Brainstorming for Innovation in Team Science

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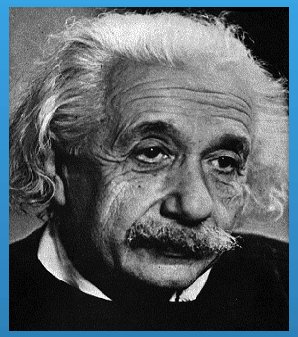
Team Science



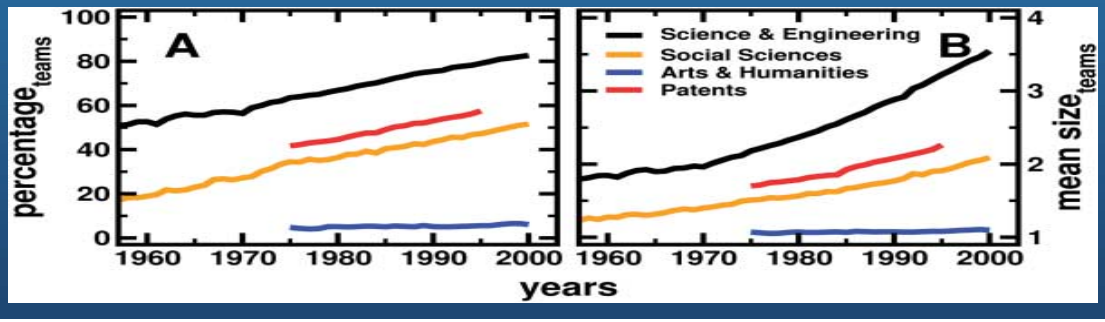
⇩

- Team science includes research projects and programs that entail collaborative approaches to analyzing research questions about particular phenomena
- Team science projects and programs can be undertaken by members of the same discipline or by those representing different disciplines and fields
- Increasingly scientific teamwork relies on cross-disciplinary collaboration to address complex scientific questions and societal problems

Team Science

Studies of 19.9 million research articles over 5 decades as recorded in the Web of Science database, and an additional 2.1 million patent records from 1975-2005 found three important facts.

1. For virtually all fields, research is increasingly done in teams
2. Teams typically produce more highly cited research than individuals do (accounting for self-citations), and this team advantage is increasing over time.
3. Teams now produce the exceptionally high impact research, even where that distinction was once the domain of solo authors.

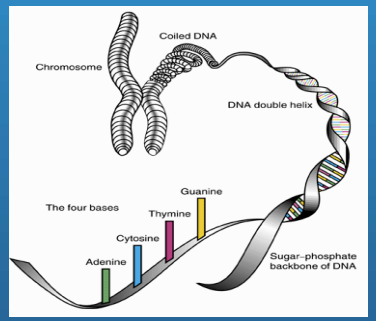


Sources: Wuchty, Jones, and Uzzi, 2007a, 2007b

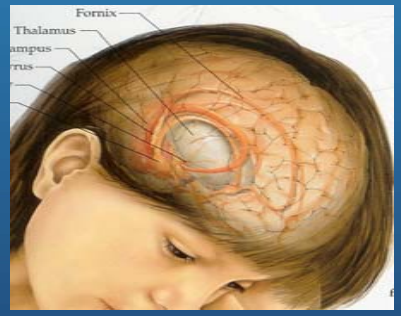
Interdisciplinary Team Collaboration

The Promise of Big Breakthroughs!

