Fiscal Year:	FY 2010	**Task Last Updated:**	FY 05/11/2011
PI Name:	Kanas, Nick M.D.		
Project Title:	Crew Interactions and Autonomy During Long-Duration Isolation and Confinement (105-Day Russian Chamber Study)		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Neurobehavioral and Psychosocial Factors Team		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **BHP**:Behavioral Health & Performance (archival in 2017)		
Human Research Program Risks:	(1) **Team**:Risk of Performance and Behavioral Health Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	94121	**Congressional District:**	8
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	Directed Research
Start Date:	03/01/2009	**End Date:**	09/30/2010
No. of Post Docs:	0	**No. of PhD Degrees:**	0
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:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Neylan, Thomas (University of California, San Francisco) Boyd, Jennifer (University of California, San Francisco) Weiss, Daniel (University of California, San Francisco) Marmar, Charles (New York University Medical Center)		
Grant/Contract No.:	NCC 9-58-NBPF00005		
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Performance Goal Text:			

Task Description:

Crewmembers participating in long-duration space missions beyond the Earth-Moon environment will have more autonomy than in previous on-orbit missions or missions to the Moon. During previous on-orbit and lunar space missions, personnel in mission control generally have timelined and coordinated crewmember work schedules, and crew-ground communications have been frequent and in real time. However, during future expeditionary missions beyond the Earth-Moon neighborhood, the long distances and mission durations will increase crewmember autonomy dramatically. Crewmembers will be responsible for planning most of their work schedules and dealing with emergencies that arise. Furthermore, there will be lags in two-way communication with the Earth of up to 44 minutes from the surface of Mars. It is not known how this increased autonomy will affect crewmember performance and safety and what its impact will be on mission control operations on Earth.
Our study of increased crewmember autonomy was conducted through the Mars 500 Program at the Institute for Biomedical Problems (IBMP) in Moscow. The Mars 500 Program is designed to study the performance and interactions of a group of six individuals confined for 520 days (and began in June 2010). The lower floor of the simulation habitat contains living and laboratory areas for the crew, and the upper floor is a mock-up of the Mars surface on which the crew can simulate geological and other planetary activities. We participated in a 105 day pilot simulation from March 31 to July 14, 2009.

In order to study the impact of high versus low crew autonomy on crewmembers and mission control personnel, we studied the 6 men in the isolation chamber, along with 18 outside individuals who monitored their activities in a simulated mission control. During the first 10 weeks of the mission, the crew interacted with mission control under a low autonomy condition, where the latter developed the work schedule and communicated with the former in real time. During the last 5 weeks, a high autonomy condition was instituted, where crewmembers planned and revised their work schedule and where a 40-minute Mars-like communication delay occurred with the outside monitors.

Our methodology was similar to that used in our previous on-orbit studies involving the Mir and International Space Station, where we evaluated mood and group interpersonal climate, both in space and in mission control. After signing informed consent, crew and mission control subjects participating in the 105 day simulation completed a weekly study questionnaire that included items from the Profile of Mood States (POMS) and two group climate measures, the Group Environment Scale (GES) and the Work Environment Scale (WES). From these measures, weekly mean subscale scores were calculated that gave us an indication of psychological constructs such as tension and other emotional states, group cohesion, and the task and support roles of the leader. Additionally, we constructed and piloted six new weekly questions that attempted to measure crewmember individual and group work planning freedom, work performance efficiency, and work performance accuracy.

The results suggested that high work autonomy was well-received by the crew, mission goals were accomplished, and there were no adverse effects. During the high autonomy period, crewmember mood and self direction were reported as being better, but mission control personnel reported more anxiety and work role confusion. Despite scoring lower in work pressure overall, the four Russian crewmembers reported a greater rise in work pressure from low to high autonomy than the two Europeans. In contrast, the European crewmembers reported a greater rise in negative dysphoric mood in going from low to high autonomy, whereas the Russians' emotional state remained the same or slightly improved. Work freedom was rated slightly higher during high autonomy, but work performance was about the same overall, although Russian scores increased and European scores decreased on all four performance measures.

