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DECIDING ON MARS: THE EFFECTS OF ISOLATION ON AUTONOMOUS TEAM DECISION-MAKING

Abstract

Long distance missions, like Mars, hinge on autonomous crews comprised of diverse experts to make high quality decisions throughout the mission. How well do analog crews perform on decision tasks involving distributed expertise? Are there mission phases where performance is particularly problematic? Does dissent within the crew improve distributed information sharing? We developed five parallel space-relevant decision making tasks requiring crews to leverage distinct information to make a team decision, where a demonstrably correct solution exists. Tasks were designed using the hidden profile paradigm. Tasks included three decision options, each with 29 or 30 pieces of available information. Eighteen pieces of information were given to all crew members, and the remaining information was distributed evenly among the crew. The information was distributed so that individually, each crew member would prefer the worst option, but that if the crew put all of the information together, they would choose the best option. The preference structure of the task was validated on MTurk (N = 1,424) ensuring that when given any crew member's individual information, the worst option was chosen, but that when given all of the crew's information, the best option was chosen. Tasks were administered during NASA's Human Exploration Research Analog (HERA) during Campaign 4. Five 4-person crews lived and worked in a 80m3 habitat for 45-day missions. One mission was aborted on MD 22 due to weather in the local area. We measured unique information sharing and decision quality on MD -4, 6, 14, 20, and 34. The findings show crew decision making suffered in isolation and confinement. The best performing crew correctly solved 60 percent of the tasks, whereas the worst performing crew did not correctly solve any of the tasks. Crew performance peaked in the second quarter of the mission (3 of 5 crews reached a correct solution). There was a strong third quarter effect; no crew reached an optimal solution on MD 34. A manipulation to create dissent within the crew improved the amount of unique negative information shared by the crew (ruling out inferior options), but did not affect the amount of unique positive information they shared (needed to rule in superior options). These findings suggest space crews will benefit from team decision training and protocols for making team decisions that mitigate these performance decrements. The tasks developed here provide a useful way for future analog studies to evaluate the efficacy of training and protocols.