Fiscal Year:	FY 2016	**Task Last Updated:**	FY 04/13/2016
PI Name:	Salas, Eduardo Ph.D.		
Project Title:	Using Real-Time Lexical Indicators to Detect Performance Decrements in Spaceflight Teams: A Methodology to Dynamically Monitor Cognitive, Emotional, and Social Mechanisms That Influence Performance		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Neurobehavioral and Psychosocial Factors Team		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) **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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Comments:	NOTE: Previous affiliation was University of Central Florida, until mid-2015		
Project Type:	Ground	**Solicitation / Funding Source:**	2012 Crew Health NNJ12ZSA002N
Start Date:	08/01/2013	**End Date:**	05/31/2017
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	5	**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:	NOTE: Element change to Human Factors & Behavioral Performance; previously Behavioral Health & Performance (Ed., 1/18/17) NOTE: End date changed to 5/31/2017 per NSBRI (Ed., 2/21/17) NOTE: End date changed to 1/31/2017 per NSBRI (Ed., 8/31/15) NOTE: End date is now 7/31/2016 (previously 11/30/2014) per NSBRI (Ed., 12/8/14) NOTE: End date is now 11/30/2014 per NSBRI (Ed., 7/15/14)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Driskell, James (Florida Maxima Corp.)		
Grant/Contract No.:	NCC 9-58-NBPF03402		
Performance Goal No.:			
Performance Goal Text:			

Task Description:

Future exploratory long-duration missions will incorporate a crew of six on a mission length of approximately 2.5 years. Challenges include the requirement for the crew to function autonomously, under significant communication delays, and with the potential for increased crew and interpersonal friction or tension. The specific aims of this research are to (1) develop a methodology to assess cognitive and emotional state at a distance though analysis of spontaneous verbal output in real-time communications and (2) test the feasibility of a real-time assessment tool, STRESSnet, to detect cognitive performance deficits, stress, fatigue, anxiety, and depression in the spaceflight operational setting.
Because the health and well-being of crew members directly affects mission success, it is important to track cognitive/emotional changes that may indicate a deficit. One problem with many existing assessment methods is that most require direct observation of behavior or performance or self-assessment by a pen and paper-type instrument. The requirement to assess individual and team functioning at a distance suggests the potential efficacy of a methodology to assess cognitive and emotional state in real-time from ongoing or spontaneous verbal output. The basic premise of this work is that spontaneous verbal output provides a natural and valid indicator of basic cognitive processes. Natural word use is not prone to the typical limitations of self-report measurements. That is, natural language use is less subject to social desirability bias, and can be derived in real-time without interfering with the cognitive processes being measured, and without interrupting crew performance. Moreover, natural word use is reliable and consistent across time and context, and can be meaningfully measured in individuals and teams.

STRESSnet is a lexical analysis tool designed to provide a non-obtrusive means of detecting stress and related deficits in long-duration spaceflight through the assessment of spontaneous verbal output in real-time crew communications. The research builds on existing work on text and sentiment analysis; however, STRESSnet is unique in that (1) it is specifically designed to assess stress and related cognitive/emotional states, (2) we draw on existing astronaut communications and mission logs to develop a lexicon that includes terms unique to this environment, and (3) we developed STRESSnet with the specific goal of application as a tool to assess user state and provide automatic schedule recommendations for crew work/leisure activities to counter identified deficits. STRESSnet provides an unobtrusive means to evaluate ongoing task communications within the crew and between the crew and mission control in order to assess cognitive/emotional states such as workload, negative affect, stress, anxiety, and depression.

Individualization of this tool to each crew member can be achieved in the 5-year pre-training period. This tool will be tested in Human Exploration Research Analog (HERA), NASA Extreme Environment Mission Operations (NEEMO), and other analogs, as well as tested in archival analyses using existing mission transcripts.

