Fiscal Year:	FY 2023	**Task Last Updated:**	FY 06/15/2023
PI Name:	Chaspari, Theodora Ph.D.		
Project Title:	Artificial Intelligence for Tracking Micro-Behaviors in Longitudinal Data and Predicting Their Effect on Well-Being and Team Performance		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
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:	77843-0001	**Congressional District:**	17
Comments:			
Project Type:		**Solicitation / Funding Source:**	2020 HERO 80JSC020N0001-FLAGSHIP, OMNIBUS1 Human Research Program: Crew Health Appendix A; Omnibus1-Appendix B
Start Date:	03/09/2022	**End Date:**	12/31/2023
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**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:	Whitmire, Alexandra	**Contact Phone:**	
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 12/31/2023 per NSSC information (Ed., 7/6//23) NOTE: End date changed to 08/31/2023 per A. Beitman/JSC (Ed., 2/22/23) NOTE: End date changed to 03/08/2024 per NSSC information (Ed., 2/15/23)		
Key Personnel Changes/Previous PI:	NOTE: Per the Principal Investigator (PI): Dr. Roma and Dr. Loerch are no longer with the project (Ed., 7/6/23).		
COI Name (Institution):	Bell, Suzanne Ph.D. (NASA Johnson Space Center)		
Grant/Contract No.:	80NSSC22K0775		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Future long-distance space exploration will have a number of challenges that increase the risk of inadequate cooperation, coordination, collaboration, and psychosocial adaptation, and can lead to behavioral health and performance decrements. In NASA-sponsored analogs, the primary methodology for capturing team interaction data is self-report surveys. While this method may provide some insights, it has significant limitations and biases. We hypothesize that micro-behaviors detected by artificial intelligence (AI) can provide unique insights into emotional reactivity and operationally-relevant team performance, beyond self-report team functioning measures commonly used in NASA-funded research. Micro-behaviors are small, often unconscious gestures, words, and tone of voice which can influence how included (or not included) the people around us feel. The most common type of micro-behaviors are micro-aggressions, which refer to subtle negative exchanges that may take a concealed form, including communications that negate one's thoughts or feelings, offensive jokes/comments, underestimation of the other's ability, or even rudeness and insensitivity. On the other hand, micro-affirmations reflect inclusion and caring and include behaviors such as active listening, recognizing others' achievements, and using friendly expressions and tone of voice. While micro-aggressions can have detrimental impact to well-being and team performance, micro-affirmations can counter-act micro-aggressions' harmful effects. Our research has three primary aims: (1) Leverage advanced multimodal data analytics to detecting micro-behaviors in longitudinal team interactions; (2) Identify emotional reactivity to micro-behaviors; and (3) Incorporate knowledge on micro-behaviors to predict operationally relevant team performance. We will leverage natural language processing analytics and build conversational markers of micro-aggressions that can "read between the lines" by knowledge automatically mined from word embeddings. We will further design linguistic measures of dialogue (in)coherence and (im)polite language, as well as vocal indices representative of empathy and sarcasm. We will further employ machine learning algorithms to learn complex multimodal patterns of micro-behaviors. The proposed AI algorithms will be evaluated on longitudinal data previously collected over 45-day missions from the NASA Human Exploration Research Analog (HERA). This will allow us to identify common targets, micro-aggressors, allies, and bystanders of micro-behaviors with potentially higher sensitivity compared to self-report measures of relational and team functioning. We will quantify individuals' emotional reactivity to micro-behaviors through electrocardiogram (ECG) measures, which will help us tease out the micro-behaviors that matter most (even in an unconscious manner). Measures related to micro-behaviors will be used in combination with existing self-report measures of relational and team functioning to predict operational team performance. We hypothesize that incorporating this additional information will augment the accurate estimation of team outcomes. Our research will make significant contributions toward reducing the Team Risk, particularly gaps 102 and 106. Identified key micro-behaviors that affect well-being and team performance can be used as unobtrusive measures with which to monitor team functioning. Insights from this 1-year project can inform targeted personalized pre-mission and in-mission intervention strategies (e.g., micro-video training) that suggest concrete action items to crew-members and gradually adapt recommendations for a specific person and/or team.