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Comments:			
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Flight Program:			
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Key Personnel Changes/Previous PI:	Added: James S. Garrett, PhD, NASA Johnson Space Center (co-I) Steven R. Anderson, PhD, KBR (co-I) Removed: Jerri Stephenson, M.S., NASA Johnson Space Center (co-I) Sara Whiting, PhD, KBR (co-I)		
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Task Description:	Artemis II will mark the first time NASA astronauts go beyond low-Earth orbit (LEO) since the Apollo era, and the first astronauts heading into space in the Orion vehicle. As such, it provides a critical opportunity to refine our understanding of the likelihood and consequences associated with the Behavioral Medicine (BMed), Team, Human System Integration Architecture (HSIA), and Sleep Risks, and prepare for future Moon and Mars missions. The overarching goal of our research is to utilize Artemis II data to further define the likelihood and consequences of these risks, and to create a research infrastructure that can be expanded to include future Artemis missions. We propose a 3-phase research effort. In Phase I, we will use summaries of existing research (e.g., evidence books and Directed Acyclic Graphs/DAGs), literature reviews, and subject matter expert (SME) input to identify and conceptualize key performance metrics, contributing factors, and BMed, Team, HSIA, and Sleep risk constructs related to performance decrements. We will describe how the constructs are expected to arise in spaceflight, and conduct a review that summarizes how metrics (e.g., behaviors and trace data, words and linguistics, and physiological data) derived from data streams available in Artemis II (e.g., audiovisual data) can serve as indicators of these constructs for in-mission measurement during Artemis. The Phase I effort will result in a finalized pre- and post-mission protocol for Artemis II, along with a measurement and coding scheme for in-mission Artemis II data. Phase II includes data collection from the Artemis II mission. Phase III will include data processing, data analysis under a Bayesian framework, coding, depiction, analysis, and report writing.
Rationale for HRP Directed Research:	This research is directed because it contains highly constrained research. Artemis II provides a critical opportunity to refine our understanding of the likelihood and consequences associated with BMed, Team, HSIA, and Sleep Risks, and prepare for future Moon and Mars missions. Two significant constraints shape the research methodology. First, there is currently no in-mission crew time available to complete measures. In-mission data will need to be collected unobtrusively from available data streams (e.g., audiovisual, existing records such as schedules, and actigraphy). Second, Artemis II is anticipated to be a crew of 4 astronauts in flight for 10 days followed by additional crewed Artemis missions. This creates a scenario where there is important data for understanding risk characterization; however, there will be a small sample size from Artemis II, and risk characterization will need to be updated over time as additional crews fly in later Artemis missions.
Research Impact/Earth Benefits:	Our research program and associated deliverables will substantially reduce NASA's Human Research Program Behavioral Medicine (BMed), Team, Human Systems Integration Architecture (HSIA), and Sleep Risks and inform gaps in knowledge related to future Moon and Mars missions. Our primary contributions will be in advancing less obtrusive methodologies for monitoring and measuring risk metrics; examining potential BMed, Team, HSIA, and Sleep risks in a new vehicle, with new mission scenarios and procedures; and characterizing risks beyond LEO as multiple stressors converge. The advances in less obtrusive methodologies may have broader application to other private and public sector organizations interested in team dynamics, well-being, sleep, and human factors. Given that Artemis II will be the first human spaceflight in Orion, these data will be particularly valuable for informing modifications necessary for future Moon and Mars missions. Finally, Artemis II data will be the first systematic data collection related to these risks beyond LEO and allow for the potentially additive or synergistic effect of multiple stressors on sleep, and psychological and team health as the crew interacts with new vehicle and system interface deigns, as well as mission scenarios.
Task Progress:	Over the past year, the Behavioral Health and Performance Laboratory and collaborators from the Fatigue Laboratory and Human Systems Integration Architecture (HSIA) have made progress on Phase I of the project. The research team has worked to identify key constructs pertaining to the BMed, Teams, Sleep, and HSIA risk areas likely to be most relevant to Artemis II missions. Alongside these efforts, the team has been consulting with relevant subject matter experts (SMEs) in the Artemis program to understand audio/video capabilities on Orion. Using the identified constructs along with the developing understanding of data-collection capabilities, the research team is beginning to identify observable behaviors and existing tools that can be used to characterize the risks in the context of audio/video capabilities available. Behavioral medicine risk The research team conducted a literature review of spaceflight and spaceflight analog evidence to identify key indicators, or constructs, of behavioral health and performance. The team narrowed these to 4 constructs that appear to be most impacted by these environments. Contextual factors that impact behavioral health were also identified and linked to possible critical periods likely to be observed during the Artemis II mission. The team also identified natural language processing (NLP) tools to analyze the audio recording (LIWC and STRESSnet) and is currently drafting a codebook that links the identified BMed constructs to the dictionaries provided by these tools. Finally, the research team is conducting a literature search to determine behavioral coding schemes to characterize BMed constructs using video data. Team risk The research team drew from the Team Risk deliverable presented to the Human Subjects Review Board (HSRB) in 2021, which identified key indicators, or constructs, of team functioning and performance with recommended measures. The research team considered each indicator in the context of the Artemis II mission, selecting those that were most applicable. Next, the team identified unobtrusive measurement methods (e.g., lexical analysis of transcripts) and/or behaviors related to those constructs, which will allow researchers to code and analyze team interactions captured in crew audio/video data and space-to-ground loops. HSIA risk HSIA is a risk that is based in part on vehicle system capabilities and how those capabilities enable crew-ground team performance in responding to unanticipated major vehicle anomalies and executing safety-critical procedures. The research team draws from analyses of responses to actual International Space Station (ISS) anomalies, related human-systems engineering disciplines (cognitive engineering, safety engineering, reliability engineering, resilience engineering) as well as organization research (high-reliability organization) to identify key indicators, or constructs, of human-systems team performance. The team is in the process of identifying candidate constructs along with their associated crew behavior indicators as well as system capabilities needed to support resilient crew-ground team performance. In parallel, the team is conducting exploratory analysis using transcripts and videos from past missions

	(Apollo, ISS) to identify mission-critical communication patterns and derive resilience-indicating behaviors for the codebook. Sleep risk The research team drew from foundational sleep literature to determine key sleep metrics (sleep duration, sleep efficiency, wake after sleep onset, and sleep latency). The state of sleep as observed in video recordings will be correlated against a known tool used during spaceflight (actigraphy) to benchmark passive tools for measuring sleep. Using both actigraphy and video recordings, the team will examine the cognitive consequences of sleep loss and circadian misalignment on the constructs defined by the BMed, Teams, and HSIA groups. The team plans to specifically analyze patterns of behavior and language during critical periods when the crew might be less alert (for example, just after waking when humans experience sleep inertia) or when the crew might need to perform high-workload tasks.
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