

Deep Space Collaboration: Impact of Social Networks on Task Switching in Collaborative Work

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Spacework is hard work. Astronauts frequently cite high workload as one of the biggest challenges they face. In particular, they report difficulty in shifting between solo tasks (e.g., conducting a biology experiment) and collaborative tasks (e.g., coordinating station repairs with mission control). These challenges are likely to be further exacerbated as crews venture to Mars, incurring extreme social isolation and communication delays of up to 20 minutes each way. Our study has 3 parts. First, we develop a conceptual framework summarizing, based on prior research, the social, psychological and organizational factors which influence the time spent on various tasks, and translate these into an agent-based simulation. The factors include behavioral measures such as attributes of the tasks and time spent on the tasks as well as subjective measures such as individuals' attitudes and their perceived network relationships with others. Second, we collected empirical data to parameterize the model using 6 four-member crews who spent either 30 or 45 days in isolated, confined and controlled environments simulating a deep space mission at NASA's Human Exploration Research Analog (HERA) facility. The data used was based on their participation, on three occasions during each mission, in a 90 minute Web-based activity titled Project Red where the four individuals in HERA collaborated with eight individuals outside HERA in "Mission Control" as part of a multi-team system (comprising four teams of three individuals each). The goal of Project Red was for the members of the multi-team system to negotiate and decide on the optimum location to drill for water on Mars. The empirical data included "big" server-side digital trace logs of all of their actions, interactions, and transactions, down to each second, while engaging in Project Red. The empirical data also included "rich" survey data which included questions on over a dozen individual trait and state psychological variables as well as relational variables about individuals' perceptions of their affective, behavioral, and cognitive network ties with each of the 11 other individuals. The agent based model was implemented in NetLogo. We used BehaviorSearch tool (Stonedahl & Wilensky, 2010) to estimate the parameters that best fit the computational model based on the empirical data. Finally, after establishing the robustness of our model, we conduct virtual experiments (VE) to test what-if scenarios: ***How does structural characteristics of the initial affective, behavioral and cognitive social networks influence individual's actions, interactions and transactions during Project Red and specifically their task switching behavior?***