error with respect to the initial mass. Initial test trials indicate an increase in situation awareness and decrease in workload. **DISCUSSION:** The algorithm was reasonably accurate across a range of conditions. Particularly, landings on the edge of achievability limit resulted in near zero fuel remaining. The algorithm could be further improved by modifying the update rate to on-demand (pilot initiates update) or near real time (continuous updates throughout flight). As terrain hazards are identified near the landing area, the pilot may need to select a new landing site. The factors that define landing site achievability often behave non-linearly and may interact in a non-intuitive manner such that even experienced pilots may struggle to accurately estimate the achievable limits. Providing the astronaut pilot the achievability limit in near real-time, we hypothesize will improve landing success and pilot performance, reduce pilot workload, and improve situation awareness. The vehicle and environmental dynamics are currently specified for a lunar landing; however, the algorithm is generalized such that it could be applied to any future planetary lander or "hopper" vehicle or to entirely autonomous landings by replacing the model of the pilot with a model of the autonomous control system.

Learning Objectives:

1. Characterize the effects of the Achievability Limit Algorithm and Display on human performance.
2. Validate the Achievability Limit Algorithm.

[272] RECENT SPACE-DRIVEN INNOVATION IN MEDICAL TECHNOLOGY. A REVIEW STUDY

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(EDUCATION - PROCESS)

MOTIVATION: The Bellagio Summit II sought to identify evidence-based information and mature data with significant clinical implications for Terrestrial populations, by reviewing and analyzing peer-reviewed internationally published literature and NASA technical resources (from 2012 to 2017). In this process, consideration was given to advances in medical technology developed specifically for assistance and monitoring of Astronauts' health and safety. Major clinical studies often include the development or optimization of available engineering resources. A considerable number of medical devices, originally born for Space applications only, are now commercialized and accessible to terrestrial patients and customers. **OVERVIEW:** Technology innovation is usually driven by progress and needs of large populations. However, despite that Astronauts are a small population with specific vital needs, innovation in Space medical technology is shown to well stand on its own. Because novelty in developing medical devices arise from both (i) adaptation of current and emerging Terrestrial technology towards Space applications, and (ii) biomedical research on Astronauts' physiology and health issues during and after Space flight, we discuss and analyze medical technology's evolution with: highlighting key advantages of using Space technology for medical assistance on Earth whether in hospitals, remote locations, or areas affected by natural disasters, and identifying the medical needs for such technology in the foreseeable Future of human Outer Space exploratory missions. **SIGNIFICANCE:** Commercialization of medical devices and tools, born within the space medicine field, is a remarkable evidence of the benefits of space research for Terrestrial applications and the space-driven innovation in medical care.

Learning Objectives:

1. Innovation in medical technology is driven by space medicine.
2. Space medical technology has terrestrial applications.
3. Identifying the medical needs during interplanetary missions to boost innovation in technology.

[273] A NOVEL TECHNIQUE TO MEASURE ACTIN'S CRITICAL CONCENTRATION IN MICROGRAVITY DURING PARABOLIC FLIGHT

A. Kozminski[1,2]
[1]Medical School / Dept. of Mechanical Engineering, University of Michigan, Ann Arbor, MI; [2]Biochemistry, Northwestern University, Evanston, IL

(ORIGINAL RESEARCH)

INTRODUCTION: Basic molecular science in orbit is logistically complicated. Sending samples back to Earth can be destructive to some biopolymers. Parabolic flight provides a useful environment for short exposures to microgravity. Narrowing an experiment's exposure to microgravity in parabolic flight can be done using various techniques. When working with actin polymers, using capping protein allows for polymerization to occur only in the microgravity portions of the flight profile. **METHODS:** Actin elongation was performed aboard a Zero-G Boeing 727 out of Ellington Field as a part of the 2014 NASA Reduced Gravity Education Flight Program. Monomeric actin was prepared pre-flight and distributed into 135 1-mL syringes at concentrations of 2.5, 5, and 10 μM. Each syringe was dispensed into 96-well plate wells containing "seed" F-actin upon entering microgravity in each parabola. Alexa-488-Phalloidin was injected into 1/3 of the wells after 10, 15 and 20 seconds to cap the polymers. Rate of elongation versus [G-actin] gives critical concentration of elongation. Controls were in 1G. **RESULTS:** Prior to the flights, samples from ground trials were successfully imaged, using confocal fluorescence microscopy, and measured using Image J (total length - length of seed = growth). Test trials were done at 10 and 18 seconds at 2.5, 5 and 10 μM G-actin. Direct, visible differences were seen amongst concentrations at both times. Statistical analysis was not performed on test trials. Upon imaging the samples from flight, ice crystals were found in all, too invasive to take measurements (most likely formed during shipping across the country). **DISCUSSION:** Without images from the flight data, the value of this experiment lies within this novel approach towards isolating effects of microgravity on biopolymer chemistry during parabolic flight. This technique was developed for actin biopolymers but can be used for other cytoskeleton proteins. The aim of this particular biopolymer investigation was to help answer questions like how the human body detects gravity on a cellular level. The implications of being able to identify how protein dynamics change with gravity go beyond medicine for healthy astronauts. This will impact our understanding of the commercial spaceflight passenger with inherent protein-based pathology. Further work aims at validating this experimental design and then using it to investigate protein dynamics in various pathologies in microgravity.

