Title

Exploring New Frontiers: Building Better Teams on Earth and Beyond

Short Title

Building Better Teams on Earth and Beyond

Abstract

The prospect of sending a team to Mars by the year 2030 challenges organizational scientists to build new conceptual lenses and leverage advanced analytic and computational methods to hasten understanding and prediction of team performance. This symposium showcases five recent advances - all inspired by the challenge of space exploration.

Press Paragraph

The prospect of sending a team to Mars by the year 2030 challenges organizational scientists to build new conceptual lenses and leverage advanced analytic and computational methods that hasten the prediction of team performance. The team endeavoring to Mars will be multicultural and interdisciplinary, living and working in uncomfortable and dangerous conditions, and doing so in close collaboration with distant teams on Earth. Tackling the teamwork challenges associated with a mission to Mars presents an unprecedented opportunity to rapidly accelerate the science of teams. This symposium showcases five teamwork advances – all inspired by the challenge of space exploration.

Social Media Statement

Space exploration challenges teams researchers to build better teams @NASA @dechurch @SONICNU @teamslab

Exploring New Frontiers: Building Better Teams on Earth and Beyond

Chair: Leslie DeChurch

Co-Chairs: Suzanne Bell & Noshir Contractor

General Summary

Understanding and predicting team performance has been a central aim of the organizational sciences for more than five decades. The National Aeronautics and Space Administration (NASA) set its sights on Mars as the “next tangible frontier for expanding human presence” (NASA, 2015, p. 1). The science of teams is now being called on to proffer highly specific recommendations for crew composition, habitat design, communication protocol logistics, scheduling systems, training procedures, and other preemptive and reactive team interventions that will be needed for a mission to Mars.

In the dangerous and uncharted territory of deep space, teamwork is a *sine qua non*. Thus, the need to prepare a human team for a mission to Mars is challenging organizational scientists to develop new theoretical frameworks and to leverage advanced analytic tools. This challenge is accelerating the pace at which new knowledge accumulates and reveals insights into team functioning valuable not only to teams in space, but also to the many teams presently working on Earth. This symposium showcases the latest advances in understanding teams fueled by the Mars Mission.

In the first talk, **Jacqueline Ng** and her collaborators tackle the challenge of crew composition, developing a conceptual framework to explain the mechanisms through which member attributes affects team functioning over time. Ng and colleagues recast team composition as a series of micro interaction events wherein attributes of individuals and tasks shape dyadic states. Dyadic interactions and their resulting interpersonal states then compile over time to form the basis of what will emerge into team processes. Their paper reports virtual experiments that test "what if the crew is composed of …" scenarios. Not only is this approach valuable for space missions, but it addresses a longstanding issue in many organizations: Who makes the team?

In the second talk, **Jessica Santoro-Webb** and her collaborators take a new look at team cohesion, advancing a microdynamic view of the coevolution of conflict, cohesion, and performance. They leverage multiple space analogs of varying durations – 4, 8, and 12 months to benchmark the trajectories of team functioning. Their study provides an extremely high resolution of view of the emergence of cohesion and its relation to other aspects of team functioning. In contrast to the common practice of measuring cohesion one or a few times, the Santoro–Webb team assesses cohesion daily. This level of granularity affords a "first look" into the coevolution of team dynamics.

In the third talk, **Shawn Burke** and her colleagues present a historiometric study yielding a taxonomy of team roles. Using archival materials from a fascinating array of previous space missions, Burke and colleagues provide a fresh look at the roles that emerge in teams who work together intensively. Though the taxonomy follows the longstanding task and relational dimensions, it uncovers additional roles that do not fit neatly into the task – social dichotomy. These include the entertainer, nurturer, and boundary spanner.

In the fourth talk, **Aurora Dixon** and her colleagues take a closer look at how personality traits affect cohesion development in teams. This paper is novel in its ability to yield specific recommendations for composing effective teams. Interestingly, whereas conscientious individuals should be screened in, open and neurotic individuals should be screened out.

