Fiscal Year:	FY 2020	**Task Last Updated:**	FY 05/29/2020
PI Name:	Basner, Mathias M.D., Ph.D.		
Project Title:	Advanced Algorithms for the Prediction of Adverse Cognitive and Behavioral Conditions in Space		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	TRISH--TRISH		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	None		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	19104-4209	**Congressional District:**	2
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2018 TRA BRASH1801: Translational Research Institute for Space Health (TRISH) Biomedical Research Advances for Space Health
Start Date:	01/01/2019	**End Date:**	12/31/2020
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No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	TRISH
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Dinges, David Ph.D. (University of Pennsylvania) Romoser, Amelia Ph.D. (Wyle Laboratories, Inc./NASA Johnson Space Center) Shou, Haochang Ph.D. (University of Pennsylvania) Stahn, Alexander Ph.D. (University of Pennsylvania) Williams, Edward Ph.D. (NASA Johnson Space Center)		
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Task Description:	This study utilizes Reaction Self-Test (RST) data collected in N=24 astronauts on 6-month International Space Station missions, arguably the largest cognitive dataset ever collected in spaceflight. The main objective is to additionally obtain data on key environmental stressors (i.e., CO2 levels, temperature, noise, and radiation) and combine them with RST data and other operational data. All data will be integrated in one carefully annotated database, which will be delivered to NASA at the end of the project and could be later amended and mined by other researchers. In addition, this project will develop an individualized dynamic prediction model that informs future Psychomotor Vigilance Test (PVT) performance based on environmental data, survey data, prior PVT administrations, and person-specific characteristics using state-of-the-art machine learning techniques such as functional concurrent regressions and neural networks for time series forecasting. At the end of the study, the team will deliver an algorithm to NASA that, for the first time, can predict adverse cognitive conditions in astronauts early and with an unprecedented precision.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This project develops a state-of-the-art predictive algorithm for adverse cognitive conditions. It is unique as it utilizes the arguably largest cognitive data set ever collected in spaceflight. It is innovative as it combines data on key environmental stressors prevalent in spaceflight with other contextual and time series data to predict cognitive performance. The fact that it will be possible for the first time to predict adverse cognitive conditions in astronauts early and with an unprecedented precision demonstrates the high impact of this proposal for both spaceflight and Earth.
Task Progress:	[Ed. note May 2020: Report submitted by TRISH to Task Book in March 2020; covers reporting as of November 2019.] This proposal addresses the Human Research Program (HRP) Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders and several other critical HRP risks and gaps. This study utilizes Reaction Self-Test (RST) data collected by the Principal Investigator (PI) and his team in N=24 astronauts on 6-month International Space Station (ISS) missions, arguably the largest cognitive dataset ever collected in spaceflight. RST consists of a survey module and a 3-minute version of the Psychomotor Vigilance Test (PVT). Our main objective is to additionally obtain data on key environmental stressors (i.e., CO2 levels, temperature, noise, and radiation) and combine them with RST data and other operational data collected by the PI and his team (Specific Aim 1). All data will be integrated in one carefully annotated database, which will be delivered to NASA at the end of the project and could be later amended and mined by other researchers (Deliverable 1). We will then develop an individualized dynamic prediction model that informs future PVT performance based on environmental data, survey data, prior PVT administrations, and person-specific characteristics using state-of-the-art machine learning techniques such as functional concurrent regressions and neural networks for time series forecasting (Specific Aim 2). We will perform model selection and identify those variables that have the highest predictive value for PVT performance (Deliverable 2) and could preferentially be collected on future spaceflight missions to inform relevant changes in cognition and behavioral health. At the end of the study, we will deliver an algorithm to NASA that, for the first time, can predict adverse cognitive conditions in astronauts early and with an unprecedented precision (Deliverable 3). The predictive algorithms can be translated to several settings on Earth where high performing individuals have to sustain high levels of cognitive performance while facing several environmental or other challenges (e.g., US Navy personnel on submarines). During the first year of the project, we obtained approval from the Lifetime Surveillance of Astronaut Health Board, the Institutional Review Board (IRB) of Johnson Space Center, and the IRB of the University of Pennsylvania to use already collected RST data for the purposes of this project. N=7 non-United States astronauts need to be re-consented, and Life Sciences Data Archive (LSDA) is in the process obtaining these consents. We also obtained key environmental variables from the ISS for the duration of the RST project (2009-2014): O2 and CO2 levels, noise levels, radiation levels, temperature levels. The temporal resolution of these data varies. We also extracted key demographic and operational information for the relevant time period. The four data streams (RST data, environmental data, demographic data, operational data) were combined in a data matrix. We are currently exploring simple associations between the different predictors and cognitive performance, and are cleaning the database from any erroneous values in the process. We have also begun identifying variables with high predictive value for Psychomotor Vigilance Test (PVT) performance.
Bibliography Type:	Description: (Last Updated: 06/19/2025)