Learning Objectives:

1. Cystoskeleton proteins act differently in microgravity.
2. Actin is a protein that can affect every tissue of the body.
3. Biopolymer chemistry is difficult to perform in an environment that exposes the polymers to a wide range of forces.

Wednesday, May 09 ***10:30 AM***
Ballroom D

S-058: SLIDE: IMPACT OF STRESS ON PERFORMANCE

Chair: John Charles
Houston, TX

Chair: Casey Pruett
Cologne, NRW, Germany

10:30 AM

[274] PERSONALITY TRAITS AND SLEEP-RELATED PROBLEMS IN CREWMEMBERS OF THE HAWAII SPACE EXPLORATION ANALOG AND SIMULATION (HI-SEAS)

N.L. Shattuck and P. Matsangas
Operations Research, Naval Postgraduate School, Monterey, CA

(ORIGINAL RESEARCH)

INTRODUCTION: Personality is an important variable when assessing team performance and cohesion, especially in small teams performing in isolated, confined, extreme environments such as space exploration. The Hawaii Space Exploration Analog and Simulation (HI-SEAS) project consists of a series of simulated Mars missions whose purpose is to study the psychosocial impact of isolated and confined

living conditions, and to assess space-flight crew dynamics and behaviors. Our study investigated the association between personality traits and sleep characteristics during the 8-month long Mission V. **METHODS:** Participants (N=6 – the entire crew, 26 to 29 years of age, four males) completed a questionnaire two weeks before the study commenced, on the day they entered the habitat, and every month thereafter. The questionnaire included four standardized tools (Epworth Sleepiness Scale – ESS, Insomnia Severity Index – ISI, Pittsburgh Sleep Quality Index – PSQI, Profile of Mood States – POMS). Personality traits were assessed with the NEO Five-Factor Inventory (NEO-FFI). To further assess differences in sleep characteristics, we calculated a single metric, a Figure of Merit (FOM), as the linear combination of ESS, ISI, PSQI, and POMS Total Mood Disturbance (TMD) scores. Higher FOM scores indicated better sleep. **RESULTS:** Two crewmembers (P3012 and P3014; one male) showed subthreshold insomnia for ~40% of the mission. P3014 was identified early as a poor sleeper and showed a gradual deterioration in mood until the third month of the mission when the mood of the crewmember stabilized. P3012/ P3014 showed increased variability in their responses on the PSQI, ISI (P3012), and ESS scores compared to other crewmembers. Compared to the other crewmembers, P3012 and P3014 scored higher in neuroticism (average severity), lower in extraversion (average severity), and lower in agreeableness (average severity). P3012 and P3014 had lower FOM scores than the other crewmembers ($p=0.018$). **DISCUSSION:** Our results provide evidence that personality traits are associated with sleep characteristics when small teams live for extended periods of time in confined and isolated environments. Specifically, higher neuroticism scores combined with lower in extraversion/agreeableness scores were associated with sleep-related problems. Follow-up analysis will focus on the association between subjective scores and objective sleep attributes obtained with actigraphy.

Learning Objectives:

1. To identify whether sleep-related attributes are associated with the personality traits of members of small teams living for extended periods of time in confined and isolated environments.
2. To describe the association between personality traits and sleep-related attributes in members of small teams living for extended periods of time in confined and isolated environments.
3. To recognize the importance of individual differences in terms of sleep-associated attributes in small teams.

