Team Science

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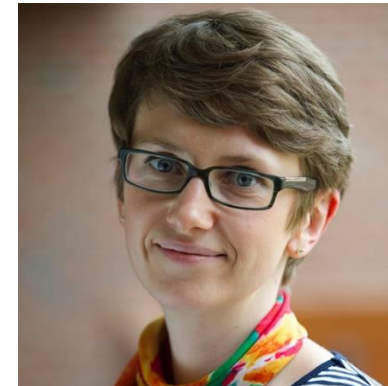
It Starts with Connections ...

How many of YOU are engaged in …

- interdisciplinary research?
- multidisciplinary research?
- transdisciplinary research?
- knew there was a difference among those terms?
- have experienced a good collaboration?
- have experienced a bad collaboration?

Team Science = Collaboration?

- Yes, but …
  - It is more
  - Collaboration is influencing the practice of science
  - Cross-disciplinary collaboration is influencing production of knowledge

Published in *Science*

　"The interdisciplinary approach is becoming one of the prominent characteristics of [science] and represents a synthesizing trend which focuses the specialized research techniques on problems common to a number of separate disciplines.

　Such cooperative research has to overcome serious obstacles when operating within the existing departmentalized framework of the universities. It appears that real progress in this direction will be made in institutions which are organized on a permanent and frankly cooperative basis.

　Psychologically, interdisciplinary research requires not only abstract, theoretical intelligence…, but also 'social intelligence.' Cooperative work is a social art and has to be practiced with patience."

Collaboration Challenges

- Problems of Infrastructure - Tangible and Tacit
  - Inherent challenge associated with structure of the modern university, *i.e.*, the discipline-bound department
  - Tacit norms that hinder interaction
  - Reward structures that focus on individual effort

- Problems of Interaction
  - Difficulty inherent in communicating and collaborating across disciplines
  - Patience and social intelligence are necessary precursors to effective collaboration in such environments

Why was that quote informative?

- Anyone involved in collaboration has probably experienced both challenges

- What is informative is not just <u>what</u> was said, but <u>when</u> it was said

  - One of first articles specifically addressing interdisciplinary research (Brozek & Keys, 1944)

- Science still struggles, so why should we think anything will change?

Josef Brozek and Ancel Keys. 1944. General Aspects of Interdisciplinary Research in Experimental Human Biology. *Science* 100(2606):507-512.
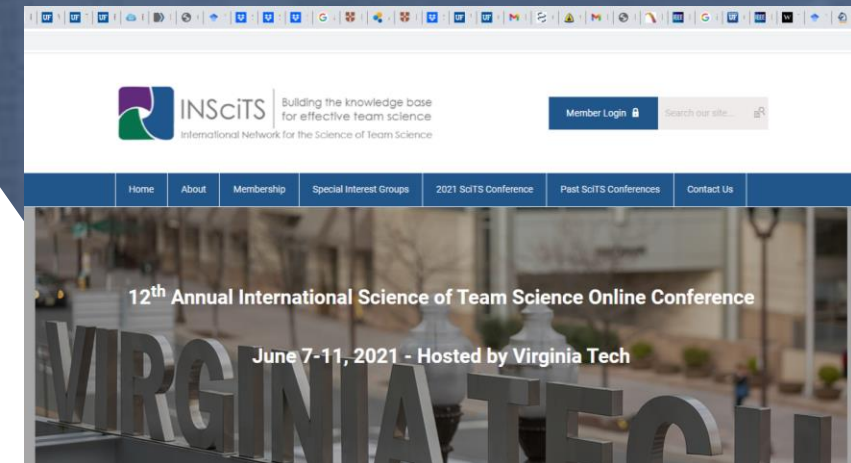
Can we overcome the challenges? YES!

