and ULR-flights cause flight crew members to become increasingly fatigued, with CAB surprisingly reporting greater levels of exhaustion than COC. Although the differences were small, these findings may indicate an underestimation of CAB workload. The results comparing layovers in the east and west appear to replicate the relevant literature; however, further studies are needed to improve statistical power.

Learning Objectives

1. The participants will learn that (ultra-)long-range flights led to increased fatigue and reduced concentration and responsiveness in flight crew members.
2. The participants will learn that cabin crews reported greater levels of exhaustion, compared to cockpit crews.

[420] THE INFLUENCE OF HELMET-MOUNTED DISPLAYS ON MUSCULAR ACTIVATION AND FATIGUE

Lucas Haberkamp¹, Andrew Spencer¹, Nicholas Robinson¹, Charles A. Weisenbach¹, Peter Le²

¹Naval Medical Research Unit - Dayton, Wright-Patterson AFB, OH, United States; ²U.S. Air Force Research Lab, 711th Human Performance Wing, Wright-Patterson AFB, OH, United States

(Original Research)

INTRODUCTION: Recent advancements in helmet-mounted displays (HMDs) seek to enhance flight performance. Unfortunately, these advancements could have unintended biomechanical consequences beyond increased physical loading. Providing additional visual and auditory information may amplify neck muscle activation, potentially leading to muscular fatigue and elevated risk of neck pain. Existing research indicates a connection between visual stressors and increased neck muscle activity; however, the effect of an HMD's visual and spatial auditory cues on neck muscle activation remains unclear. **METHODS:** 11 participants performed a flight task in the motion-enabled Disorientation Research Device. The Varjo VR-2 headset presented HMD symbology, out-the-window scenes, and cockpit visuals. We used a within-subjects, repeated measures 3x2 factorial design, encompassing two spatial audio conditions (off/on) and three HMD symbology formats: current display format, forward-referenced attitude format, and conformational attitude referenced. To measure neck muscle activity, we continuously collected surface electromyography (EMG) data from the bilateral sternocleidomastoids, cervical extensors, and levator scapulae. EMG data were normalized to maximum voluntary exertions performed pre-flight. We extracted median frequency and median muscle activation from EMG data. We employed a linear mixed-effects model to analyze the influence of timing, display format, and spatial audio. **RESULTS:** Employing spatial audio decreased left levator scapulae muscle activation ($p < .01$). No other muscles showed significant differences between spatial audio and display formats. During the simulated flight, the right levator scapulae's activation decreased ($p < .01$), while the left cervical extensor's activation increased ($p < .01$). Notably, the median frequency increased for both the right levator scapulae ($p = .02$) and left cervical extensor ($p < .01$). **DISCUSSION:** Our findings underscore the potential biomechanical implications of HMDs. The reduction of left levator muscle activation with spatial audio is encouraging but warrants further investigation. As the flight task proceeded, signs of muscle fatigue were evident in the right levator scapulae and the left cervical extensor. This fatigue, indicated by increased median frequency, raises concerns about potential HMD usage and its relationship to neck pain. These findings highlight the need for ergonomic considerations in HMD design and use.

Learning Objectives

1. Discuss how a helmet-mounted display's visual and spatial auditory cues may influence neck muscle activation and fatigue.
2. Provide insights into the efficacy of using neck muscle activity as a marker of cognitive workload in a dynamic simulated flight environment.

[421] FATIGUE, SLEEPINESS, AND RISK-TAKING BEHAVIOR IN MILITARY AVIATORS

Elizabeth Damato, Kenneth Kincl Jr, Hannah Boehringer, Michael Decker

Case Western Reserve University, Cleveland, OH, United States

(Original Research)