10:45 AM
[275] P300 ASSESSMENT OF COGNITIVE CAPACITY DURING THE CONTROL OF AN OBJECT WITH SIX DEGREES OF FREEDOM

B.W. Johannes[1], A.W. Gaillard[2], S.V. Bronnikov[3], Y.A. Bubeev[4], T.I. Kotrovskaya[4] and J. Rittweger[5]

[1]Institute of Aerospace Medicine, German Aerospace Center (DLR), Cologne, Germany; [2]Psychology, Tilburg University, Tilburg, Netherlands; [3]Ergnomics, Russian Space Corporation, Moscow, Russian Federation; [4]Psychology - Psychophysiology, Institute of Biomedical Problems, Moscow, Russian Federation; [5]Muscle and Bones, Institute of Aerospace Medicine, Cologne, Germany

(ORIGINAL RESEARCH)

INTRODUCTION: In a ground based study a method was tested and verified foreseen for the investigation of cognitive capacity during the spacecraft docking training onboard the space station (experiment PILOT-T). Eighteen subjects participated. The P300 component of evoked EEG potentials in response to acoustic stimuli as secondary task was examined. **METHODS:** The subjects passed successfully a self-sufficient educational program ("6df") in individual time spans (16 to 32 sessions). In a familiarization session the complete experiment was run once, using the standard 6df-tasks. EEG was registered continuously using the space equipment foreseen for the application on the ISS. Acoustic stimuli of similar physical properties but different frequencies were applied as secondary task. Subjects had to count the rare tone to complete a monitoring task (switching power supply among several active solar panels). In the experimental session after three standard tasks the subjects were confronted with two untrained more difficult tasks (rotating object to dock on). **RESULTS:** There were significant negative correlations found between the docking quality, given task difficulty, and subjectively perceived difficulty. The performance in the secondary tasks was unrelated to these factors. The magnitude of the P300 component was, as expected, more expressed during the standard tasks than in the difficult tasks; the latency was prolonged. There was a certain range of individual P300 changes. Using a series of R-based significance calculations for individual's data a decision matrix was tested for possible proficiency classification of the subjects by means of exploratory cluster analyses. **DISCUSSION:** The results confirm the assumption that P300 might be a useful tool to investigate the operator's cognitive capacity during a mission relevant operation as the hand controlled docking of a spacecraft on a space station. A decreased P300 magnitude could be an indicator of reduced free cognitive capacity, needed for unexpected changes or events.

Learning Objectives:

1. applied P300 research.
2. hand controlled docking maneuver.
3. cognitive capacity.

11:00 AM
[276] INSIGHT AND TASK PERFORMANCE IN SIMULATED SUBORBITAL SPACEFLIGHT: IMPLICATIONS FOR INFORMED CONSENT

E. Stratton[3], R.S. Blue[4], J. Vardiman[4], C. Mathers[5], T. Castleberry[4,6], F. Bonato[1], A. Bubka[1], K. Seaton[2] and J. Vanderploeg[4,6]

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(ORIGINAL RESEARCH)

INTRODUCTION: Commercial spaceflight participants (SFPs) will likely have little specialized knowledge in the aerospace field. Imparting sufficient knowledge for SFPs to understand the risks associated with spaceflight may be difficult and, in part, will require that individuals recognize their own roles and responsibilities as vehicle occupants and the potential risks imparted by themselves and those around them. We sought to understand how minimally trained laypersons would perform during a simulated emergency during centrifuge-simulated suborbital spaceflight. We evaluated participant insight regarding their own performance and their perceptions of the efficacy of the training they received. **METHODS:** 148 individuals participated in one of four centrifuge training programs of varied complexity and duration, culminating in two simulated suborbital spaceflights. At most, subjects underwent seven centrifuge runs over 2d, including two +Gz runs (peak +3.5Gz, Run 2) and two +Gx runs (peak +6.0Gx, Run 4) followed by three runs approximating suborbital spaceflight profiles (combined +Gx and +Gz, peak +6.0Gx and +4.0Gz). 137 subjects further participated in a simulated emergency scenario and were evaluated on task performance and queried on their awareness of their own performance. **RESULTS:** Subjects made numerous mistakes during simulated emergency scenarios. Further, most subjects demonstrated poor awareness of their own performance. Only around half of perfect scorers believed that they completed the emergency scenario without error, and a third of subjects believed that they had performed flawlessly despite significant errors during the emergency scenario. **DISCUSSION:** Results suggest that SFPs have difficulty performing tasks in stressful scenarios and retrospectively demonstrate poor understanding of their performance. This may highlight an opportunity to better educate future SFPs on risks imparted by vehicle occupants, personal responsibility, and similar factors that may significantly alter the risk profile of commercial spaceflight. Improved awareness of these issues may better allow SFPs to fully participate in the informed consent process before choosing to accept the risks inherent to commercial spaceflight.

Learning Objectives:

1. Discuss the roll of spaceflight participant performance in risk characterization.
2. Discuss how insight can affect a spaceflight participant's ability to take part in the informed consent process.
3. Discuss layperson performance in emergency scenarios during simulated suborbital spaceflight.