Manned Space Flight



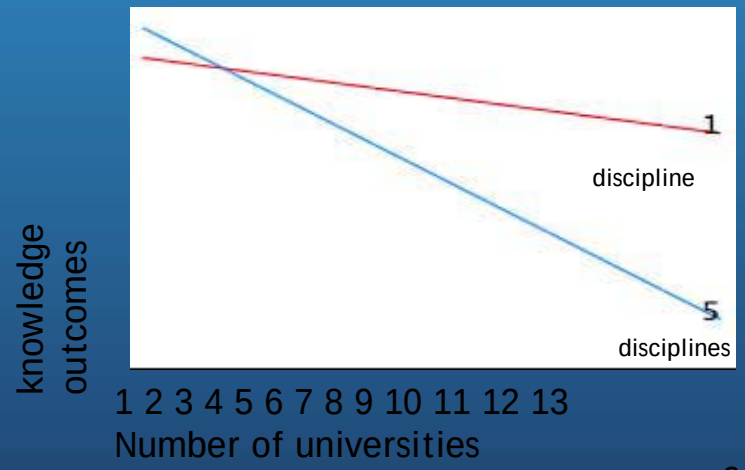
Mapping of Human DNA



New Brain Cancer Treatments

...but not all Teams are Successful

- Study of NSF-funded project teams finds collaborations involving more universities produced fewer patents, publications, and other knowledge outcomes, **especially when more than one discipline was represented** in the project.
- Prior experience mitigates the harmful effects of distance and disciplinary differences.



Source: Cummings & Kiesler, 2008

BRIDGES: Our Objective

- To understand how interdisciplinary teams can better connect and collaborate to produce knowledge outcomes that would be unattainable by either individual or additive efforts.
- To provide actionable recommendations for interdisciplinary science teams to enhance their performance.

Team Integrative Capacity

Social integration
processes of visioning, suggesting ideas, connecting, coordination promotion, perspective seeking, and reflexivity

Emergent States

Cognitive integration
processes of knowledge consideration, accommodation, and assimilation facilitate knowledge transformation & innovation

Salazar, Lant, Fiore, & Salas, 2012

What makes a team more creative?

Card Tower Game

- The goal of this exercise is to have your team build the tallest free standing tower with 3 x 5 cards
- Here are the rules:
  - You will be given 5 MINUTES to plan and build your tower.
  - You will have 2 MINUTES for the actual construction of the tower.
  - While you plan, you MAY NOT DAMAGE THE CARDS IN ANY WAY, but you MAY SPEAK.
  - While you build the tower, you may NOT SPEAK to each other.
- Materials: 50 3X5 cards.
- Time Required: 15 minutes
- Group Size: Groups of 4-5 people
- Tom Wujec – TED TALK: https://www.ted.com/talks/tom_wujec_build_a_tower

Communication as Process

"A reciprocal process of team members' sending and receiving information that forms and re-forms a team's attitudes, behaviors, and cognitions"

(Salas et al., in press, p. 16)

Poor Communication

"Miscommunication and…misinterpretation…are two of the biggest causes of conflict [on teams]"

(Janssen, 2002, p. 109-110)

https://m.youtube.com/watch?v=PbODigCZqL8

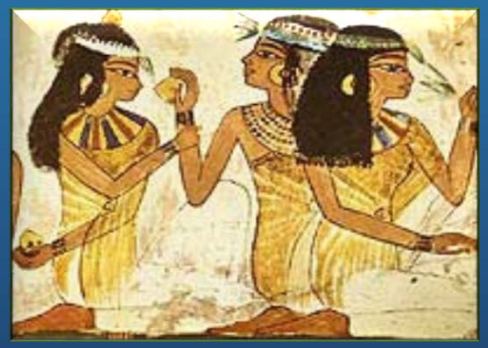
A workplace concern: Exclusion

- The experience of social exclusion transcends national boundaries.

- Around the world, individuals and groups who do not belong to the "main stream" are excluded from job opportunities, information networks, team membership, and the decision making process.

The Challenge

Creating a work environment that welcomes diversity, is inclusive of those who are different from the ‘main stream’, and allows individuals to utilize their talents in a mutually satisfactory way.



Diverse Interdisciplinary Teams

combine or juxtapose concepts and methods drawn from their different fields and backgrounds, but also work more intensively to integrate their divergent perspectives, even while remaining anchored in their own respective fields.

(Stokols, et al., 2008)

We practice the Four Principles of Interdisciplinary Communication!

