Enhancing the Effectiveness of Team Science: Implications for Leadership

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Facilitating Knowledge Integration and Innovation in Science Teams

Science needs interdisciplinary research (IDR) teams to work on complex problems.

Complex science problems require multiple sets of expertise to generate effective solutions.

Solutions to complex problems require knowledge integration in order to develop innovative and effective approaches.

IDR teams are more likely to successfully integrate their knowledge and develop innovative solutions when they have integrative capacity (Salazar, Lant, Fiore & Salas, 2012).
The **ability to transform knowledge through integration** is a core competence for interdisciplinary science teams to achieve their goals (Salazar, Lant, Fiore & Salas, 2012).

**TEAM Integrative capacity**

- A team’s ability to combine the variety of knowledge and resources from distinct disciplines in novel ways to accomplish their collective aim (Salazar et al., 2012).

**LEADER Integrative capability**

- A leader’s ability to assist a team in weaving together the diverse contributions of its members via the facilitation of interdependent social and cognitive processes (Salazar, Lant, & Slyngstad, 2015).
Team Integrative Capacity

Interdisciplinary Science Team

Social integration processes lead to emergent states

Emergent States lead to Cognitive Integration Processes

Knowledge transformation & innovation

Cognitive integration processes
Leader Integrative Capability

Integrative Leadership
Multidisciplinary Expertise & Problem Construction

Emergent State
Member Goal Commitment

Innovative team knowledge products

(Salazar, Lant, & Slyngstad, 2015)
Developing a Leader’s Integrative Capability

What characteristics and behaviors are associated with integrative capability?

Teams led by individuals with integrative capability will generate more integrated and innovative solutions.

Investigated the effect of team leader multidisciplinary expertise

Investigated the effect of team leadership development
Longitudinal Team Science Study

Entities:
1. Formal Leadership - CEO of Metro Medical Center & Dean of Science
2. Evaluative Committee – Strategic Science Committee, 12 world renowned scientists; Chair: Dean of Science & Senior Scientist
3. Departments – 26 academic departments, comprised of full and part-time faculty & staff
4. Science Teams – 64 Teams Submitted Brief Proposals for Consideration, five teams were selected to receive funding
Multi-method Approach

Quantitative Analysis & Qualitative Case Study

Dependent Variable:
- Innovativeness
  Measure: senior scientist expert rating

Main Effect Independent Variable:
- Leader Multidisciplinary Expertise
  Measure: assessment of expertise based on CV

Mediator:
- Team Goal Commitment
  Measure: Six item scale

Control Variables:

**Leader**
- Endowed Chair

**Team level**
- Team Size
- Rank heterogeneity
- Disciplinary diversity
- Prior collaborated with PI
- Perception of Interconnection
- Perception of Closeness
- Multidisciplinary Expertise
Mediated Regression Interpretation

Leader
Multidisciplinary
Expertise

(B=.59; p< .05)

Goal
Commitment

Team
Innovativeness
What are leaders doing that leads to goal commitment and innovation?
Leader Communication: Analysis of team science meeting dialogue

Leaders with multidisciplinary expertise facilitate deep knowledge integration through...

FOCUS

• Clarifying Goals
• Confining Problem Space

BREADTH

• Comprehensive Participation
• Connection builders
Can Team Leadership Development Improve Integrative Capabilities? Team Integrative Capacity?

- Quasi-experimental
- Teams randomly assigned
- Sample:
  - Interdisciplinary Student Teams
  - Interdisciplinary Science Teams
- Pre-Post Measures*:
  - Integrative Capacity Index
  - Transdisciplinary Orientation Scale
  - External Ratings of Innovativeness

<table>
<thead>
<tr>
<th>Strategic Team Mapping</th>
<th>Communication Principles</th>
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<tr>
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* Measures available upon request
Leadership *prior* to Team Interaction: Strategic Team Mapping

• Designing a team is the process of purposefully configuring the elements of the team to foster the achievement of valued outcomes.

• Team Leaders given a 90-minute evidence-based training to support goal specification, planning and team design.
9-Step Team Mapping Exercise

- Purposefully configure the elements of interdisciplinary teams to achieve valued outcomes:
  - **Motivate joint effort**
  - **Utilize talent**
  - **Assign roles and responsibilities**
  - **Uncover interdependencies**
  - **Anticipate conflict zones**
  - **Integration Coordination**
Pre & Post Training Measures: Integrative Capacity Index

Social Integration Behavior Subscales align with Team Mapping objectives and assess processes and emergent states facilitated by training and leader behaviors:

• **Visioning:**
  – E.g., “I have a good understanding of what our team is trying to accomplish.”

• **Coordination Promotion:**
  – E.g., “Team members actively try to coordinate with each other.”
Leadership *during* Team Interaction: Team Communication Training

With team leaders and members present, vignettes and a simulation are used to teach the following four principles:

1. Perspective Seeking
2. Promotive Voice
3. Team Reflection
4. Managing Connections
• Developed content appropriate for the training from over 120 hours of team science team meetings
  – Use several “real world” vignettes demonstrating team leader communication using (and not using) the 4 principles
  – Provide team communication development aids (e.g., worksheets, handouts)
  – Promote the transfer of training through the use of a team problem-solving simulation with hidden information
Pre-Post Training Measures: Integrative Capacity Index

Social Integration Behavior Subscales align with the 4 Communication Principles and assess processes facilitated by each:

• **Perspective Seeking:**
  - E.g. “I try to figure out how the people around me view different situations.”

• **Suggesting Ideas:**
  - E.g., “I share my expertise with other team members by making suggestions.”

• **Reflexivity:**
  - E.g., “The team steps back from daily routines to consider whether the methods used are the best available.”

• **Connecting with Others:**
  - E.g., “I point out the common ground shared by people who have different perspectives on an issue.”
Measuring Outcomes: Cognitive Processes and Team Performance

- Cognitive Integration Behavior Subscales are facilitated by SIBs and emergent states and support innovation:
  
  • **Knowledge Consideration:**
    - E.g., “I listen to the viewpoint of each team member even if it is not widely shared by other members.”

  • **Knowledge Accommodation/Assimilation:**
    - E.g., “My understanding of my work tasks often changes after my team members have shared a different perspective.”

  • **Knowledge Transformation:**
    - E.g., “Each member influenced the team’s mutual understanding of a task, even if their impact was small.”

- External & Self-Report Ratings of Team Innovativeness
Integrative Capacity Index: Good model fit, reliability, and discriminant validity

\[ \chi^2 = 1228.39, \quad \chi^2/\text{df} = 1.98, \quad \text{CFI} = .87, \quad \text{TLI} = .86, \quad \text{RMSEA} = .07 \]
Predictive Validity of the Integrative Capacity Index

Team Integrative Capacity Regressed onto Professor Rated Effectiveness

- **Y-axis:** Professor Rated Team Effectiveness
- **X-axis:** Team Integrative Capacity

The graph shows a positive correlation between Team Integrative Capacity and Professor Rated Effectiveness, indicating that higher integrative capacity is associated with higher effectiveness ratings.
Integrating differences at the intersection of disciplines, professions, sectors can require:

- Multidisciplinary Expertise
- Interdisciplinary-focused Problem Construction
- Inclusive and integrative team design
- Communication focused on humble inquiry and making connections between ideas, members, and methodologies
THANK YOU!

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## Mediated Regression Results

<table>
<thead>
<tr>
<th></th>
<th>Goal Commitment</th>
<th>Innovativeness</th>
<th>Innovativeness</th>
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