INTRODUCTION: Fatigue and sleepiness reduce aviator performance and safety. Past studies have supported a link to poor judgement and increased risk-taking. Our objective was to determine whether fatigue and sleepiness altered risk-taking behavior in military aviators. **METHODS:** This study was approved by Institutional Review Boards at Case Western Reserve University and the Air Force Research Laboratory. Fatigue and sleepiness were measured using the Multidimensional Fatigue Inventory (MFI) and the Epworth Sleepiness Scale (ESS). Risk taking behavior was measured using the Balloon Analogue Risk Task (BART). The study participants consisted of 50 military aviators (45 male 5 female). Using Mann-Whitney U-tests, group means were compared to determine whether differences existed between aviators who endorsed fatigue and/or sleepiness and those who did not. **RESULTS:** Two groups emerged based on reported levels of fatigue and sleepiness. Group 1 exhibited a mean MFI general fatigue score less than 9 and a mean ESS score less than 10. Group 2 had a mean MFI general fatigue score greater than 9, a mean ESS score greater than 10, or both. Group 2 (16.00 ± 0.52) popped a greater number of balloons than Group 1 (13.81 ± 0.82) when performing the BART ($p = .043$). Group 2 (3.99 ± 0.10) also applied a greater number of pumps per balloon than Group 1 (3.54 ± 0.18 ; $p = .041$). **DISCUSSION:** The study results identified a relationship between levels of fatigue, sleepiness, and risk-taking behavior in military aviators, further supporting the threat that fatigue and sleepiness pose to aviator safety. These findings provide support for the use of the BART or other risk-taking measure to evaluate the effectiveness of fatigue and sleepiness mitigation strategies.

Learning Objectives

1. The audience will understand the prevalence of fatigue and sleepiness among military aviators.
2. The audience will be able to communicate the relationship between fatigue, sleepiness, and risk-taking behavior.

[422] EVALUATION OF COGNITIVE ENHANCEMENT EFFECTS OF DONEPEZIL IN MILITARY ROTARY-WING AVIATION

Samantha Wolf, Isaiah Persson, Ryan Mackie, Amanda Kelley

U.S. Army Aeromedical Research Lab, Fort Novosel, AL, United States

(Original Research)

INTRODUCTION: Pharmaceuticals like modafinil and mixed amphetamine salts have been studied extensively with respect to cognitive enhancement. The results have been mixed and tend to be moderated by individual differences in baseline level of function. A systematic review of cognitive enhancement techniques in healthy, rested adults identified donepezil as an alternate pharmaceutical strategy for cognitive enhancement. **METHODS:** We evaluated the cognitive enhancement effects of a single dose (5 milligrams [mg]) of donepezil in healthy, rested Soldiers using a randomized, placebo-controlled, within-subjects, double-blind experimental design. The independent variable was drug (donepezil 5 mg, placebo) and abstract reasoning ability was included as a moderator variable. The primary outcomes were cognitive ability (attention, visual information processing, memory), marksmanship performance, and flight performance on a subset of aviators. Participants were 23 male, U.S. Army active-duty Soldiers. Eight participants were rated aviators and completed three simulated flights. **RESULTS:** Out of nine tasks (including three simulated flights), only one significant difference between drug conditions was found. The effect was seen on one of the simulated flights, performed only by rated aviators. Rated aviators comprise approximately 36 percent of participants who completed the study ($n = 8$). **DISCUSSION:** The findings from this study do not support continued evaluation of a single dose of donepezil to enhance cognitive function or performance. The secondary objective of the study was to evaluate

any negative side effects of the drug administration. Again, the findings are not supportive of any further effects, and reported side effects were minimal. Further research, particularly that focuses on the role cognitive workload and intrinsic motivation may play, is required prior to recommendations regarding donepezil and its enhancement properties.

Learning Objectives

1. Participants will learn about cognitive performance and cognitive enhancement with pharmaceutical intervention.
2. Participants will learn whether, and if so, to what extent, donepezil enhances cognitive function and performance in healthy, rested Soldiers.

Wednesday, 05/08/2024
Grand Ballroom CD South, EF

4:00 PM

[S-71]: PANEL: THE 14TH ANNUAL RAM BOWL

*Sponsored by American Society of Aerospace
Medicine Specialists*

Chair: Allen Parmet

Co-Chairs: Rebecca Blue, Roy Allen Hoffman, Joanna Nelms

PANEL OVERVIEW: The 14th Annual RAM Bowl features participants from the Air Force, Navy, Army, Mayo Clinic, UTMB and international representatives competing for the Louis H. Bauer Trophy. Aerospace Medicine Residents are required to demonstrate multiple competencies to satisfy the requirements of ACGME and ABPM and serve as specialists in the field.

