Fiscal Year:	FY 2017	**Task Last Updated:**	FY 03/10/2017
PI Name:	Rosenberg, Marissa Ph.D.		
Project Title:	Characterizing the Recovery of Sensorimotor Performance in Returning Astronauts (Postdoctoral Fellowship)		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Sensorimotor Adaptation Team		
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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:	77058	**Congressional District:**	22
Comments:			
Project Type:	GROUND	**Solicitation:**	2015 NSBRI-RFA-15-01 First Award Fellowships
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No. of PhD Candidates:	2	**No. of Master' Degrees:**	1
No. of Master's Candidates:	1	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
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Key Personnel Changes/Previous PI:			
COI Name (Institution):	Reschke, Millard (MENTOR/ NASA Johnson Space Center)		
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POSTDOCTORAL FELLOWSHIP
This project aims to characterize the functional performance decrements after long duration spaceflight due to alterations of the sensorimotor system during gravity transitions. This project collaborates directly with Field Test, a currently NASA directed study (Principal Investigator: Millard Reschke). Data is collected on crewmembers three times within 24 hours of landing, the first being within 2 hours of impact in the medical tent at the landing zone. This is the first time that data has been collected within the first day of landing for long-duration crews. Additional data points are taken pre-flight and approximately 7 days after landing. Field Test is also a collaboration with the Institute of Biomedical Problems in Moscow, Russia and Russian cosmonauts are tested at Star City. More specifically, this project is focused on determining the efficacy of different non-pharmacological countermeasures to landing-induced motion sickness. Thus far, 100% of returning long-duration crewmembers experience motion sickness symptoms. Most commonly used

Task Description:	pharmacological antiemetics (such as scopolamine or promethazine) have undesirable side effects, such as drowsiness, slowed response time, and fatigue. Using data from the Field Test, we aim to determine if retinal slip is correlated to degree of landing-induced motion sickness. We hypothesize that landing sickness is driven by increased retinal slip caused by changes in the otolith during gravity transition, which is critical for maintaining gaze. Increased retinal slip increases the difficulty for a crewmember to focus an image on their retina. The ability to maintain focus of an image while in motion can be estimated by dynamic visual acuity (DVA). DVA is worsened in astronauts by an average of 0.75 eye-chart lines one day after landing (Peters et al., 2011), suggesting that retinal slip is increased after gravity transition. If the severity of motion sickness is correlated to the decrement in DVA, this suggests that it is indeed retinal slip driving the sensory conflict resulting in motion sickness. Previously, the use of stroboscopic goggles has shown to be effective in minimizing motion sickness symptoms due to retinal slip (Reschke et al., 2007). We aim to simulate the decrement in DVA caused by sensorimotor re-adaptation by using minifying lenses and test the efficacy of stroboscopic goggles in preventing retinal slip and improving DVA. If successful, this could be implemented as a countermeasure for landing sickness in returning astronauts as part of the current Field Test. Similarly, Stochastic resonance (SR) is a mechanism whereby noise can assist and hence enhance the response of neural systems to relevant, subthreshold sensory signals. We will take advantage of this mechanism in this study to develop a unique stochastic vestibular stimulation (SVS) countermeasure system to mitigate SMS (space motion sickness). The hypothesis of this project is determine the efficacy of SVS as a non-pharmacological countermeasure to replace or reduce the promethazine dosage requirements and improve performance during transitions to new gravitational environments after short and long transit durations during exploration class missions.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Although these studies are designed specifically to help crewmembers during a gravity transition, there are several Earth-based impacts as well. First, being able to characterize sensorimotor recovery and quantify improvement is critical for patients undergoing sensorimotor rehabilitation. In addition, determining individual predictors to determine if one is a slow adapter or a fast adapter can help predict rehabilitation time and recovery speed. Second, our battery of easy, mobile, and efficient functional tasks can be used a diagnostic tool to determine the amount of functional deficit patients may suffer as well as a quantitative way to mark performance. The data we are collecting, especially for the tandem walk test, will allow us to quantify a normal sensorimotor performance. Third, our non-pharmacological countermeasures for mitigating nausea can help many who suffer from vertigo in their daily lives without the need for drugs like promethazine, which cause fatigue.
Task Progress:	Specific Aim 1: Field Test Over the last year, the full Field Test has completed testing on 9 crewmembers at the landing site in Kazakhstan. Overall, 71 testing sessions have been completed, including baseline data collection and post-flight follow up sessions. Using this data along with data from the Pilot Field Test, I have developed automated data analysis scripts for the Recovery from Fall, Tandem Walk, Sit-to-Stand, and Dynamic Visual Acuity tasks. We are currently working on improving data analysis of the tandem walk task and further automating all scripts. We visited our collaborators at the Institute for Biomedical Problems in Moscow for a data analysis planning meeting and to observe the test sessions and ensure our methods are consistent. We plan on sharing our automated scripts with them so the analyses are also consistent. Specific Aim 2: Stroboscopic Vision Goggles. Within the last three months (August-October), we completed testing of 20 healthy non-astronaut subjects. Although data analysis is on-going, the results thus far suggest that indeed, dynamic visual acuity is significantly worse with the minifying lenses, but is unchanged from baseline with the combination of stroboscopic goggles and minifying lenses. However, their dynamic visual acuity is still slightly worse with the stroboscopic goggles and minifying lenses, but this is likely due to the nature of the DVA test instead of an actual worsening of vision while in motion. Depending on the final results of the analysis, we may transition to using the stroboscopic goggles in the field if crewmembers are unable to perform the field test due to nausea. Specific Aim 3: Stochastic Vestibular Stimulation Between May and August, we completed data collection on 20 subjects to determine if stochastic vestibular stimulation is an effective countermeasure for motion sickness. Each test session was 2 hours and subjects participated in two sessions, comprising of a total of 80 hours of testing. Data analysis on this study is also still in progress, but initial results suggest that subjects lasted longer overall and had a less steep motion sickness progression when SVS was administered. Between March and May this year, we also conducted a study at Baylor College of Medicine to determine the minimum level of stimulation that warranted a specific amount of balance disturbance. This study was performed on 15 healthy subjects who stood with their eyes closed on foam and were given galvanic vestibular stimulation (GVS) ranging from 0 mA-4.5 mA by increments of 0.5 mA. In this study, we found that at 3.0 mA, the amount of balance disturbance subjects experienced plateaued, such that at amperage higher than 3.0 mA, subjects were not further disturbed. This will be used for future studies where GVS will be used to simulate vestibular dysfunction as an analog to spaceflight, such that we give the minimum stimulation for the maximal effect.
Bibliography Type:	Description: (Last Updated: 03/22/2017)
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Abstracts for Journals and Proceedings	Rosenberg MJF, Kreutzberg GA, Galvan-Garza RC, Mulavara AP, Reschke MF. "Non-pharmacological countermeasure to decrease landing sickness and improve functional performance while disoriented." 2017 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 23-26, 2017. 2017 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 23-26, 2017. , Jan-2017
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