1. Perspective Seeking
2. Promotive Voice
3. Team Reflection
4. Managing Connections

Evidence Based Principles

- We compared over 60 different interdisciplinary medical science teams generating research proposals over 9 months.
- Our research team attended the meetings of 10 of these 60 teams, recording, transcribing, and coding team dialogue.
- This training is based on what we found by comparing the communication of the most and least innovative teams…
- and we'll be providing you with real science team dialogue excerpts, de-identified and stylized for educational purposes, in order to illustrate the communication principles.

Vignette 1.1

- **LEADER**: (*Looking at other clinical trial members*). Let me just take a few minutes here. We, the clinical trials core team, have a good idea of where the trials will go, as we've been thinking about this for a long time. We'd like to figure out more about the variation in response and are considering a few ways to do so. We know that there are alcohol preferring and non-preferring mice. We want to keep exploring if there are clear differences in stimulant responsivity in other strains; we want to move to rats.

- **MEMBER 1**: Testing with rats is quite time consuming. Perhaps in mice it would be the easiest? There is a big literature on that for cocaine, amphetamines, alcohol, etc.

- **LEADER**:(defensively) Yeah, we're aware. Not all of our ideas will be so time-consuming – for instance we will look at a behavioral response as a first discriminator – like mice preference for drugs. Anyhow, the plan is to continue in our current direction and I feel that the clinical trials team has some really great ideas. We'll write them up and if anyone wants more detail on where we're headed, just let me know and I'll email info.

Vignette 1.2

- **LEADER**: Let me just take a few minutes here. We have a good idea of where the trials will go. But I think that the strengths that we have here, **meaning here in this room right now**, are the very basic science people and the genetics people, and so I would focus us on some of the going backward, in terms of thinking about questions like, *how does this treatment really work*? *What are the mechanisms of the cellular, genetic, and cell pathology levels*? And *can we explain the variability in response, both at the animal level and human level*?

- **MEMBER 1**: Ok, are there particular strains that have key features?

- **MEMBER 2**: Yes. Let's see, most of the community is collecting data at all levels, physiological, neurobiological, etc. This can be an advantage because we can cross correlate these results with other physiological measures.

- **LEADER** : We know that there are alcohol preferring and non preferring mice. This is probably the best-established finding about genetic strains that we have. Are there any strains where we know there are clear differences in stimulant responsivity?

Vignette 1.2, cont'd:

- **MEMBER 2**: In mice it would be easiest. There is literature on that for cocaine, amphetamines & alcohol
- **LEADER**: And these mice are available for research?
- **MEMBER 2**: Yes. Most of these mice are commercially available.
- **LEADER**: So, I want to ask, what would be the outcome measure, perhaps self-administration and behavioral outcomes? And would we also want to look at the brain responses? Might we be able to map out in vitro metabolic responses and neuro-chemical responses within certain limits, as i.e., variability of response?
- **MEMBER 3**: Yes, we probably could. We'd have to think about what we want to induce and how. We'd need a test for mice even though micro-dialysis would not be as easy as it might be with rats; plus, we'd have genetic analysis available if we used mice.
- **LEADER**: Good – great ideas. Doing this, plus looking at the simple behavioral responses of mice preference could be a real strength. These ideas together really enhance the project and makes that bridge from the clinical back to the basic.

Principle 1: Perspective Seeking

Perspective Seeking is characterized by:

- Seeking to **understand** others' positions or perspectives
- Consideration of how others **feel** about any given idea or topic
- Taking on **viewpoints** different from your own in order to understand others' perspectives
- Directly **asking** about others' uniquely held information

Perspective Seeking - How?

How do we facilitate Perspective Seeking?

- "Floating a trial balloon"
- Critical questions (e.g., playing devil's advocate)
- Clarifying questions – to better understand meaning
- Inquiring questions – asking for new insight from fellow team members

Question your questions: The question you ask is the frame through which you get answers…

- 5 + 5 = ??
- What two numbers add up to 10?