In the fifth talk, **Tripp Driskell** and his colleagues present a novel tool STRESSnet to unobtrusively measure team members' felt experience of strain through their communication. Though clearly intended for space flight, this advance has many applications for teams back on Earth. As more teams are moving more of their communications to digital modalities, a tool like STRESSnet could be invaluable in characterizing the quality of teamwork, and detecting breakdowns that signal a need for team leader intervention. This paper is a wonderful example of how an innovation sparked by a specific applied problem (space flight) leads to a broader advance.

This session features innovations in theory and methods. Jacqueline Ng, Jessica Santoro-Webb, and Shawn Burke's papers lend novel theoretical insights to teams research. Ng to team composition, Santoro –Webb to team process dynamics, and Burke to team roles. Furthermore, this symposium features valuable methodological advances. Each of the five papers is leveraging methodologies that have been thus far under utilized in teams research, including agent based modeling, social network analysis, longitudinal analysis, historiometric analysis, experience sampling, and lexical analysis.

Because we have five presentations, instead of a discussant, the Chairs will take on the role of facilitators to engage a meaningful dialogue among the audience and presenters. From the shuttle program, to Skylab, to the modern space analogs of HI-SEAS and HERA, the goal of sending a high performing team to Mars is rapidly advancing the science of teams within I/O Psychology.

Reference

NASA (2015) Journey to Mars: Pioneering Next Steps in Space Exploration. Retrieved from: http://www.nasa.gov/sites/default/files/atoms/files/journey-to-mars-next-steps-20151008_508.pdf

Crew Recommender for Effective Work in Space: CREWS

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Team composition, the configuration of member attributes and their relationships, is a critical enabling structure for fostering effective teamwork and will likely to play an important role in the effectiveness of future long-distance space exploration (LDSE) missions (Hackman, 2002; Wageman et al., 2005). LDSE present a particularly salient social context in which team members are required to live with one another in isolated, confined and remote (ICE) spaces for long-durations of up to 30 months, and are likely to require close coordination and more autonomy than previous space missions. Together, these conditions provide a context requiring a large level of interpersonal compatibility among crew members (Bell et al., 2015). Yet, limited research exists on team composition in LDSE environments and it is unclear how team composition can be used to optimize crew functioning and performance. Thus, our research aims to link key input variables (e.g., individual differences, network relational factors, task characteristics) to team dynamics (e.g., social integration, team processes) in LDSE contexts, identify team functioning patterns that arise under different member compositions, and create a predictive model of team composition. To investigate these research goals, we develop a theoretically grounded agent-based model (ABM) of team composition based on empirical data for future LDSE missions.

We leverage agent-based modeling (ABM) as a theory-building tool. ABM is a form of computational modeling that explains the emergence of dyadic relations among a set of agents (i.e., team members). It is ideal for understanding the effects of team composition because we can explain the variety of factors that give rise to dyadic states and relations among team members as they interact with one another over time. Importantly, we recast team composition as a relational-level phenomenon, as opposed to one that originates at the individual or team level of analysis. We submit that the effects of member characteristics first shape aspects of team functioning like cohesion or conflict through their effects on dyadic properties that then compile up to the team level.

We develop an ABM of team dynamics using empirical data from eight four-person single- and mixed-gendered missions from NASA's Human Exploration Research Analog (HERA), an analog for simulation of ICE conditions of mission exploration scenarios (*see* Figure 1). The data collection for this project will occur over two years, comprised of four 30-day missions in 2016 and four 60-day missions in 2017. During each mission, crew members engage in over a hundred independent and interdependent tasks.

At the beginning of each mission, we collect HERA pre-measure data on crew members' surface-level differences (e.g., age, gender, race, military background) and deep-level differences (e.g., personality, values, decision-making style). We then collect team dynamics data on affective and instrumental ties at seven time points during each mission.

