

<b>Fiscal Year:</b>	FY 2016	<b>Task Last Updated:</b>	FY 06/01/2016
<b>PI Name:</b>	Basner, Mathias M.D., Ph.D.		
<b>Project Title:</b>	Neurostructural, Cognitive, and Physiologic Changes During a 1-year Antarctic Winter-Over Mission		
<b>Division Name:</b>	Human Research		
<b>Program/Discipline:</b>			
<b>Program/Discipline--Element/Subdiscipline:</b>	HUMAN RESEARCH--Behavior and performance		
<b>Joint Agency Name:</b>	<b>TechPort:</b>	No	
<b>Human Research Program Elements:</b>	(1) <b>HFBP</b> :Human Factors & Behavioral Performance (IRP Rev H)		
<b>Human Research Program Risks:</b>	(1) <b>BMed</b> :Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders		
<b>Space Biology Element:</b>	None		
<b>Space Biology Cross-Element Discipline:</b>	None		
<b>Space Biology Special Category:</b>	None		
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<b>Zip Code:</b>	19104-4209	<b>Congressional District:</b>	2
<b>Comments:</b>			
<b>Project Type:</b>	GROUND	<b>Solicitation / Funding Source:</b>	2013 HERO NNJ13ZSA002N-Crew Health (FLAGSHIP & NSBRI)
<b>Start Date:</b>	08/01/2014	<b>End Date:</b>	07/31/2018
<b>No. of Post Docs:</b>	1	<b>No. of PhD Degrees:</b>	0
<b>No. of PhD Candidates:</b>	0	<b>No. of Master' Degrees:</b>	0
<b>No. of Master's Candidates:</b>	0	<b>No. of Bachelor's Degrees:</b>	0
<b>No. of Bachelor's Candidates:</b>	0	<b>Monitoring Center:</b>	NASA JSC
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<b>Flight Program:</b>			
<b>Flight Assignment:</b>	NOTE: Element change to Human Factors & Behavioral Performance; previously Behavioral Health & Performance (Ed., 1/17/17) NOTE: Extended to 7/31/2018 per K. Ohnesorge/JSC and NSSC information (Ed., 12/7/16)		
<b>Key Personnel Changes/Previous PI:</b>	May 2016 report: Damien Leger and Gabi Ambrecht were added as Co-Investigators as we are sharing actigraphy data with them. May 2015 report: David Roalf, PhD was added as a Co-Investigator to take over most of the tasks of Ted Satterthwaite, MD. Alexander Stahn, PhD and Hanns-Christian Gunga, MD PhD were added as Co-Investigators for Cognition in Neumayer-III, Halley-VI, and SANAE. Simone Macri and Mirjam Münch were added as Co-Investigators as we are sharing actigraphy data with them.		

