

Fiscal Year:	FY 2011	Task Last Updated:	FY 05/02/2011
PI Name:	Barstow, Thomas Ph.D.		
Project Title:	Standardized 'Pre-flight' Exercise Tests to Predict Performance during Extravehicular Activities in a Lunar Environment		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:	TechPort:	Yes	
Human Research Program Elements:	(1) HHC: Human Health Countermeasures		
Human Research Program Risks:	(1) Aerobic: Risk of Reduced Physical Performance Capabilities Due to Reduced Aerobic Capacity (2) Muscle: Risk of Impaired Performance Due to Reduced Muscle Size, Strength and Endurance		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	66506-0109	Congressional District:	1
Comments:			
Project Type:	GROUND	Solicitation / Funding Source:	2009 Crew Health NNJ09ZSA002N
Start Date:	07/01/2010	End Date:	06/30/2013
No. of Post Docs:		No. of PhD Degrees:	
No. of PhD Candidates:	1	No. of Master' Degrees:	1
No. of Master's Candidates:		No. of Bachelor's Degrees:	
No. of Bachelor's Candidates:	9	Monitoring Center:	NASA JSC
Contact Monitor:	Norsk, Peter	Contact Phone:	
Contact Email:	Peter.norsk@nasa.gov		
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:	Chris Lewis, Ph.D. has left Kansas State University and is no longer on the project. We are actively pursuing a replacement engineer.		
COI Name (Institution):	Warren, Steven (Kansas State University)		
Grant/Contract No.:	NNX10AK60G		
Performance Goal No.:			
Performance Goal Text:			
Task Description:	<p>The original Apollo missions and more recent extravehicular activities on the International Space Station have provided basic information that can be applied to activities that may occur during future long-duration lunar missions. However, despite these previous efforts, significant gaps remain in our understanding of the more complex physiological costs of different activities in a true lunar environment. Recently a ground-based simulation of a 10-kilometer Lunar Walkback was conducted to better understand the physical capabilities of a suited astronaut in partial gravity. Unfortunately, this study was limited because of the use of a stationary treadmill that did not accurately simulate the lunar environment (i.e. landscape and terrain). To date this overall lack of physiologic data collected during true lunar activities or their accurate simulation has limited the ability of NASA physicians and scientists to predict if an astronaut candidate is physically capable of completing the multiple lunar activities that may be required during long-duration missions. Therefore, the</p>		

	goals of this proposal are to 1) develop a mobile testbed to accurately simulate partial-gravity lunar activities, and 2) determine subject performance and the concomitant physiological responses to these activities, which will allow us to 3) create a series of standardized tests that can be performed in a pre-flight setting to determine the readiness of the astronaut to perform physically demanding activities during a lunar mission.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>The results of these studies will help identify which key components of physical fitness are required to perform different physical tasks. These results will, therefore, be applicable in a wide variety of settings, from rehabilitation to athlete evaluation, to determining the relative preparedness of astronauts for in-flight and destination EVAs. These insights will be especially important when astronauts return to a gravitational environment, either on earth or at their destination.</p> <p>These results will provide target information regarding minimum required strength and endurance from which in-flight and destination exercise countermeasures can be based. The strategy employed here can also function as a template for approaching the establishment of field tests for other occupations in which there is a demand for minimal physical performance, such as been done for firefighters and police officers.</p>
Task Progress:	<p>To date, 10 subjects (7 males) have completed the entire protocol for Phase 1.1 (including all laboratory and field tests). An additional 5 subjects will complete all testing by the middle of May. We have recruited subjects with an intentionally wide range of fitness levels. The purpose of this wide range of fitness levels is to improve our ability to predict relative success in the lunar field tests from one or more fitness characteristics.</p> <p>Preliminary simple regression analysis of the results for the 10 subjects who have completed all aspects of the testing to date has produced some exciting insights. There was a modest correlation ($r = 0.583$, $p < 0.05$) between 10 km walk-back time and Vo_{2max}, but there was no significant relation with gas exchange (or ventilatory) threshold (GET). In contrast, there were highly significant relationships between both 10 km time ($r = 0.894$, $p < 0.0005$) and average pace ($r = 0.872$, $p < 0.001$) with critical velocity.</p> <p>The total time to perform the material transport test was inversely, significantly correlated with upper body Vo_{2max} and critical power, and with static hand grip endurance, with the correlation coefficients ranging from 0.63 to 0.792, but was not significantly correlated with upper body GET.</p> <p>It should be noted that much of the statistical evaluation of the data, including the multiple regression and CART approaches, will require results from a greater number of subjects in order to achieve minimal statistical power. This will be accomplished over the summer and fall of 2011.</p>
Bibliography Type:	Description: (Last Updated: 01/23/2020)
Abstracts for Journals and Proceedings	Broxterman RM, Ade CJ, Barstow TJ. "A Single Test for the Determination of Critical Velocity." To be presented at the 58th Annual Meeting of the American College of Sports Medicine, Denver, CO, May 31-June 4, 2011. Medicine & Science in Sports & Exercise 2011 May;43(5 Suppl):in press. , May-2011
Abstracts for Journals and Proceedings	Ade CJ, Broxterman RM, Warren S, Taylor RD, Gadbury GL, Barstow TJ. "Development of Standardized Exercise Tests for Predicting Planetary Task Performance." 18th Humans in Space Symposium, Houston, TX, April 11-14, 2011. 18th IAA Humans in Space Symposium, Houston, TX, April 11-14, 2011. , Apr-2011
Articles in Peer-reviewed Journals	Ade CJ, Broxterman RM, Barstow TJ. "Critical velocity and maximal lactate steady state: Better determinants of 2-hour marathon." J Appl Physiol. 2011 Jan;110(1):287-8; discussion 294. PMID: 21542169 , Jan-2011
Dissertations and Theses	Broxterman R. "Ryan Broxterman: A single test for the determination of the velocity:time-to-exhaustion relationship." Master's thesis, Kansas State University, May, 2011. , May-2011
Significant Media Coverage	Diederich S. "'The road to space goes through Manhattan, thanks to NASA grant.' Article on PI Barstow's NASA research." Kansas State Collegian, September 3, 2010. http://www.kstatecollegian.com/2010/09/03/the-road-to-space-goes-through-manhattan-thanks-to-nasa-grant/ , Sep-2010
Significant Media Coverage	Barstow T. "Researchers explore physiological effects of space travel with NASA grant." Kansas State University News Services, August 23, 2010. http://www.k-state.edu/media/newsreleases/aug10/nasa82310.html , Aug-2010