[423] THE 14TH ANNUAL RAM BOWL

Allen Parmet¹, Rebecca Blue², Rahul Suresh³, Joanna Nelms⁴, Roy Allen Hoffman⁵, Alex Garbino⁶, Walter III Dalitsch⁷, Mary Cimrmanic⁸, John Barson⁹

¹University of Southern California, Kansas City, MO, United States; ²UTMB, Scottsdale, AZ, United States; ³NASA/JSC, Galveston, TX, United States; ⁴TX ANG, Austin, TX, United States; ⁵U.S. Navy, Falls Church, VA, United States; ⁶NASA/JSC, Clear Lake, TX, United States; ⁷U.S. Navy, Dayton, OH, United States; ⁸Marquette University, Milwaukee, WI, United States; ⁹U.S. Army, Atlanta, GA, United States

(Education - Program/Process Review)

The 14th Annual RAM Bowl features participants from the Air Force, Navy, Army, Mayo Clinic, UTMB and international representatives competing for the Louis H. Bauer Trophy. Aerospace Medicine Residents are required to demonstrate multiple competencies to satisfy the requirements of ACGME and ABPM and serve as specialists in the field. Multiple tools are available for developing appropriate didactic knowledge in aerospace medicine, public health, epidemiology, biostatistics and health care management. Residents participate in a college bowl format that test aerospace medicine competencies including the flight environment (atmosphere, radiation, vibration, acceleration, and microgravity), clinical aerospace medicine, aircraft and space vehicle systems/operations, accident investigation, historical events, aerospace physiology, human factors, ergonomics, medical standards, Federal Aviation Administration regulations, passenger transport, restraint and escape, cockpit resource management and aeromedical transportation. Questions are divided into toss-up and bonus questions. Multiple rounds of competition will lead to the selection of an individual victor and awarding of the Louis H. Bauer Trophy to the top team, sponsored by the American Society of Aerospace Medicine Specialists.

Learning Objectives

1. The contest will enable participants to prepare for ABPM examinations in Aerospace Medicine.

2. Attendees will receive an intense review of Aerospace and Preventive Medicine.

THURSDAY, MAY 09, 2024

Thursday, 05/09/2024
Grand Ballroom A

10:00 AM

[S-72]: PANEL: PHYSIOLOGIC EPISODES IN HIGH-PERFORMANCE AVIATION: NATO WORKING GROUP FINDINGS

Chair: Ryan Mayes

Co-Chair: Erik Frijters

PANEL OVERVIEW: Tactical aviation has a long history of physiologic episodes (PHYSEPs) associated with flight in challenging environments. However, in the last decade, pilots of multiple high-performance aircraft (fighter/attack jets and trainers) have experienced a higher-than-expected rate of these episodes in multiple services. In order to facilitate dialogue across nations regarding PEs, a North American Treaty Organization (NATO) working group was formed in 2018. With over 20 members from 10 NATO and partner nations, this group seeks to develop a better understanding of the potential causes of PHYSEPs, compare PHYSEP presentation and experience across nations and airframes, and create international consensus on causes, mitigations, and response where appropriate. This panel will present a summary the NATO working group's final report, including findings and recommendations, an overview of a proposed multinational aircrew experience study, an envisioned "end state" for how to mitigate the impact of physiologic episodes in high-performance aviation, and three presentations covering the group's "exposure matrix." The exposure matrix presentations will each describe the exposures experienced in high-performance aviation and analyze which are most critical for physiologic episodes; environmental exposures, breathing gas and equipment, and individual factors will all be discussed along with combined stressors.

[424] PHYSIOLOGIC EPISODES IN HIGH-PERFORMANCE AVIATION: NATO WORKING GROUP FINDINGS AND NEXT STEPS

Ryan Mayes

USAFSAM, Wright-Patterson AFB, OH, United States

(Education - Program/Process Review)

BACKGROUND: in-flight physiologic episodes (PHYSEPs) among high-performance aircraft pilots have been attributed hypoxia or g-induced loss of consciousness (GLOC). Accordingly, training, pilot selection, and incident response investigations have been centered around this paradigm. However, as jet life support systems and aircrew flight equipment have improved, it stands to reason that these traditionally-attributed causes of PHYSEPs may be incomplete. In the last decade, multiple PHYSEPs have been noted among 4th- and 5th-generation fighter pilots in multiple services that do not appear to be connected to hypoxia or GLOC. **DESCRIPTION:** In order to facilitate international information sharing and create a consensus understanding of PHYSEPs, a North American Treaty Organization (NATO) working group was formed in 2018. This group has 20+ members representing 10 NATO and partner nations. The group expects to finalize its report in 2024, which will include findings and recommendations, PHYSEP classification and definition, a matrix of exposures present in the high-performance aviation environment, supporting factors such as training, sensors, and organization, and a construct for a multi-national study. **DISCUSSION:** PHYSEP symptom presentation can vary widely, and the cause of PHYSEPs are multifactorial