"The formulation of a problem is far more essential than its solution which may be merely a matter of mathematical or experimental skill"

- Albert Einstein

Perspective Seeking - Obstacles

What gets in the way?

- Lack of psychological safety; that is, high risk of ridicule
- Assuming that ideas are unanimously shared or understood by the whole group
- Assuming that an idea already has "buy-in" from others
- Strong association of ideas with certain individuals leading others to feel intimidated about asking questions that may challenge the idea

Edmondson, 1999; Detert & Edmondson, 2011

Perspective Seeking

- **Facilitators of Innovation**
  - Members, especially leaders, seek input about a new idea they have in the form of a question. *"Could the symptoms be caused by the new medication?*
  - Clarifying or critical questions about ideas are posed – especially by those from other disciplines – to enhance understanding and idea quality.
  - A wide range of members are invited to share their input.

- **Inhibitors of Innovation**
  - Members, especially leaders, fail to seek input, or bring up new ideas in a declarative fashion. *"The symptoms are caused by the new medication."*
  - Clarifying or critical questions focus on implementation (e.g., who is going to do what, deadlines, and equipment) rather than on idea development.
  - Input is only elicited from a select set of members.

Principle 2: Promotive Voice

Promotive Voice is characterized by…

- "attempts to **propose** new ideas/opinions/suggestions to improve the overall functioning of the work unit or organization" **as it pertains to your area of expertise**

Liang, 2007

Promotive Voice - How

- *Sharing expertise* in a way that all members will understand and that facilitates the team's ability to generate solutions or ideas.
- *Offering original ideas* that have not been previously discussed, especially if they derive from your own discipline.
- *Building on* a previously suggested idea with suggestions or constructive critiques that extend and enhance the depth of knowledge.

Promotive Voice - Obstacles

Why don't people use promotive voice?

- When someone suggests an idea, we assume that they strongly identify with this idea and would interpret alternative suggestions as criticism
- People believe they should only speak up about a new idea when they have evidence to support it and it is fully thought out.
- People believe everyone shares my knowledge

Detert & Edmondson, 2011

Promotive Voice

Facilitators of Innovation:

- Original ideas are mentioned AND built upon throughout the discussion by both team leader(s) and members.
- Ideas and suggestions are offered by a wide variety of team members, rather than a select few.

Inhibitors of Innovation:

- Original ideas are mentioned but CUT OFF before building on or critically assessing the ideas presented.
- Ideas and suggestions by leaders and other high status members dominate, deterring others from voicing their suggestions.

Principle 3: Team Reflection

Team Reflection is characterized by:

- A concern with reviewing and reflecting upon objectives, strategies, and work processes, in order to meet team objectives and adapt to the wider environment (Patterson et al, 2005, p. 386)

Team Reflection – Obstacles?

- Systematic review of team components and processes takes time – but the grant is due in a week!
- Once task-related problems are uncovered, it can be difficult to make changes.
- Once teams establish routines of interaction, they are difficult to change.

Team Reflection

Review objectives:

- *Define and Adjust goals and activities as needed* based on current progress and progress that still needs to be made

Review how you're getting there:

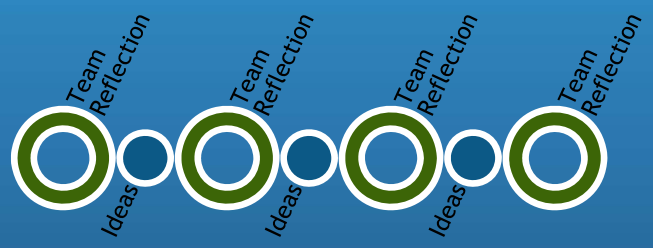
- Methods
- Team Process
- Tools
- Communication

Team Reflection - When?

When does reflection happen in innovative teams?

Most Creative Teams

Less Creative Teams



- Set aside time for reflecting on team processes regularly, but try to avoid doing it in the middle of idea- generation meetings so that ideas can be fully developed.