Increased autonomy can be safe and advantageous. It is time to study the effects of high autonomy with larger subject samples during on-orbit space missions (e.g., to the International Space Station) in order to prepare for future deep space exploratory missions, where high autonomy will be the norm.

Rationale for HRP Directed Research:

Research Impact/Earth Benefits:

Crewmembers participating in long-duration space missions beyond the Earth-Moon environment will have more autonomy than in previous on-orbit missions or missions to the Moon. During previous on-orbit and lunar space missions, personnel in mission control generally have timelined and coordinated crewmember work schedules, and crew-ground communications have been frequent and in real time. However, during future expeditionary missions beyond the Earth-Moon neighborhood, the long distances and mission durations will increase crewmember autonomy dramatically. Crewmembers will be responsible for planning most of their work schedules and dealing with emergencies that arise. Furthermore, there will be lags in two-way communication with the Earth of up to 44 minutes from the surface of Mars. It is not known how this increased autonomy will affect crewmember performance and safety and what its impact will be on mission control operations on Earth.
In 2006, we were directed by NASA/Johnson Space Center to study the impact of high autonomy on crewmembers and monitoring personnel involved with a variety of space simulation missions conducted on Earth in an effort to prepare for expeditionary missions to Mars and other distant locations. The current ground simulation study was conducted through the Mars 500 Program at the Institute for Biomedical Problems (IBMP) in Moscow. The MARS 500 Program is designed to study the performance and interactions of a group of six individuals confined for 520 days. We participated in a 105 day pilot simulation. The Specific Aims of our study were: to assess the impact of higher crewmember autonomy on crew and mission control mood and group interpersonal climate (using previous questionnaire scales), and to assess crewmember individual and group work planning freedom, work performance efficiency, and work performance accuracy (using newly constructed pilot measures).

Results from this study indicated that increased crew autonomy can be safe and advantageous. It is time to study the effects of high autonomy with larger subject samples during on-orbit space missions (e.g., to the International Space Station) in order to prepare for future deep space exploratory missions, where high autonomy will be the norm.

Additionally, some of findings contributed to recommendations regarding the recent Chilean miner isolation event [see below].

References

1. Kanas, N. Notes for the Underground. Summary of NASA research as it applies to the trapped Chilean miners. The New York Times Op-Ed Section, http://www.nytimes.com/ , August 29, 2010.

Task Progress:	Crewmembers participating in long-duration space missions beyond the Earth-Moon environment will have more autonomy than in previous on-orbit missions or missions to the Moon. We participated in a 105 day pilot simulation from March 31 to July 14, 2009 as part of the Mars 500 Program at the Institute for Biomedical Problems (IBMP) in Moscow. Results from this study indicated that increased crew autonomy can be safe and advantageous. It is time to study the effects of high autonomy with larger subject samples during on-orbit space missions (e.g., to the International Space Station) in order to prepare for future deep space exploratory missions, where high autonomy will be the norm.
Bibliography Type:	Description: (Last Updated: 03/17/2017)
Articles in Peer-reviewed Journals	Kanas N, Saylor S, Harris M, Neylan T, Boyd J, Weiss DS, Baskin P, Cook C, Marmar C. "High versus low crewmember autonomy in space simulation environments." Acta Astronaut. 2010 Oct-Nov;67(7-8):731-8. http://dx.doi.org/10.1016/j.actaastro.2010.05.009 , Oct-2010
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Papers from Meeting Proceedings	Kanas N, Harris M, Neylan T, Boyd J, Weiss D, Cook C, Saylor S. "High versus low crewmember autonomy during a 105-day Mars simulation mission." 61st International Astronautical Congress, Prague, Czech Republic, September 27-October 1, 2010. 61st International Astronautical Congress, Proceedings, p. 1-4, 2010. , Sep-2010
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Significant Media Coverage	Kanas N. "'Notes for the Underground.' Summary of NASA psychosocial research as it applies to the trapped Chilean miners published in The New York Times." The New York Times, August 30, 2010, p. A17. http://www.nytimes.com/2010/08/30/opinion/30kanas.html?_r=1 , August 29, 2010., Aug-2010