- Increased emphasis on collaborative research that creates teams of scientists to address complex phenomena
  - Funders (*e.g.*, NIH) are specifically encouraging and supporting collaborative research projects
- Academia, Industry & Policy communities all making more of a concerted effort to study scientific collaboration
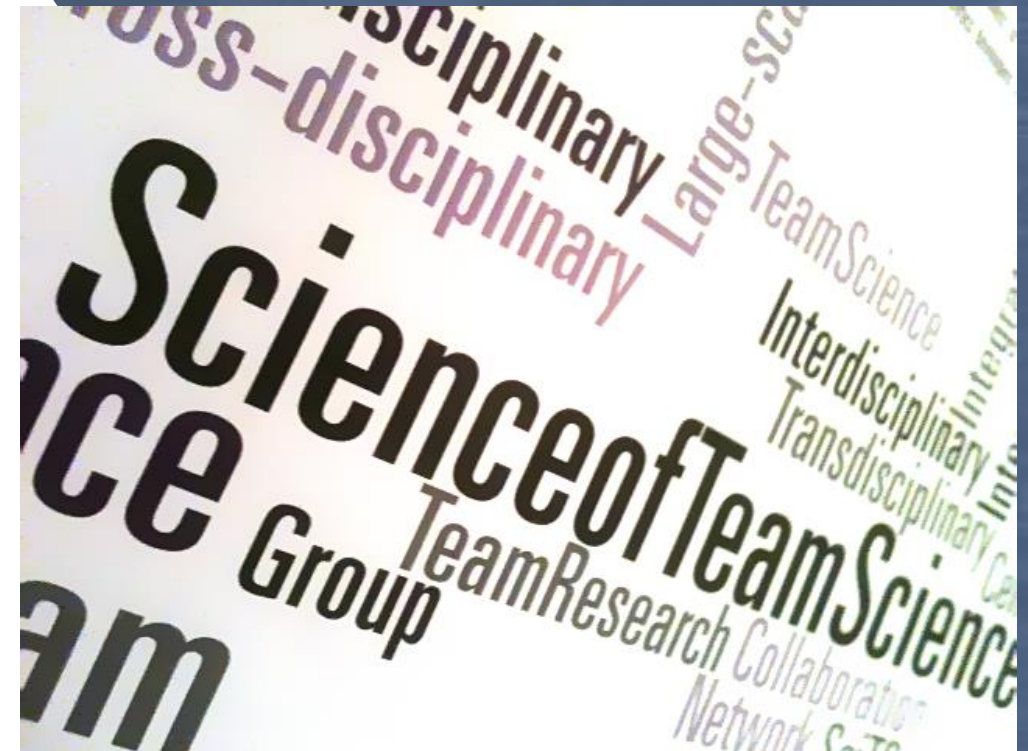
- Tremendous growth in the study and understanding of groups and teams
  - Scientific study of teamwork can be a true catalyst for change
    - Matured into its own area of inquiry producing a rich base of knowledge
    - Helps us to better understand complex coordination used by teams

Can we overcome the challenges? YES!

INSciTS | Building the knowledge base for effective team science

International Network for the Science of Team Science

Definitions

- What is a "team"?
- Groups *vs*. teams
- Disciplinary, multidisciplinary, interdisciplinary, transdisciplinary, cross-disciplinary

Definitions

Teams	**two or more people working interdependently (collaborating) towards a shared common goal or task**
Team-Building	**process of gathering the "right" people & getting them to work together to accomplish a goal/task**
Team Management	**directing a group of individuals to work as a unit to accomplish a goal/task**

