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THE IMPACT OF NETWORK ACUITY ON INFORMATION SHARING UNDER COMMUNICATION DELAYS IN SPACE MULTITEAM SYSTEMS

Abstract

Communication delays involved in long-distance space missions are a major challenge for effective information sharing within a multiteam network including space crews and mission support. Both crews and mission support need to leverage not only their direct contacts but also their indirect contacts (e.g., contacts' contacts) to route messages effectively. However, information-sharing failures often occur and are linked to accidents on space missions. Prior research suggests that ineffective information sharing results from an individual's lack of awareness of the networks of their contacts. Here, we introduce the concept of network acuity to conceptualize an individual's ability to leverage their perceptions of the network to route information effectively., we ask three research questions related to network acuity. To what extent do communication delays impact people's network acuity? Are there individual characteristics that predict network acuity? To what extent can people improve network acuity?

We collected data from NASA's Human Exploration Research Analog (HERA), Campaign 3 and 4. We studied 9 different, 4-member crews, each interacting on a simulated task with an 8-member mission control center (MCC) (N = 251). Data were collected using a web-based portal linking the crew and MCC to engage in a network routing task. Due to "bandwidth constraints," they were required to choose only 2 direct contacts (from 11 others) to relay messages sent by JPL to implement a decision. They each receive messages that must be relayed to specific others in the crew-MCC system in the fewest number of steps. In total, we conducted 53, 12-person network sessions. Each network was assigned to either a 180-second communication delay, a 60-second communication delay, or no communication delay condition. From this network routing task, we measured network acuity based on the extent to which each individual routed messages through their contact who was on the shortest path to the final target.

Our results show that communication delays increased network acuity among HERA crews' but decreased it among MCC members. Further, those crew members who scored higher on the personality characteristic of goal priority tic had higher network acuity. Finally, crews' network acuity improved over the course of their 30- or 45-day mission in an isolated environment. Overall, our findings suggest that selecting crew members with high network acuity will play a key role in alleviating the risk of information-sharing failures within a multiteam network under conditions of communication delays.