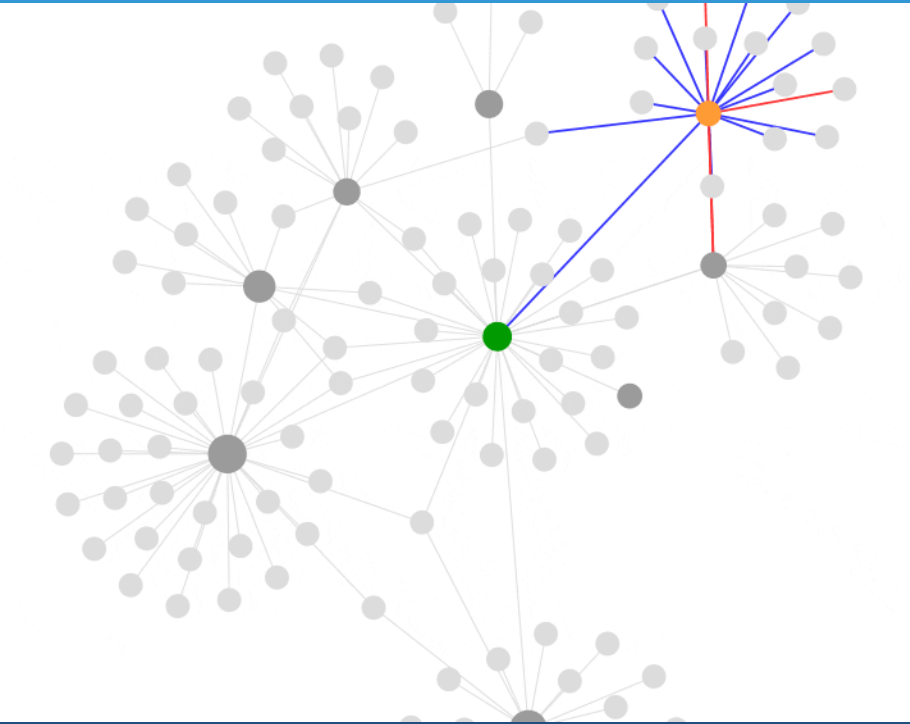
Principle 4: Managing Connections

Managing Connections is characterized by:

- *Building interpersonal connections* among team members
- *Leveraging resources* that stem from interpersonal connections, either internal (i.e. team members) or external (e.g. community or advocacy groups) to the team, to forge novel insights between disparate perspectives.

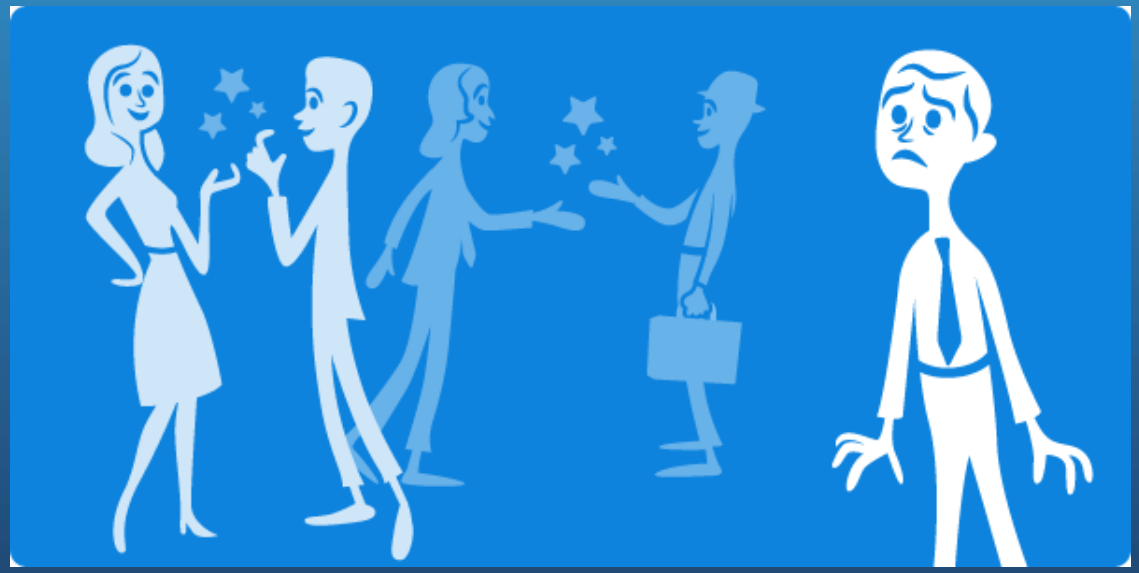
Managing Connections - How?