We may be evolutionarily programmed for team work

Teams seem to survive better than individuals
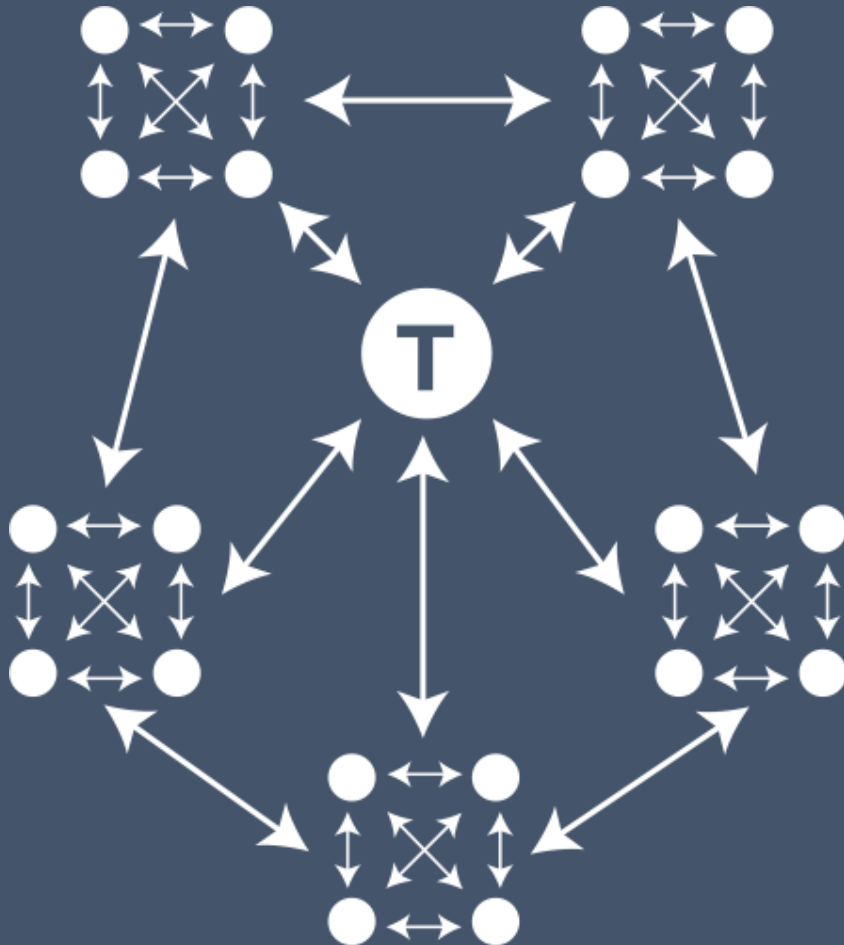
Group *vs.* Team

Groups

Group *vs.* Team

Teams

Teaming

Teaming is teamwork on the fly. It involves coordinating and collaborating without the benefit of stable team structures. Teaming calls for developing both affective (feeling) and cognitive (thinking) skills.

Edmondson, A. C. (2012). *Teaming: How organizations learn, innovate, and compete in the knowledge economy*. John Wiley & Sons.

Group *vs.* Team

	Groups	Teams
Members	Independent	Interdependent
Goals	Individual	Shared
Identity	Individual (me)	Shared (we)
Leadership	Often single	May be shared
Products	Individual	Collective
Reward	Individual	Collective
Cohesion	None/limited	Esprit de corps
Conflict	Reactive	Expected/proactive

Unidisciplinary?
Multidisciplinary?
Interdisciplinary?
Cross-disciplinary?
Transdisciplinary?

