Fiscal Year:	FY 2010	**Task Last Updated:**	FY 11/16/2009
PI Name:	Hienz, Robert D. Ph.D.		
Project Title:	Cognitive/Behavioral, Sensory, & Motor Changes Induced by Solar Particle Event (SPE) and Galactic Cosmic Ray (GCR) Irradiations		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Radiation health		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **SR**:Space Radiation		
Human Research Program Risks:	(1) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	bhienz@jhmi.edu	**Fax:**	FY 410-550-2780
PI Organization Type:	UNIVERSITY	**Phone:**	410-550-2788
Organization Name:	The Johns Hopkins University School of Medicine		
PI Address 1:	Department of Psychiatry & Behavioral Sciences		
PI Address 2:	5510 Nathan Shock Drive		
PI Web Page:			
City:	Baltimore	**State:**	MD
Zip Code:	21224-6823	**Congressional District:**	7
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2008 Space Radiobiology NNJ08ZSA001N
Start Date:	01/01/2009	**End Date:**	12/31/2010
No. of Post Docs:	1	**No. of PhD Degrees:**	1
No. of PhD Candidates:	1	**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Cucinott1a, Francis	**Contact Phone:**	281-483-0968
Contact Email:	noaccess@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: Received NCE through 12/31/2010, per J. Dardano/JSC; original end date was 12/31/2009 (9/2009)		
Key Personnel Changes/Previous PI:	(November 2009): A new Postdoctoral Fellow, Catherine M. Davis, Ph.D., is now on the project. Dr. Davis is assisting the Principal Investigator in project management and publication preparation, and is responsible for managing technical aspects of the project (hardware purchasing and construction, software development of behavioral control programs and data analysis software), as well as daily oversight and conduct of the studies.		
COI Name (Institution):	Weed, Michael (Johns Hopkins University)		
Grant/Contract No.:	NNX09AC52G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Assessing the biological consequences of living in the space radiation environment represents one of the highest priority areas of NASA research. Of critical importance is the need for an assessment of the vulnerabilities of the central nervous system (CNS) leading to functional neurobehavioral changes during long-term space missions, and the development of effective countermeasures to such risks. The present research addresses this need via the application of a comprehensive animal model to determine the effects of radiation exposure on neurobehavioral tests of vigilance and impulsivity. This 1-year project is assessing the likelihood of space radiation producing immediate and/or long-term functional changes in the CNS by measuring neurobehavioral function in rodents via animal tests analogous to "vigilance" tests in humans and relevant to astronaut mission performance effectiveness. Groups of animals are trained on the task, following which they receive head-only radiation and then re-tested immediately as well as periodically for up to 12 months post-exposure to assess potential long-term performance deficits. To determine the likely mechanisms of damage to the CNS following radiation exposure, (e.g., radiation-induced changes in neurotransmitter system function), this research is also testing the hypothesis that, since monoamine neurotransmitter systems are implicated in vigilance and impulsivity, radiation-induced damage to monoamine neurotransmitter systems is responsible for the cognitive/behavioral impairment following exposure to space radiation.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Research conducted on the effects of ionizing radiation on cognitive/behavioral function will provide the basis for extrapolating the effects of the space radiation environment on human cognitive function and performance. The Earth-based applications of this research will extend to providing a means for generalizing these effects to numerous types of radiation exposures (e.g., workplace, medical) on earth. Thus the outcomes of these studies are expected to have an important impact on safety and the quality of life in many Earth-based applied settings, and the society at large will further benefit from the resulting methodological advances that effectively provide quantitative risk assessments for radiation exposure on cognitive function.
Task Progress:	Progress during this first year consists of the development of an automated, computerized training and testing facility for measuring long-term effects of radiation exposure on cognitive/behavioral functions involving vigilance and impulsivity in rodents at the Johns Hopkins Medical Institutions. Initial establishment of the laboratory has been completed, and includes 10 experimental testing chambers and associated equipment for assessing neurobehavioral function in rodents, and provide for the daily automated, computerized training and testing of behavioral functions in test subjects. The facility supports both the exportation of groups of well-trained subjects to radiation exposure facilities such as Brookhaven National Laboratory (BNL) and the Department of Radiation Oncology of the Johns Hopkins Hospital, as well as the importation of radiation-exposed rodents from such facilities for detailed, long-term neurobehavioral risk assessments at our facility. During this one-year period, 80 rats have been trained on a rodent psychomotor vigilance task (rPVT), which is an animal analog of the Psychomotor Vigilance Task (PVT) used to study ‘vigilance’ in humans and validated to detect cognitive deficits caused by a variety of factors in space flight (e.g., sleep loss, sleep shifts, motion sickness). The rPVT task consists of a subject continuously monitoring and indicating the location of a brief visual target that occurs randomly in time. The task simultaneously assesses reaction time, vigilance, and impulsivity. Once trained on this task, all animals were exported to BNL for head-only radiation exposure and then returned to Johns Hopkins for follow-up testing. Radiation exposure doses consisted of 0, 25, 50, 100, and 200 cGy (5 dose levels) for protons (150 MeV/n). The zero-dose level represents non-exposed control animals (i.e., shipped to BNL, sedated and restrained for radiation exposure, but not actually radiated). Exposures of these 80 animals occurred on October 29-30, and the animals returned to Johns Hopkins approximately 1 week later and are just resuming their post-exposure testing runs. Results will be forthcoming as their psychomotor vigilance performances are tracked over the next 12 months. Results from this first year of the project demonstrated the feasibility of establishing a computer-based, automated training and testing facility for assessing cognitive and behavioral function in the rodent model. Additional results indicate that rodents are readily trainable on cognitive/behavioral tasks that are also employed as standards for assessing normal human cognitive/behavioral function, and that the analog of a human psychomotor vigilance task can be employed with rodents to automatically assess neurobehavioral function on a daily basis. These findings support the likely continued success of the rodent model for studying the cognitive, neurobehavioral, and CNS risks associated with living in the space radiation environment.
Bibliography Type:	Description: (Last Updated: 01/12/2021)