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	We built conversational markers of micro-behaviors that can "read between the lines" by automatically mining knowledge from word embeddings, linguistic measures of dialogue (in)coherence and (im)polite language, and prosodic changes representative of empathy and sarcasm. Our current analysis focused on communication behaviors related to work performance and information sharing processes (e.g., regulation, agreement/disagreement). Data were coded using a paradigm developed for the larger project, which was adapted from two previous coding schemes on team interaction: Schermuly and Scholl's discussion coding system and Gushin et al.'s work on communication between spaceflight crews and mission control. We leveraged machine learning classifiers and dialog state tracking models, combined with natural language processing techniques relying on lexicon-based methods and data-driven methods, to learn complex multimodal patterns of micro-behaviors and automatically detect positive and negative micro-behaviors between team members. We evaluated the proposed methods on the Team Interaction Battery (TIB) task collected pre-, in-, and post-mission by five teams with 36 crew members (11 female) in the NASA Human Exploration Research Analog (HERA). Exploratory analysis suggests that negative micro-behaviors included increased sentences with passive voice for both the sender and the target, potentially due to the subtlety of their expression. Negative micro-behaviors also depicted fewer second-person personal pronouns (e.g., "you") compared to turns without those behaviors. While this finding for negative micro-behaviors might initially be nonintuitive, since blaming language tends to include a large number of second-person pronouns, this result might also reflect the fact that negative micro-behaviors are many times indistinct and not sharply expressed. Positive micro-behaviors had a significantly higher positive affect, a lower percentage of angry language, and a higher percentage of language related to achievements compared to negative micro-behaviors. Acoustic turn similarity between sender and target was the highest for instances of positive micro-behaviors (i.e., indicating convergence between speakers) and the lowest for instances of negative micro-behaviors (i.e., indicating divergence between speakers). Our experimental findings indicate that the psycholinguistic markers extracted using the linguistic inquiry and word count (LIWC), STRESSnet dictionaries, and acoustic features can achieve an f1-score up to 55% in a three-class classification problem, which is well above the 33% chance accuracy. Our findings also suggest that modeling turns between the sender and target of micro-behaviors is significantly more effective in detecting micro-behavior than only modeling the sender's information. Finally, we demonstrate the effect of introducing context for detection purposes. Dialog state tracking approaches that model the linguistic interaction between team members and incorporate contextual information about the task and sentiment of the conversation can further yield improved performance, depicting an f1-score of 57.73%.
Bibliography Type:	Description: (Last Updated: 03/07/2024)
Abstracts for Journals and Proceedings	Paromita P, Khander A, Begerowski SR, Bell ST, Chaspari T. "Linguistic and vocal markers of micro-behaviors between team members during analog space exploration missions." NASA Human Research Program Investigators' Workshop (IWS), Galveston, Texas, February 7-9, 2023. Abstract. NASA Human Research Program Investigators' Workshop (IWS), Galveston, Texas, February 7-9, 2023. , Feb-2023

Abstracts for Journals and Proceedings	Begerowski SR, Khader AM, Paromita P, Chaspari T, Bell ST. "What's that supposed to mean? Capturing micro-behaviors in teams." Society for Industrial Organizational Psychology (SIOP), Boston, Massachusetts, April 19-22, 2023. Abstract. Society for Industrial Organizational Psychology (SIOP), Boston, Massachusetts, April 19-22, 2023. , Apr-2023
Articles in Peer-reviewed Journals	Paromita P, Khader A, Begerowski S, Bell ST, Chaspari T. "Linguistic and vocal markers of microbehaviors between team members during analog space exploration missions." IEEE Pervasive Computing. 2023 Apr-Jun. https://doi.org/10.1109/MPRV.2022.3232780 , Jun-2023