Collaboration Across Disciplines: Some More Definitions

- **Unidisciplinary**

- **Multidisciplinary**
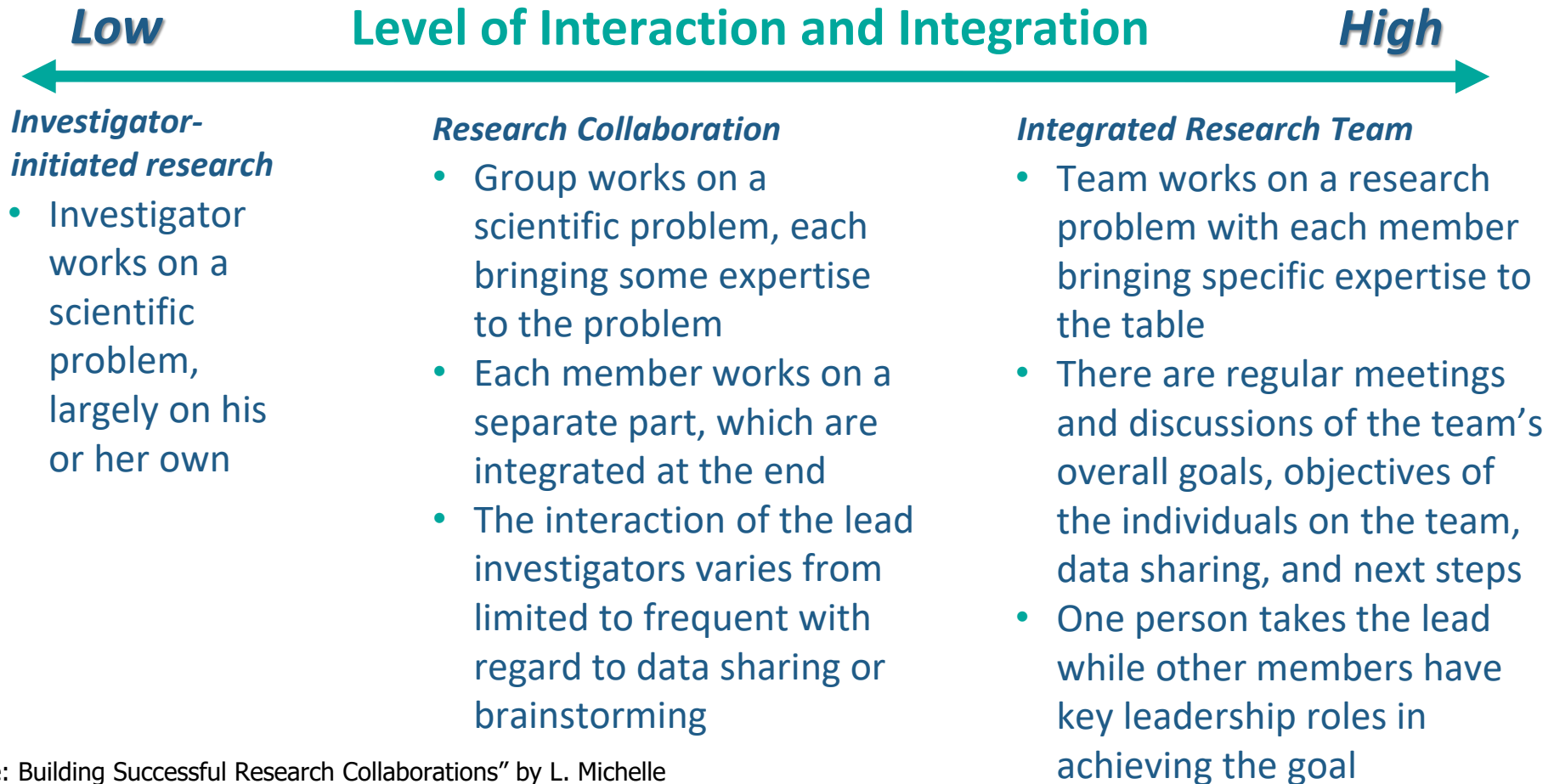 additive, complementary, independent, sequential

- **Interdisciplinary**
  interactive, combine, integrate

- **Transdisciplinary**
  holistic, transcend disciplinary perspectives, new methodologic or conceptual frameworks

Cross-Disciplinary

Team Science > Collaboration

Level of Interaction and Integration

Investigator-initiated research

- Investigator works on a scientific problem, largely on his or her own

Research Collaboration

- Group works on a scientific problem, each bringing some expertise to the problem
- Each member works on a separate part, which are integrated at the end
- The interaction of the lead investigators varies from limited to frequent with regard to data sharing or brainstorming

Integrated Research Team

- Team works on a research problem with each member bringing specific expertise to the table
- There are regular meetings and discussions of the team's overall goals, objectives of the individuals on the team, data sharing, and next steps
- One person takes the lead while other members have key leadership roles in achieving the goal

Is there evidence for impact of team science?

The Increasing Dominance of Teams in Production of Knowledge

Stefan Wuchty,[1]* Benjamin F. Jones,[2]* Brian Uzzi[1,2]*†

We have used 19.9 million papers over 5 decades and 2.1 million patents to demonstrate that teams increasingly dominate solo authors in the production of knowledge. Research is increasingly done in teams across nearly all fields. Teams typically produce more frequently cited research than individuals do, and this advantage has been increasing over time. Teams now also produce the exceptionally high-impact research, even where that distinction was once the domain of solo authors. These results are detailed for sciences and engineering, social sciences, arts and humanities, and patents, suggesting that the process of knowledge creation has fundamentally changed.

