The Use of Paradox to Study, Diagnose, and Develop Scientific Teams

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Overview and Purpose

- To explore how the use of paradox can be applied to:
  - Understanding the range of social, structural, disciplinary, professional, and scientific phenomenon that is embedded in team science
  - Diagnosing conflicts, dilemmas, and contradictions inherent in team science
  - Addressing issues that occur in team science through team science specific interventions
Many reviews (Börner et al, 2010; Cummings & Kiesler, 2005; Fiore, 2008; Stokols, Hall, Taylor, & Moder 2008; Spring, Moller, Falk-Krzesinski, & Hall, 2012) of the literature indicate a variety of issues, inclusive of:

- Few theoretical models, taxonomies, and frameworks
- Underutilization of other disciplines
- The paradigm of “paradox can be used to address both of the above concerns"
What Is Paradox Generally?

- Statements, arguments, reasoning, axioms, perspectives, frames of reference, inferences, logic, behaviors, cognitions, stories, images, or symbols that are:
  - Opposite
  - Contradictory
  - Interrelated
  - Exist simultaneously
  - Both true and false
  - Both valid and invalid
- Results in tensions, issues, conflict, dilemmas, and opportunities
The Nature of Paradox
General Paradox Theory

- Paradox can be seen in virtually all disciplines
  - **Philosophy:** Kierkegaard (1962) – Buddha, Muhammed, Christ can be both human and divine
  - **Psychology:** Jung (1965) – notion of conscious and unconscious
  - **Literature:** Orwell (1996) – notion from “Animal Farm” that all animals are equal, but some are more equal
  - **Organizational Science:** Harvey (1974) – Abilene paradox – team members agree privately to steps required to cope with a problem, but implemented same failed solution
Paradox Theory Applied to Organizations (Teams)

- Lewis (2000) and Smith & Lewis (2011) categorized tensions as:
  - Learning – adjustment, review, and change, innovation to destroy past and to create future
  - Organizing – structuring or leading, collaboration and competition, control or flexibility
  - Belonging – individual identity vs. collective, competing values, and membership
  - Performing – multiple and competing goals, stakeholders use divergent success strategies
Mangematin (2001) reported tensions that arise between and across public and private scientists typically involve wealth creation vs. discovery.

Leahy (2016) examined a range of competing costs and the benefits to scientific, disciplinary, and institutional collaboration.

Kotarba, Wooten, Freeman, & Brasier (2013) reported dilemmas faced by team scientists involving:

- Routine and tradition vs. experimentation and innovate
- Commitment vs. time constraints
- Mentoring vs. following
- Principal investigator vs. team
- Organization vs. scientific expertise
- Scientific work vs. clinical work
Why the Practice of Team Science Creates a Paradoxical Environment

- Use of multiple disciplines in different ways (Rosenfield, 1992; Jacobs & Frickel, 2005)
- Complex and dynamic collaborations (Falk-Krzsesinski et al., 2010; Falk-Krzesinski, 2011)
- Involves multiple levels (Börner, 2010)
- Involves multiple stages of research and team evolution (Hall et al., 2012)
Proposed Model Involving Paradox in Team Science

**Antecedents**
- Disciplinary Diversity
- Collaboration Complexity
- Multiple Levels
- Phase of Research

**Types of Paradox**
- Learning Paradox
- Organizing Paradox
- Belonging Paradox
- Performing Paradox

**Paradox Diagnosis**
- Survey
- Structured Interview
- Narrative & Discourse
- Network Analysis

**Paradox Interventions**
- Team Training
- Team Building
- Knowledge, Memory, Cognitive Integration
- Structure & Design

**Consequences**
- Generative-ness & Innovation
- Dysfunction & Process Loss
Klein’s (2010) Characteristics of Interdisciplinarity

<table>
<thead>
<tr>
<th>Multidisciplinarity</th>
<th>Interdisciplinarity</th>
<th>Transdisciplinarity</th>
</tr>
</thead>
<tbody>
<tr>
<td>juxtaposing</td>
<td>integrating</td>
<td>transcending</td>
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<tr>
<td>sequencing</td>
<td>interacting</td>
<td>transgressing</td>
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<tr>
<td>coordinating</td>
<td>linking</td>
<td>transforming</td>
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<td>focusing</td>
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<td>blending</td>
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<td>complementing</td>
<td>hybridizing</td>
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Collaboration Complexity

- Ambiguity
- Rate of Change
- Geographical Distance
- Leadership & Followership
- Authority & Power
- Member Characteristics
- Goals & Values
- Roles & Expectations
- Resource Scarcity
Multiple Levels of Team Science (Borner et al, 2010)
Phases of Team Based Translational Research (Hall et al., 2012)
## Types of Paradox and Team Science Illustrations

<table>
<thead>
<tr>
<th>Type</th>
<th>Team Science Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning</strong></td>
<td></td>
</tr>
<tr>
<td>Exploration vs. exploitation</td>
<td>Scientific discovery vs. commercialization</td>
</tr>
<tr>
<td>Stability vs. change</td>
<td>Methodological familiarity vs. adoption or development of new methods</td>
</tr>
<tr>
<td>Short-term vs. long-term</td>
<td>Incremental scientific progress vs. scientific breakthrough</td>
</tr>
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<td><strong>Organizing</strong></td>
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</tr>
<tr>
<td>Alignment vs. flexibility</td>
<td>Hierarchical team vs. egalitarian network</td>
</tr>
<tr>
<td>Control vs. autonomy/empowerment</td>
<td>Management science vs. science</td>
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<tr>
<td>Belonging</td>
<td></td>
</tr>
<tr>
<td>Competing identities</td>
<td>Researcher vs. mentor/educator</td>
</tr>
<tr>
<td>Individual vs. collective</td>
<td>Team leader vs. team member/follower</td>
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<tr>
<td>Performing</td>
<td></td>
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<tr>
<td>Cooperation vs. competition</td>
<td>Research agenda of network vs. principle aims of team</td>
</tr>
<tr>
<td>Multiple objectives and stakeholders</td>
<td>Scientific objectives vs. patient/community objectives</td>
</tr>
</tbody>
</table>
Use of Lewis’ (2000) paradox framework is most useful. It involves:

- **Tensions** which are cognitively or socially constructed (self-referential loops, mixed messages, system contradictions)
- **Paralyzing defenses** which initially reduce anxiety, but ultimately intensify tensions (splitting, projection, repression, reaction formation, ambivalence)
Diagnosis and identification of team level paradox can use numerous methods and techniques that have become popularized in groups (teams) over the last 20 years (Hollingshead & Poole, 2012).

Diagnosis can also rely on performance models (Salas, Rosen, Burke, Nicholson, & Howse, 2007) or process models (LePine, Piccolo, Jackson, Mathieu, & Saul, 2008).
Diagnosing Team Paradox

- **Survey** (Wageman, Hackman, & Lehman, 2005; Loughrey, Ohland, & Moore, 2007)

- **Structured Interviews** (Kotarba, Wooten, Freeman, & Brasier, 2013; Weingraf, 2001)

- **Narrative and Discourse** Kotarba, 2014; Wetherell, Taylor, & Yates, 2001)

- **Network Analysis** (Scott & Carrington, 2011; Katz, Lazer, Arrow, & Contractor, 2004)
Addressing Team Paradox (Lewis, 2000)

- Possible resolution methods:
  - Acceptance
  - Confrontation
  - Transcendence

- Ways of addressing different types of paradox:
  - Learning Paradox: Social Reframing
  - Organizing Paradox: Dynamic Equilibrium
  - Belonging Paradox: Social Acceptance
Categories of Team Interventions Appropriate for Team Science (Wooten & Brasier, 2014)

- **Team Training** (Salas et al., 2008; Delise, Gorman, Rentsch, Steele-Johnson, 2010)

- **Team Building** (Klein et al., 2009; Salas, Rozell, Mullen, & Driskill, 1999)

- **Knowledge, Memory, and Cognitive Integration** (Salazar, Lant, Fiore, & Salas, 2012; Cannon-Bowers, Salas, & Converse, 1993)

- **Structure and Design** (Guimera, Uzzi, Spiro, & Amaral, 2005; Calhoun et al., 2013; Ben-Menahem, Von Krough, Erden, & Schneider, 2016)
# Methods and Techniques Associated with Intervention Categories (Wooten & Brasier, 2014)

<table>
<thead>
<tr>
<th>Team Training</th>
<th>Team Building</th>
<th>Knowledge, Memory, &amp; Cognitive Integration</th>
<th>Team Assembly, Strategies, &amp; Designs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge Acquisition</td>
<td>Goal Setting</td>
<td>Knowledge Consideration</td>
<td>Collaborative Networks</td>
</tr>
<tr>
<td>Skill Development</td>
<td>Development of Interpersonal Relations</td>
<td>Knowledge Assimilation</td>
<td>Strategic Core</td>
</tr>
<tr>
<td>Attitude Change</td>
<td>Role Clarification</td>
<td>Knowledge Accommodation</td>
<td>Mediated Information</td>
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<tr>
<td></td>
<td>Problem Solving</td>
<td>Knowledge Transformation</td>
<td>Exchange</td>
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<tr>
<td></td>
<td></td>
<td>Transactive Memory</td>
<td>Autonomy &amp; Independence</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Addresses Effective Team Process &amp; Affect</td>
<td>Addresses Innovation, Collaboration, Self-Correction</td>
<td>Diverse Disciplinarity</td>
</tr>
<tr>
<td>Acquisition</td>
<td></td>
<td></td>
<td>Addresses Efficiency &amp; Discipline Integration, Utility, &amp; Creation</td>
</tr>
<tr>
<td>Skill Development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitude Change</td>
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Addresses Baseline Capabilities and Readiness

Addresses Effective Team Process & Affect

Addresses Innovation, Collaboration, Self-Correction

Diverse Disciplinarity

Addresses Efficiency & Discipline Integration, Utility, & Creation
# Example of Team Interventions Appropriate for Various Types of Paradox

<table>
<thead>
<tr>
<th>Type of Paradox</th>
<th>Potential Team Intervention</th>
</tr>
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<tbody>
<tr>
<td>Learning</td>
<td>Team training intervention in collaboration and transformational leadership skills</td>
</tr>
<tr>
<td>Organizing</td>
<td>Team assembly, structure, design intervention to create flexible structure across institutions</td>
</tr>
<tr>
<td>Belonging</td>
<td>Team building intervention involving role clarification</td>
</tr>
<tr>
<td>Performing</td>
<td>Knowledge, memory, and cognitive integration intervention involving creating a shared mental model across stakeholders</td>
</tr>
</tbody>
</table>
Conclusions

- The application of “paradox” is particularly useful in team science due to tensions that are contextually inherent (e.g., multiple disciplines, complexity, multiple levels, stage of research).

- Specific examples of team science paradox can be seen in the categories of learning, organizing, belonging, and performing.

- A range of techniques are available to diagnose the occurrence of paradox in team science and related symptoms (tension, conflict, dilemma, dysfunction).

- Interventions specific to team science can be deployed to address specific types of paradox.
References


References


References