- *Make connections* among team members in a way that facilitates team member recognition, understanding, and use of knowledge resources across disciplines.
- *Introduce or refer* team members to someone (internal or external to the team) who can help with the work or idea.



Managing Connections – Obstacles?

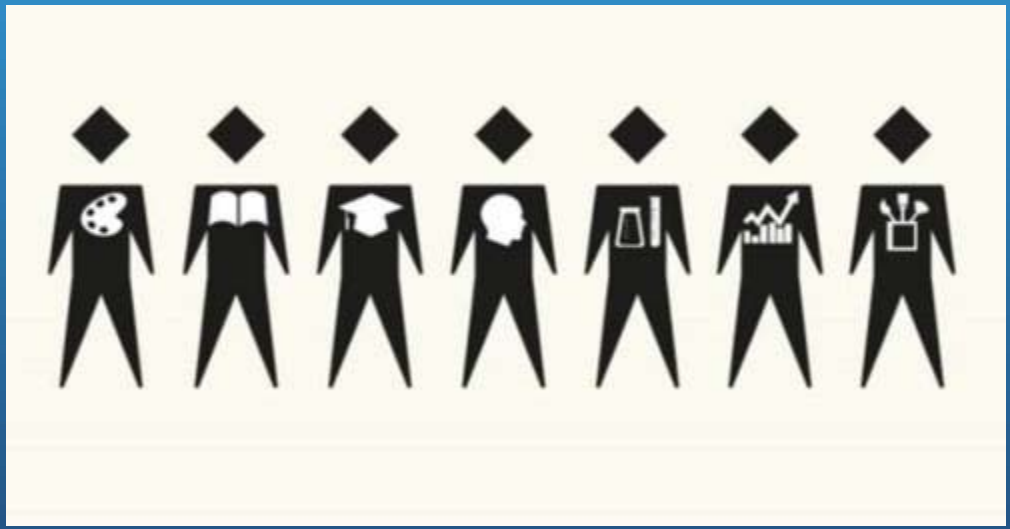
- If I share my connections with others, they may gain professional opportunities before me.
- Distance and virtuality makes it difficult to connect with people.



Detert & Edmondson, 2011;
Prusak & Cohen, 2001

Managing Connections

- Whenever expertise, tools, or partnerships need to be brought together for completion of *translational* work.
- To foster the novel combination of diverse *disciplinary* perspectives



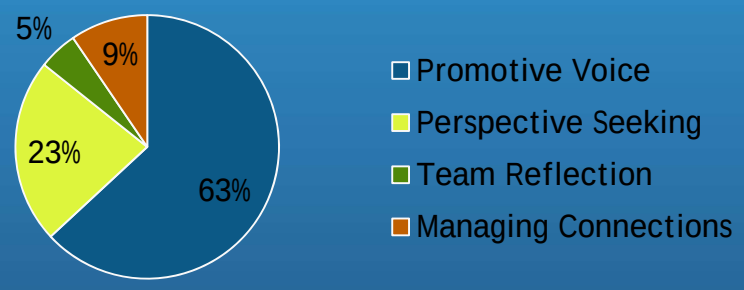
To Summarize: What Does an Effective Team Meeting Look Like?

vs.

