The Costs of Switching Between Team and Multiteam Tasks and the Role of Shared Cognition

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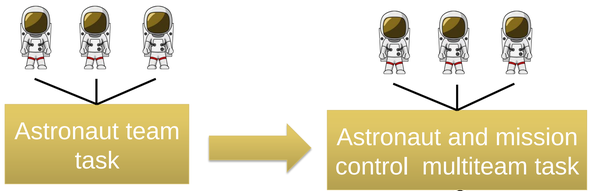
Introduction

The multiteam system structure of NASA requires individuals to regularly shift goal focus in response to dynamic situational requirements. The ability of an astronaut crew to switch from one type of work structure to another may affect team performance, coordination and stress (NASA Human Research Program: Behavioral Health and Performance, 2011)

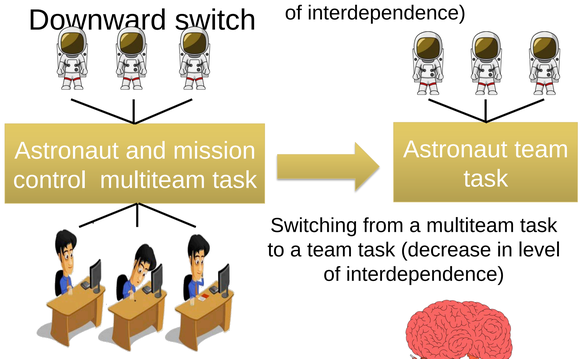
Vertical Task Switches (Mcdonald et al., 2015)

Upward switch



Switching from a team task to a multiteam task (increase in level of interdependence)

Downward switch



Switching from a multiteam task to a team task (decrease in level of interdependence)

Shared Mental Models

- When switching between tasks in team and multiteam contexts, individuals draw on mental models of the task environment.
- The more similar individuals' mental models are to their teammates, the more synchronized and entrained they get to that mode of work.
- This synchronization makes transitioning to that mode of teamwork smoother, but makes transitioning away from that mode more difficult.

Hypotheses

H1: Individuals with mental models more similar to teammates will switch to more interdependent tasks slower than individuals whose mental models are less similar to teammates

H2: Individuals with mental models more similar to teammates will be able switch to more interdependent tasks faster than individuals whose mental models are less similar to teammates

H3: Switching from less interdependent work to more interdependent work will take longer than switching from more interdependent work to less interdependent work

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ATLAS ADVANCING TEAMS, LEADERS, & SYSTEMS

Method

Sample

52 individuals (30 men, 22 women)

- 19 teams
- 10 multiteam systems

Undergraduate subject pool

Measures

Switch costs

- Upward switch time: time it takes to switch from a team task to a multiteam task
- Downward switch time: time it takes to switch from a multiteam task to a team switch task

Mental models

- Individual mental models: pairwise comparison ratings of task related attributes. Individuals rate how related items are in terms of completing their task on a scale of 1 (not at all related to 7 (strongly related)

	Flashlight	Jackknife	Rain coat	Compass
Flashlight				
Jackknife				
Rain coat				
Compass				

- Mental model similarity: Degree of overlap between two teammates' pairwise comparison scores. Assessed using Pathfinder (Schvaneveldt, 1990)

Task

Ocean Team 

Land Team 

Each team completed three survival planning tasks:

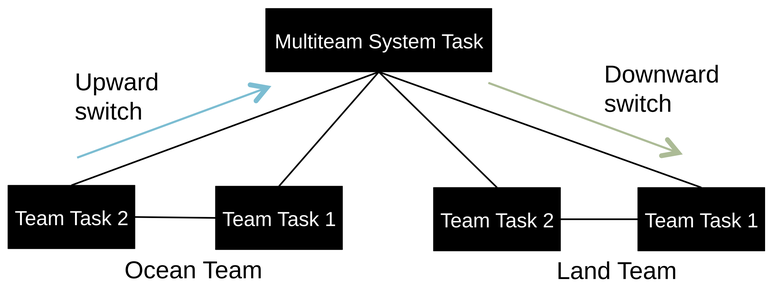
- Team Task 1
- Team Task 2
- Multiteam Task

Team Tasks

- Collaborate with teammates
- Rank 15 items in terms of importance for TEAM survival

Multiteam Task

- Collaborate with teammates and other team
- Rank 30 items in terms of importance for TEAM survival as well as MULTITEAM success



Individuals performed 5 upward switches and 5 downward switches throughout the duration of the session

Results

Analyses were performed using a hierarchical linear model with a 2-level nested structure – switch time points (level 1) nested in individuals (level 2). β are standardized regression weights with 51 degrees of freedom and *indicating significance at the .05 level.

With every standard deviation increase in an individual's mental model similarity with teammates, that person's upward switch time decreases by .17 standard deviations (.23 seconds) – H1 not supported

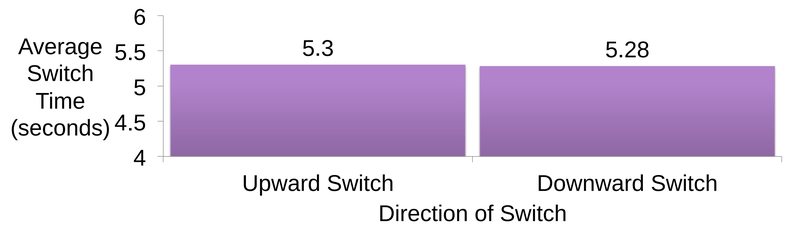
Mental model similarity with teammates → **β = -.17*** → Upward Switch Costs

With every standard deviation increase in an individual's mental model similarity with teammates, that person's downward switch time decreases by .25 standard deviations (.34 seconds) – H2 supported

Mental model similarity with teammates → **β = -.25*** → Downward Switch Costs

There was no observed difference in the amount of time it took to make an upward relative to a downward switch – H3 not supported

Upward vs Downward Average Switch Cost



Discussion

- Individuals with mental models similar to teammates will be more adaptable and able to switch their attention between various task responsibilities more easily compared to individuals with mental models dissimilar to their teammates
- The time it takes to switch tasks is the same whether individuals are switching from more interdependent to less interdependent work or from less interdependent to more interdependent work
- When missions require collaboration between mission control and astronaut crews, it's important for the crew to be on the same page with each other to make transitioning to and from collaborating with mission control less disruptive

References & Acknowledgements

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References

McDonald, J. D., DeChurch, L. A., Asencio, R., Carter, D. R., Mesmer-Magnus, J. R., & Contractor, N. S. (2015). Team task switching: A conceptual framework for understanding functional work shifts. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 59,* 1157-1161.

Schvaneveldt, R. W. (1990). *Pathfinder associative networks: Studies in knowledge organization*. Norwood, NJ: Ablex Publishing.

Landon, L. B., Vessey, B. W., & Barrett, J. D. (2016) Evidence report: Risk of performance and behavioral health decrements due to inadequate cooperation, coordination, communication, and psychosocial adaptation within a team. *Human Research Program Behavioral Health and Performance*