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Behaviour, Performance and Psychosocial Issues in Space (1)

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RE-PAIRING TO REPAIR: A COUNTERMEASURE THAT ENHANCES CREW RELATIONS IN DEEP SPACE

Abstract

Human exploration of deep space will require unprecedented levels of crew autonomy. Under increased communication delay, crew members will have to function, as a team, more independently from mission control. At the same time, these explorers will live and work for extended periods of time in a small space, apart from loved ones, while facing extreme physical challenges associated with gravity and radiation. Past observations of extreme teams demonstrates that these conditions degrade interpersonal relationships requisite to autonomous team performance. The purpose of our research is to develop and test a computational model capable of recommending countermeasures that support crew relations in deep space.

We developed and validated the CREWS computational model on data from 4-person crews living in NASA's Human Exploration Research Analog (HERA) for either 30 or 45 days. The model simulates interpersonal relationships between crew members, based on personal characteristics of crew members gathered before the mission, along with the mission timeline and task schedule. CREWS anticipates the different ways crew relations are likely to change on each mission day. For instance, individuals who are high in self-monitoring are less prone to developing negative relationships, but high workload days promote negative relationships. By performing *in silico* simulations of potential countermeasures, the model is capable of evaluating which options would be most effective at mitigating risks related to changing crew relations.

We tested the computational model's effectiveness at recommending one type of countermeasure: The *crew re-pairing* countermeasure is to change which sets of crew members are assigned to work as a pair on the most interdependent tasks. Given several potential task assignments, our model predicts how these assignments impact crew relations. These predictions are used to adjust the schedule so that it incorporates personal, relational, situational, and operational demands.

To evaluate our model's effectiveness at recommending pairs of crew members, we tested the countermeasures in four crews completing 45 day missions in HERA. Prior to the mission, our model predicted the "best" and "worst" pairings of crew members to work together. Using an "A-B-A-B" block experimental design within each crew, we compared the results of implementing the "best" and "worst" pairings. During the anticipated "best" pairings, crew members were more likely to report positive social relationships and were less likely to report that working together was damaging to their relationship. These findings

demonstrate the viability of using computational models to recommend team countermeasures for deep space exploration.