<b>COI Name (Institution):</b>	Bilker, Warren ( University of Pennsylvania ) Dinges, David Ph.D. ( University of Pennsylvania ) Elliott, Mark Ph.D. ( University of Pennsylvania ) Goel, Namni Ph.D. ( University of Pennsylvania ) Gur, Ruben Ph.D. ( University of Pennsylvania ) Satterthwaite, Theodore M.D. ( University of Pennsylvania ) Johannes, Bernd Ph.D. ( German Aerospace Center (DLR), Institute of Aerospace Medicine ) Mollicone, Daniel Ph.D. ( Pulsar Informatics, Inc. ) Roalf, David ( University of Pennsylvania ) Stahn, Alexander ( Charité Berlin ) Gunga, Hanns-Christian ( Charité Berlin ) Macri, Simone ( Istituto Superiore di Sanità ) Münch, Mirjam ( Charité Berlin ) Leger, Damien M.D., Ph.D. ( Université Paris Descartes ) Ambrecht, Gabriele ( Charité Berlin )
<b>Grant/Contract No.:</b>	NNX14AM81G
<b>Performance Goal No.:</b>	
<b>Performance Goal Text:</b>	
<b>Task Description:</b>	<p>This proposal primarily addresses the Behavioral Medicine (BMed) 3 Gap on the nature and duration of cognitive performance changes in-flight and post mission, by assessing neurostructural, cognitive, behavioral, physiologic, and psychosocial changes in maximally N=24-28 crewmembers during a 10-12 month Antarctic winter-over in Concordia station, and in the same number of controls matched to crewmembers based on age, gender, and educational attainment. State-of-the-art quantitative structural and functional magnetic resonance imaging (fMRI), in both resting-state and activated; diffusion tensor imaging; and arterial spin labeled fMRI will be performed in crewmembers and controls 4 months before, immediately after, and 6 months after the mission. During the mission, crewmembers will wear a wrist-watch like device that measures movement activity and proximity to other devices 24/7 to investigate sleep-wake behavior and crew cohesion. Once monthly, subjects will perform the Cognition test battery to quantify changes in cognitive performance. Cognition was specifically designed for high-aptitude astronauts and astronaut surrogates. It consists of 10 brief, validated neuropsychological tests that cover a wide range of cognitive domains. A 24-hour, two-electrode electrocardiogram (ECG) will be performed monthly to investigate systematic changes in heart rate, heart rate variability, objectively assessed workload, and sleep fragmentation with time-in-mission. Behavioral alertness will be assessed with a 3 min. Psychomotor Vigilance Test (PVT) on a weekly basis along with brief surveys to assess subjective ratings of mood, workload, stress, sleep quality, tiredness, sickness, and conflicts among crewmembers. The results will be compared with findings from Mars520 and International Space Station (ISS), as many of the variables to be gathered overlap with those successfully obtained by our team in these and other space analog environments. The Cognition test battery was also implemented in the Antarctic stations Neumayer-III, Halley-VI, and SANAE. After this project we will have a much better understanding whether, to what extent, and for how long neurostructural and neurofunctional changes are induced in subjects over-wintering in the isolated and confined space analog environment of Concordia station.</p>
<b>Rationale for HRP Directed Research:</b>	
<b>Research Impact/Earth Benefits:</b>	<p>With the proposed work we will relevantly contribute to the goal of the Human Research Program (HRP) to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration. More specifically, our findings, based on state-of-the-art neuroimaging technologies and on innovative, non-invasive, low burden, yet methodologically sound measurement technologies for cognitive, physiological, and crew cohesion outcomes, will relevantly contribute to the development of technologies to provide mission planners and system developers with strategies for monitoring and mitigating crew health and performance risks. These methodologies will also be useful for assessing subjects living in isolated, confined, and extreme environments on Earth.</p>
<b>Task Progress:</b>	<p>Task progress in year 2:</p> <p>The first of two winter-over (WO) campaigns in Concordia station is completed. All 13 crewmembers participated in the study. We received MRIs from all crewmembers at all 3 time points (pre-mission October 2014, immediately post-mission November-January 2015/16, 6-months post mission May 2016). In September 2015, 4 members of the research team traveled to Christchurch, NZ and Hobart, Tasmania to set up the GE scanners and perform phantom scans on themselves. These scans will be used to facilitate comparisons between the 3 scanners (Siemens scanner at envihab Cologne and two different models of GE scanners in Christchurch and Hobart).</p> <p>Overall, compliance during the 2015 winter-over campaign was good. We received</p> <ul style="list-style-type: none"> <li>- 101 out of 117 expected Cognition test bouts (86.3%), - 433 out of 481 expected PVTs (90.0%), and - 112 out of 117 expected 24 hour ECG measurements (95.7%).</li> </ul> <p>Actigraphy compliance was variable between crewmembers. 38% were fully compliant, 31% took the actigraph off during the night, 31% only wore the actigraph during some periods of the day.</p> <p>For WO2016, we were able to obtain baseline cognitive and neuroimaging data from all 13 crewmembers in October 2015. Data acquisition for the 2016 winter-over campaign started in February 2016. Compliance for the WO2016 campaign is lower compared to the preceding year, probably due to the higher workload generated by 7 research projects implemented in Concordia by ESA during this winter-over.</p> <p>Cognition data acquisition in the Antarctic Neumayer-III and Halley-VI stations is ongoing with good subject compliance. We were not able to obtain any Cognition data from the SANAE station in the 2015 winter-over, and we do not expect any data for the 2016 winter-over, either.</p> <p>Data acquisition for the 2015 winter-over control group was finalized. We received all pre-mission scan equivalents. As</p>

	<p>the control group started with a delay, we are still waiting for the post-mission scan equivalents. We also received:</p> <ul style="list-style-type: none"> <li>- 121 out of 156 expected Cognition test bouts (77.6%), - 404 out of 507 expected PVTs (79.7%), and - 110 out of 130 expected 24 hour ECG measurements (84.6%).</li> </ul> <p>Participants for the 2016 winter-over control group were selected by DLR (German Aerospace Center). Pre-mission scans were performed and the crew has begun Cognition and ECG data acquisition.</p>
<b>Bibliography Type:</b>	Description: (Last Updated: 04/05/2024)
<b>Abstracts for Journals and Proceedings</b>	<p>Basner M, Dinges DF, Nasrini J, McGuire S, Hermosillo E, Ecker AJ, Johannes B, Gerlach DA, Stahn A, Gunga HC, Mollicone DJ, Mott CG, Melzer T, Roalf D, Elliott M, Prabhakaran K, Bilker W, Gur RC. "Neurostructural, Cognitive, and Physiologic Changes During a 1-Year Antarctic Winter-Over Mission." 2016 NASA Human Research Program Investigators' Workshop, Galveston, TX, February 8-11, 2016.</p> <p>2016 NASA Human Research Program Investigators' Workshop, Galveston, TX, February 8-11, 2016. , Feb-2016</p>
<b>Articles in Peer-reviewed Journals</b>	<p>Basner M, Savitt A, Moore TM, Port AM, McGuire S, Ecker AJ, Nasrini J, Mollicone DJ, Mott CM, McCann C, Dinges DF, Gur RC. "Development and validation of the Cognition test battery for spaceflight." Aerospace Medicine and Human Performance. 2015 Nov;86(11):942-52. <a href="http://dx.doi.org/10.3357/AMHP.4343.2015">http://dx.doi.org/10.3357/AMHP.4343.2015</a> ; PubMed <a href="#">PMID: 26564759</a>; PubMed Central <a href="#">PMCID: PMC4691281</a> , Nov-2015</p>
<b>Articles in Peer-reviewed Journals</b>	<p>Basner M, McGuire S, Goel N, Rao H, Dinges DF. "A new likelihood ratio metric for the psychomotor vigilance test and its sensitivity to sleep loss." J Sleep Res. 2015 Dec;24(6):702-13. Epub 2015 Jun 29. <a href="http://dx.doi.org/10.1111/jsr.12322">http://dx.doi.org/10.1111/jsr.12322</a> ; PubMed <a href="#">PMID: 26118830</a> , Dec-2015</p>