We use these data, as well as coded task characteristics in the ABM to model the evolution of affective and instrumental networks in LDSE missions. The inclusion and relative contributions of these variables over time are determined using a mixed-methods approach leveraging existing psychological and network theories on team composition and team functioning, validated by the empirical data. Our model then aggregates these dyadic level interactions to make predictions about team level phenomena.

We model team member relations as directed ties at the dyadic level. As shown in Figure 2, changes to network ties are conceptualized as a function of prior network ties and teaming episodes, which determine who does what with whom at each time period during the simulation. Every teaming episode results in an episodic experience describing how a given task influences network ties between the active participants in the task, differentiated between the “perceiver” and the “perceived” individual. The episodic experience is calculated by aggregating the influences of various psychological and network effects, and is comprised of parameters that represent surface-level characteristics, enduring deep-level characteristics and task traits. We implement Carton and Cumming (2013)’s algorithm of dyadic differences to predict the formation of faultlines and the resultant subgrouping and isolates based on the surface-level characteristics.

Following every teaming episode, the network ties between individuals will shift in the direction of that task’s episodic experience score. Once surface- and deep-level characteristics and task effects determine episodic experience, network effects also moderate the evolution of networks over time. In particular, our model examines the tendency of network ties to maintain balance and reciprocity over time (Monge & Contractor, 2003). Thus, ties that are not maintained are shown to decay over time, and a threshold point determines the presence of an active or inactive tie.

We will present results from four NASA HERA teams, as well as results from five non-ICE teams as case comparisons. Results from the first two missions of the 2016 provide evidence that positive affect, behavioral and informational ties are closely related, and that positive and negative affect can coexist in team members’ relationships. Additionally, we find that subgrouping based on demographic and value differences is an important factor in identifying the emergence of both affective and informational ties, and that differentiating between the perceiver and the perceived individual can help explain reciprocated and non-reciprocated relationships over time. Virtual experiments conducted on the first two missions also indicate that both surface- and deep-level team composition variables influence network tie formation.

In our presentation, we will show the model fit on data from the third and fourth missions of the 2016 campaigns, and compare the predictive ability of our model to non-ICE data. We also present additional virtual experiments manipulating team composition. This can identify optimal combinations of crew members that minimize the risk of performance decrements due to inadequate cooperation, coordination, communication, and psychosocial adaptation within a team. Ultimately, our long-term objective is to provide a predictive and prescriptive aid in composing future teams for LDSE.

References

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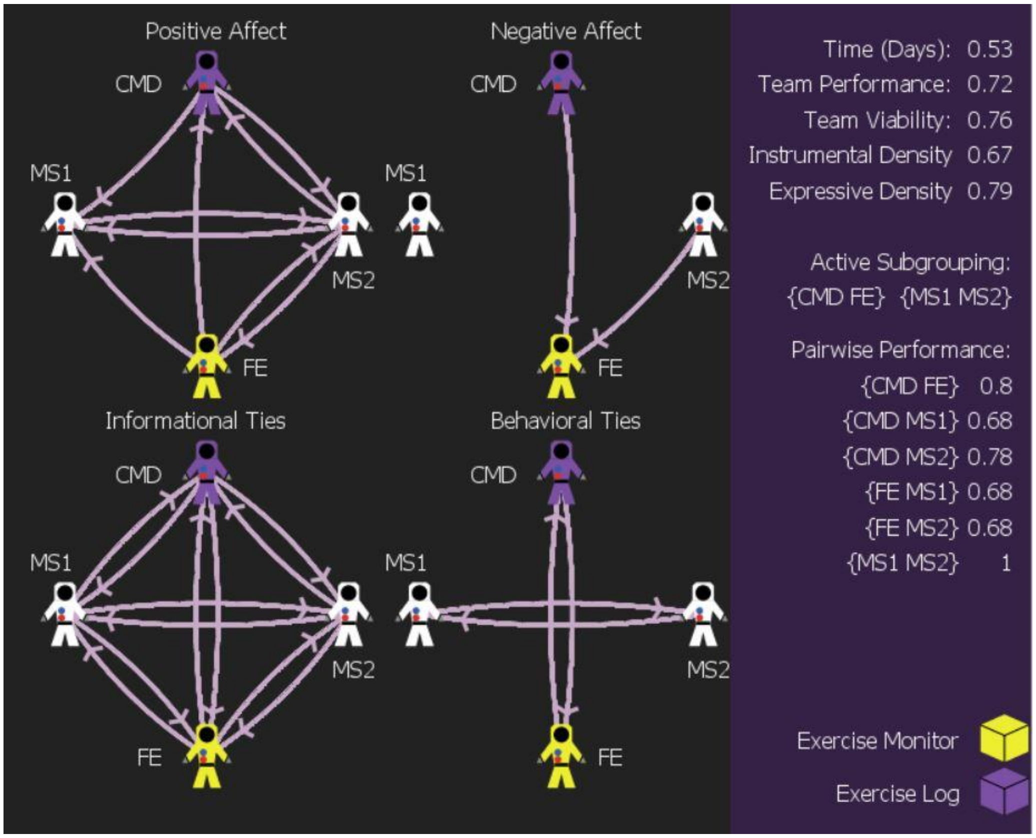

