

Fiscal Year:	FY 2013	Task Last Updated:	FY 04/23/2013
PI Name:	Hunter, Jean Ph.D.		
Project Title:	Effects of Retronasal Smelling, Variety and Choice on Appetite and Satiety		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Space Human Factors Engineering		
Joint Agency Name:	TechPort:	No	
Human Research Program Elements:	(1) SHFH :Space Human Factors & Habitability (archival in 2017)		
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Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	14853-5701	Congressional District:	22
Comments:			
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No. of Master's Candidates:		No. of Bachelor's Degrees:	1
No. of Bachelor's Candidates:	4	Monitoring Center:	NASA JSC
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Flight Program:			
Flight Assignment:	NOTE: New end date is 8/31/2014, per PI and NSSC information (Ed., 4/23/14) NOTE: New end date is 4/30/2014, per NSSC information (Ed., 1/31/13)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Binsted, Kim (University of Hawaii, Honolulu) Spies, Rupert (Cornell University) Halpern, Bruce (Cornell University)		
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	<p>Menu fatigue and its sequelae, lower food intake and weight loss, have been documented in military, polar exploration, and space settings, and among subjects in bed rest studies. Isolation, confinement, stress, and low acceptability of available foods amplify menu fatigue. Adequate levels of acceptability, variety, and usability are required to maintain food intake and crew health and performance.</p> <p>We wish to use isolated and confined subjects at the NASA bed rest facility, and different subjects in a Mars analog environment, to explore three issues: 1) the relationship between nasal patency and smelling (orthonasal and retronasal) in the microgravity analog of bed rest and in the isolation/confinement setting of a Mars-like habitat, 2) the effect of orthonasal and retronasal smelling on appetite under conditions of menu fatigue, and 3) the hypothesis that a bulk ingredient based food system, with crew-prepared foods, will improve crew food satisfaction and mitigate menu fatigue. The last study will include an ESM cost comparison of crew-prepared and prepackaged food systems.</p> <p>Study #1 on smelling and nasal patency reopens an earlier finding (Vickers et al, 2001) that taste, olfaction and trigeminal response are unaffected by fluid shifts resulting from bed rest. We have returned to the olfaction aspect of that question with objective measurements of nasal cavity dimensions and nasal airway resistance, with a broader and more closely food-related set of odorants, and by adding tests of retronasal smelling which is more representative of odorant perception during eating.</p> <p>Study #2 seeks to link odorant acceptability ratings for pure, food-related odorants to bed-rested subjects' appetite, or desire to eat a meal. Subjects will rate the pleasantness and perceived food-relatedness of odorants connected and unconnected with the bed rest menu. Subjects will also be asked to observe and smell their meals, then rate their appetite and desire to eat the meal. These measurements are taken during the pre-bed rest ambulatory period, during the period of dynamic adaptation to fluid shift in early bed rest, in late bed rest when fluid shifts have stabilized and menu fatigue is increasing, and during the recovery period. Odorants used include the vapor phase odors of foods on the bed rest menu, other food-related odorants not related to the bed rest menu, and pure odorants as controls. We expect to find shifts in odorant acceptability over the course of the study, testing the hypothesis that odorants related to the menu will drop in acceptability over time due to menu fatigue.</p> <p>Study #3, a Mars analog study, will test the hypothesis that allowing crews to prepare some of their own meals will mitigate menu fatigue and increase food satisfaction. An analog crew of 6 volunteers will inhabit a Mars analog habitat for 4 months. After an initial acclimation period they will consume meals of two different types: meals containing only prepackaged, shelf-stable foods including instant backpacking foods and commercial packaged foods from the bed rest study, and meals prepared by the crew from a pantry of shelf-stable ingredients. Food preparation time, recipes used, acceptability and intake of each food, self-reported mood and self-reported health status will be tracked; estimated nutritional intake will be tracked from intake and recipe data. We will also generate an ESM cost comparison of the two food systems from video estimates of crew time spent on food-related activities, and from usage data for water and electrical power related to food preparation and cleanup.</p> <p>Finally, analog crewmembers will undergo the same airway patency and odorant identification tests as the bed rest subjects, both to provide an ambulatory isolated/confined control and to detect, if possible, effects of habituation to environmental odors upon perception. Analog subjects will also replicate the study of odorant liking, food-relatedness, and appetite done on the bed rested subjects.</p>
Task Description:	
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>Our investigation of nasal patency, olfaction, and appetite in bed rested subjects is generally relevant to the care and nutrition of patients confined to bed for medical reasons. Our research on foods and cooking for long term planetary surface missions is relevant to the provisioning of small isolated groups on Earth such as scientific field stations, and also generally relevant to the adventure tourism industry.</p>
Task Progress:	<p>Task Progress: Bed rest data has been acquired for seven subjects. As measured by acoustic rhinometry for the first 5 cm of distance behind the nasal entrance, nasal cavity volume is reduced on average 15% within an hour of the start of bed rest, then fluctuates through day 5 of bed rest. Thereafter, weekly nasal patency testing during bed rest reveals a characteristic profile: a ~10% reduction in nasal volume except for an apparent return to baseline at day 30. Nasal volume briefly increases to 15% over baseline during the first few hours of recovery from bed rest with a gradual return toward baseline during rehabilitation. A data sharing agreement under negotiation with another researcher is expected to give us access to confirmatory MRI data of the pre-, during, and post-bed rest anatomy of the nasal passages.</p> <p>The clinical literature on nasal patency observes that patients' self-assessed degree of nasal congestion is poorly correlated with objective measures of congestion. 3 of the 6 subjects tested so far are able to self-assess changes in nasal tissue swelling and nasal airflow 77 to 86% of the time ($P < 0.05$). The remaining subjects' ratings are poorly correlated. Half of the bed rest subjects report nasal congestion during bed rest even though all experience nasal congestion. The 2010 Integrated Medical Model indicates that 60% of astronauts report nasal congestion. It is possible to conjecture that more astronauts may be undergoing changes in nasal patency but are not sensitive to it.</p> <p>Menu fatigue is measured by asking the subjects to indicate their interest in eating each food served to them, the pleasantness of its odor, the acceptability of the food when consumed, and hunger and satiety ratings before and after the meal. Two out of six subjects have demonstrated significant menu fatigue coupled with diminished ratings of intensity, pleasantness, and "interest in eating" for odors sourced from the FARU meals. This association requires further analysis which will begin in the next year. The analog phase of the study is in the final stages of preparation. Arrangements have been made to lease a testbed facility specifically designed for long-term simulations and sited in a barren, rugged environment analogous to Martian volcanic terrain. An environmental assessment of the site, including both an archaeological survey and an arthropod survey, has resulted in a finding of no significant impact. Six "astronaut-like" crewmembers have been selected from an application pool of nearly 700. The crew and three backups were trained at a Cornell workshop and the six prime crewmembers undertook a two-week training mission in January 2013, at the Mars Desert Research Station in southern Utah. Equipment, experimental procedures, survey webforms, EVA procedures, and crew/ground communications were evaluated. Crew diet planning and food ordering are in progress. The analog study is anticipated to run mid-April through mid-August, 2013.</p>
Bibliography Type:	Description: (Last Updated: 03/01/2018)

**Abstracts for Journals and
Proceedings**

Caldwell BJ, Halpern BP, Binsted K, Hunter JB. "Transient and Long Term Nasal Tissue Swelling in 70-day 6° Head-Down Tilt." 2013 NASA Human Research Program Investigators' Workshop, Galveston, TX, February 12-14, 2013.
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