The Impact of Social Connectedness, Communication Delay, and Sleep Deprivation on Cognitive Network Similarity in Analog Teams

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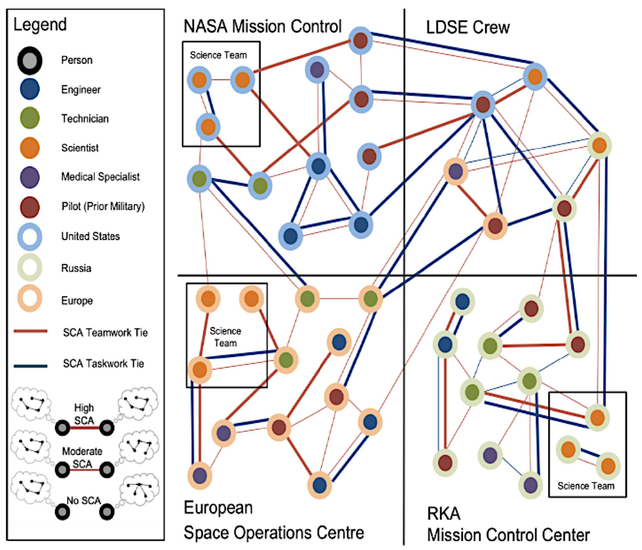
Introduction

Shared cognition is a *core* team process competency

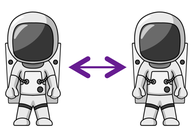
(NASA Human Research Program: Behavioral Health and Performance, 2011).



What impact will long-distance space exploration (LDSE) have on shared cognition?

There are three elements that impact shared cognition, and set LDSE teams apart from teams on Earth:

1. Social Connectedness (Hinds & Weisband, 2003; Campton, 2001; Moreland & Myaskovsky, 2000)



H1: Individuals who are on the same functional team will be more likely to share cognitive similarity ties (H1a) and those who are physically separated will be less likely to share those ties (H1b).

2. Communication Delay (Hollingshead, 1998; Lewis, 2004; Palazzolo et al., 2006; Wegner, 1987)

H2: Individuals under communication delay will be less likely to share cognitive similarity ties with other members in the multiteam system (MTS).

3. Sleep Deprivation (Barnes, 2012; Barnes & Hollenbeck, 2009; Mullins, Cortina, Drake, & Dalal, 2014)

H3: Individuals who are sleep deprived will be less likely to share cognitive similarity ties with other members in the MTS.

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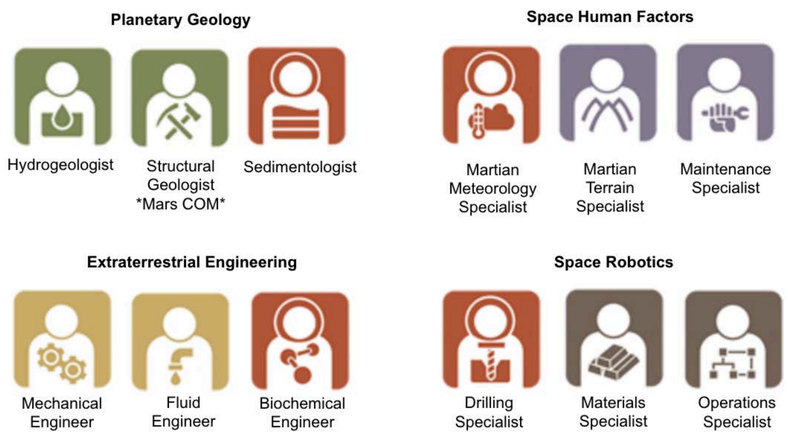
Method

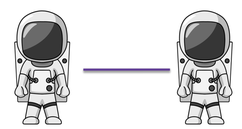
Procedure

- Observed crews in the HERA analog, and "Mars Mission Control" members stationed at Georgia Tech working on Project RED – teams worked together to build a well for sustainable life on Mars in the Argyre Quadrangle
- Sample: 4 4-person HERA crews and 10 8-person mission controls (10 MTSs, 12 members each; *N* = 120 individuals)

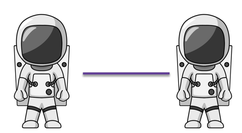


Measures

- Cognitive ties:
  - Task-related cognitive similarity: comparing locations for the well, designing an effective well, minimizing costs to our and other disciplinary teams, sending calculations, and experimenting with different calculations



  - Team-related cognitive similarity: motivating one another, coordinating our work, managing conflict, monitoring our progress, and sharing information



- Social connectedness:
  - Crew versus mission control
  - Functional specialization (created via task roles)
  - Physical co-presence

Results

Table 1

Predicting shared task-related cognitive similarity ties

Predictor variable	*Odds ratio* Model 1	*Odds ratio* Model 2
Edges (Control)	.04***	.04***
Balance (Control)	2.64***	2.69**
Popularity (Control)	.16	n/a
HERA vs. MMC team (Control)	.70	.7[illegible]
Same functional team (H1a)	.32	.84
Separation (H1b)	2.08**	2.36**
Communication delay (H2)	1.43	1.07
Sleep deprivation (H3)	1.95**	
Learning effect	—	1.49*

Note. *N* = 120 individuals, *J* = 10, *I* = 1,320. Separation is reverse-coded.
p* < .01, * *p* < .001

Members were 108% less likely to share cognitive ties if they were separated from one another.

Members were 95% more likely to share cognitive ties if they were sleep deprived → learning effect.

Table 2

Predicting shared team-related cognitive similarity ties

Predictor variable	*Odds ratio*
Edges (Control)	0.00***
Balance (Control)	16.44***
Popularity (Control)	73.70
HERA vs. MMC team (Control)	.90
Same functional team (H1a)	.86
Separation (H1b)	1.11
Communication delay (H2)	1.31
Sleep deprivation (H3)	1.11

Note. *N* = 120 individuals, *J* = 10, *I* = 1,320, **p* < .01, *** *p* < .001

If Members A and B shared a tie, and B and C shared a tie, A and C were 1,544% more likely to also share a tie.

Discussion

- Physical separation leads members to have a less similar understanding of the task, even among mission control members in the same building.
- Multiteam-work can be learned; crews were more likely to develop shared cognition with mission control members as they completed the task additional times. This was not driven by familiarity, as there was a new mission control each time the task was completed.
- LDSE factors have a strong effect on task-related shared cognition, but no discernible effect on team-related shared cognition.

Acknowledgements

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