Rationale for HRP Directed Research:

Research Impact/Earth Benefits:

The operational context of spaceflight is dynamic, complex, and extreme (e.g., Mallis & DeRoshia, 2005; NASA, 2007). In the long-duration exploratory missions of the future, these demands may be exacerbated because of the longer periods of isolation and confinement, the increased autonomy of the crew, and the potential for greater tension and interpersonal conflict (Beven, 2012). In brief, flight crews will be exposed to an array of environmental, task, and interpersonal stressors that can negatively impact performance as well as jeopardize the safety and well-being of crew members. According to the NASA Human Research Roadmap (Slack, Shea, Leveton, Whitmire, & Schmidt, 2009), Long-duration missions to remote environments will increase astronaut exposure to extreme isolation and confinement, resulting in higher stress levels and an increased risk of crew morale deterioration. Furthermore, Strangman (2010) has noted that there exists a large number of reports from the early age of exploration to the present day indicating that mood disturbance, depression, anxiety, and hostility are all substantial concerns for spaceflight (cf. Shepanek, 2005; Stuster, 2011). Unlike teams in the experimental laboratory that can be examined under a microscope, teams in the real world operate autonomously, apart from direct observation and supervision, and operate in a fluid, dynamic manner to achieve the team's objective (Driskell, Burke, Driskell, Salas, & Neuberger, 2014). Therefore, the requirement exists to develop non-obtrusive means of detecting cognitive performance deficits, stress, fatigue, or anxiety in situ without the intrusion of the psychologist's typical array of questions and questionnaires. The requirement to assess individual and team functioning at a distance suggests the potential efficacy of a methodology to assess cognitive and emotional states in real-time from ongoing or spontaneous verbal output. In brief, we believe that we can track stress, anxiety, and related cognitive and emotional states in team performance settings via non-obtrusive monitoring of lexical output.
References

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Slack, K., Shea, C., Leveton, L. B., Whitmire, A. M., & Schmidt, L. L. (2009). Risk of behavioral and psychiatric conditions. Human Health and Performance Risks of Space Exploration Missions. NASA SP-2009-3405. Houston, TX: National Aeronautics and Space Administration Lyndon B. Johnson Space Center, 3-45.

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Shepanek, M. (2005). Human behavioral research in space: quandaries for research subjects and researchers. Aviation, Space, and Environmental Medicine, 76, B25-B30.

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Task Progress:	To date, we have collected data from HERA Campaign 1 (C1M1 – C1M4), HERA Campaign 2 (C2M1 – C2M4), and NEEMO18. The Year 1 effort was to conduct a proof-of-concept study to demonstrate the feasibility of this approach in the Year 1 HERA analogs. This was accomplished, demonstrating that (a) lexical measures can distinguish between high stress and nominal stress in HERA, (b) these measures are consistent with traditional pen and paper measures of stress, and (c) they show sensitivity to variations in stress levels. However, it is important to note that our goal in this project is to develop and test a lexical analysis tool that is tailored for, and optimized to, the LDSF (long duration space flight) environment, rather than simply apply an existing lexical analysis program. That is, we proposed to develop a lexical analysis tool, STRESSnet, that is specifically tailored to assess stress effects in the LDSF environment. This requires that we base this tool on a comprehensive model of the stress domain that draws on existing theory on stress, performance, and well-being, and that we incorporate terms drawn from the existing spaceflight corpus. In Year 1, at the direction of the project sponsors, we had to shift our focus immediately to testing a preliminary version of STRESSnet in HERA1 to demonstrate the feasibility of this approach. Thus, the methodological development of the STRESSnet tool was accelerated to meet this schedule, resulting in a quickly-composed scale that was suitable for testing. In Year 2, we are able to perform the more detailed, iterative tasks that are required for the development of the STRESSnet dictionaries. Therefore, there are two primary YR2 tasks that were performed: (1) Data collection and analysis of HERA C2M1 – C2M4 (analyses are still ongoing). (2) Tool revision and elaboration to derive the STRESSnet lexical dictionaries. This report focuses on the tool development task. The products of this task are the searchable dictionaries of lexical terms to assess stress and related states. To derive these dictionaries, we first developed a comprehensive model of stress, performance, and well-being. Guided by this model, we derived five major stress dimensions to be examined (attentional focus, cognitive load, anxiety, negative emotion, and social impairment), as well as a number of sub-facets within each core dimension. To develop lexical measures for each sub-facet (such as sadness), we first scavenged existing sources (available scales, questionnaires, existing lexical dictionaries, as well as reviewing Johnson Space Center (JSC) mission transcripts) to develop an initial inventory of terms reflecting that sub-facet or construct. We then initiated a series of iterative ratings of these word lists in order to include additional relevant terms and exclude irrelevant terms.
Bibliography Type:	Description: (Last Updated: 09/04/2023)
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