Figure 1. ABM interface predicting affective (positive, negative) and instrumental (informational, behavioral) ties.

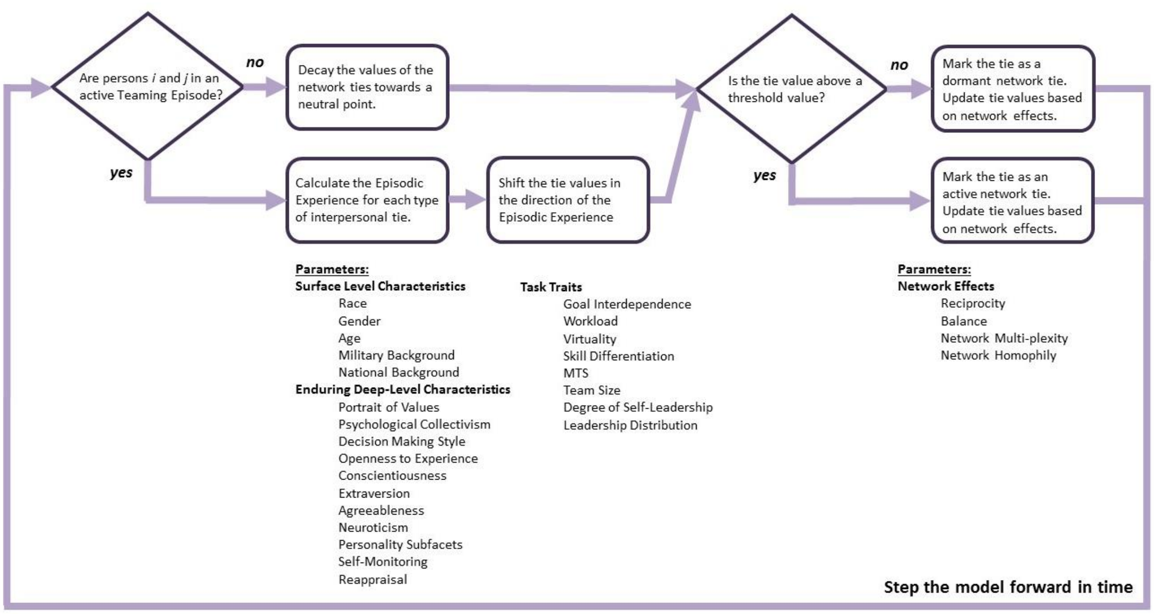

Figure 2. The process through which network ties are updated over time in the model.