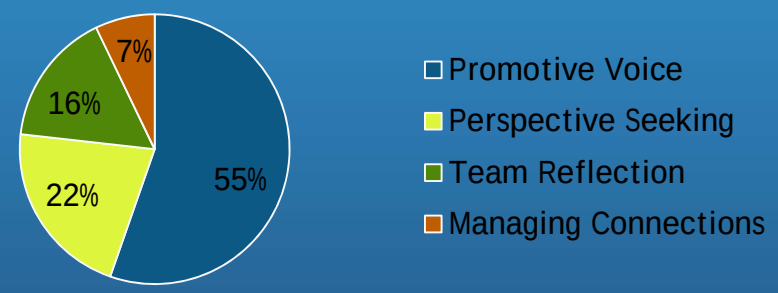
Communication – It Matters!

% Breakdown of Principles in Meetings

Most Creative Team



Less Creative Team



Promotive voice, or idea discussion, is what teams do the most during their idea-generation meetings. What differentiates their performance?

Most innovative team…

-Team Reflection on goals at the beginning to bring group together is ideal.

-Promotive voice is best at the beginning of a discussion/meeting.

-Perspective seeking extends the length of idea development (string of shapes).

-Reflection on how to implement work wraps up meeting.

-Connecting members from different disciplines enables them to execute work.

Team Activity: MRSA Root Cause Analysis

Background: You and your team members are part of the Task Force on MRSA working for the County Health Department. Recent MRSA cases that were reported over the 4th of July holiday have been linked to the local Healthy Lives Clinic, Inc. Since the outbreak, Healthy Lives Clinic, has completed an internal investigation and believes that they have found the sequence of events that allowed MRSA to reach some of their patients.

Objective: To ensure that this problem does not happen again, the County Health Department feels strongly we should conduct our own independent investigation. You and your team members will discuss the events that took place at Healthy Lives Clinic and determine the cause of the outbreak.

- .

Assignment

Materials: Each of the participants in your group will be receiving different materials. Together, the material includes all of the information that Health Lives Clinic used to conduct their internal investigation. Memos will provide further explanation of the materials you have received.

Instructions: You will have 10 minutes to review privately materials you received. After the review time has elapsed, the group discussion will begin. You will have 15 minutes to discuss as a group and try to determine the root cause of the outbreak.

To more effectively complete the task, please draw on the communication principles:

1) **Perspective Seeking**

2) **Promotive Voice**

3) **Team Reflection**

4) **Managing Connections**

Key Takeways

Engage in the Principles of Communication for Interdisciplinary Teams!

- Perspective seeking
- Promotive voice
- Team reflection
- Managing connections

Measuring Outcomes: Cognitive Mediating Processes and improved innovativeness

- 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."
- External & Self-Report Ratings of Team Innovativeness

Descriptive Data

Variable	M (SD)	Min	Max	1	2	3	4	5
1. Team Sizes	5.82 (2.40)	3	11					
2. Age	4.48(1.31)	2.5	7.5	.23				
3. Gender	.82 (.25)	.33	1.00	.16	-.26			
4. PI Prior Funding	4.69(.47)	.32	.90	-.47	-.08	-.01		
5. Cognitive Integration	.5.99 (.43)	4.81	6.58	-.61*	-.07	-.16	.22	
6. Idea novelty	5.7 (1.14)	3.5	7.0	-.71**	.08	-.20	.25	.72**

* $p < .05$, ** $p < .01$

Results

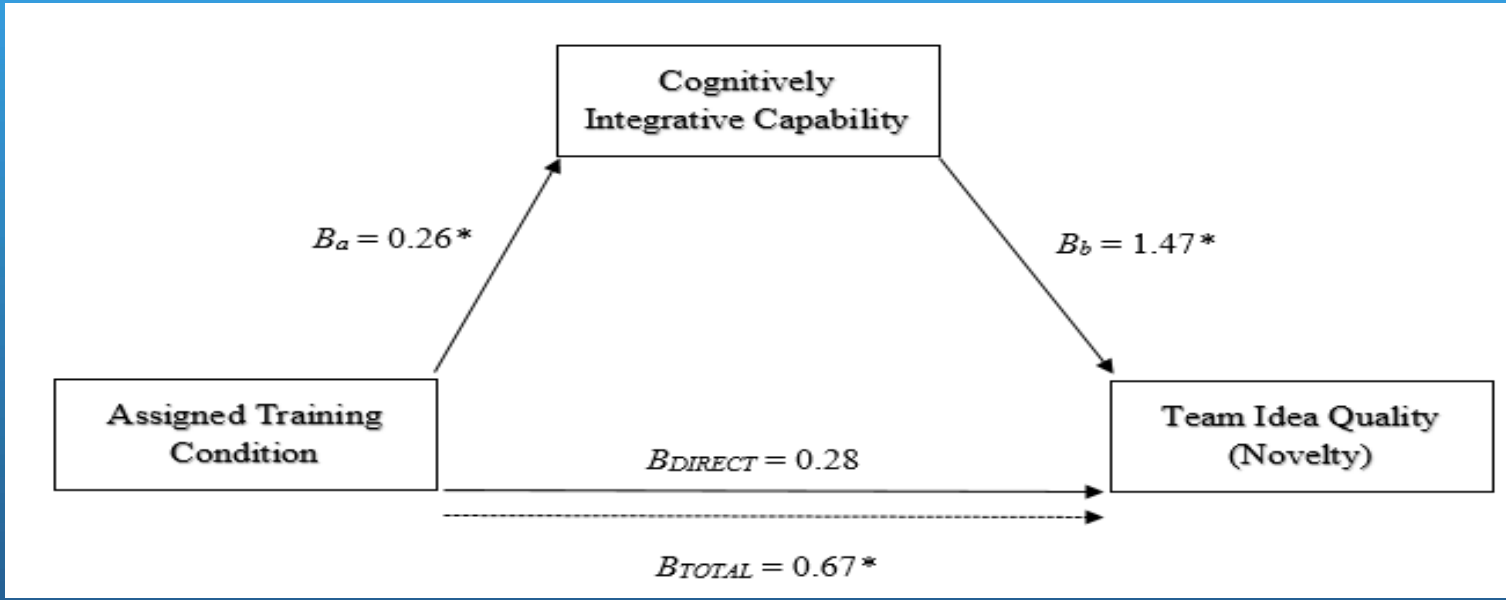


Figure 2. Theoretical model tested in Study 5 via bootstrapped mediation analysis. Reported coefficient estimates incorporate team-level covariates for average age, *B = -0.05, p = .53,* and gender, *B = -0.05, p = .92*.

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Preliminary Results: Is team effectiveness enhanced by the completion of both trainings? Yes!

Means and Standard Deviations of Team Effectiveness

Condition	*N*	*M (S.D.)*
Only One Training	14	5.5 (.83)
Both Trainings	24	5.9 (.83)

- Univariate Analysis of Variance Predicting Team Effectiveness

Source	*df*	*SS*	*MS*	*F*	*P*
Corrected Model	6.62	5	1.32	2.053	.09
Intercept	17.94	1	17.93	27.78	.00
Gender	.18	1	.18	.28	.60
Age	3.14	1	3.14	4.87	.04
Highest Degree	.59	1	.59	.93	.34
Site	1.33	1	1.33	2.06	.16
Both Trainings	3.50	1	3.50	5.43	.03
Error	3.05	32	.65		
Total	20.66	38			
Corrected Error	1.33	37			

R Squared =.24 (Adjusted R Squared =.13)

Conditions for Successful Teaming

- A "real" team or set of teams matched to task requirements.
- Compelling direction.
  - Challenging, clear and consequential
- Appropriate enabling structure.
  - Task design
  - Team composition
  - Core norms of conduct
- Supportive organizational context.

Wageman, Hackman & Lehman (2005)