How has team size grown?
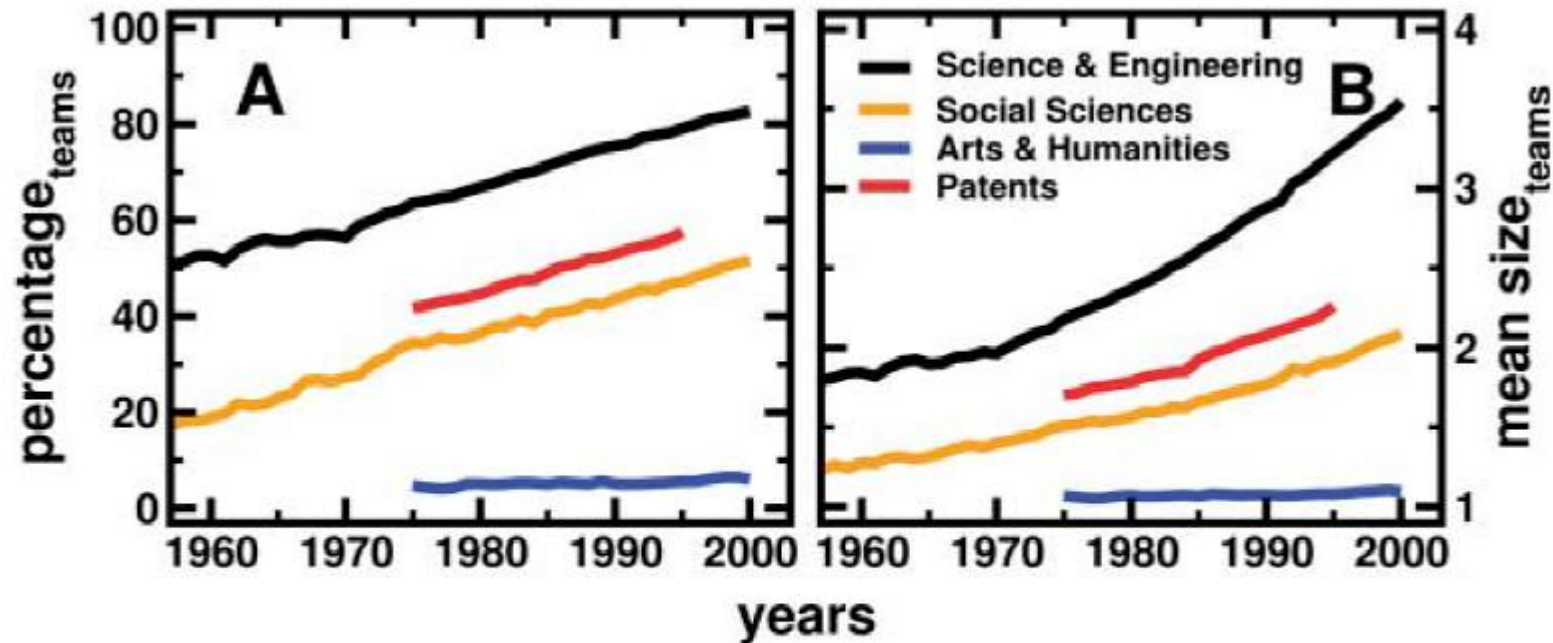
Fig. 1. The growth of teams. These plots present changes over time in the fraction of papers and patents written in teams (**A**) and in mean team size (**B**). Each line represents the arithmetic average taken over all subfields in each year.

How is team size related to impact?

$$RTI = \frac{\text{mean \# citations team-authored}}{\text{mean \# citations solo-authored}}$$

Fig. 2. The relative impact of teams. (A to D) Mean team size comparing all papers and patents with those that received more citations than average in the relevant subfield. (E to H) The RTI, which is the mean number of citations received by team-authored work divided by the mean number of citations received by solo-authored work. A ratio of 1 indicates that team- and solo-authored work have equivalent impact on average. Each point represents the RTI for a given subfield and year, whereas the black lines present the arithmetic average in a given year.

How can we USE team science?

- Recognize scientific problems that would best be answered using a team science approach
- Interdisciplinary and transdisciplinary research require action
  - connecting or interacting among disciplines
- Not just any activity, but team activity: a process engaged by members of a coordinated scientific team
  - "two or more individuals who must interact and adapt to achieve specified, shared, and valued objectives" (Salas, *et al*., 1992)

How can we USE team science?

- Characteristics of Teams
  - Multiple information sources
  - Intensive communication
  - Task-relevant knowledge
  - Meaningful task interdependencies
  - Coordination among members with specialized roles/responsibilities
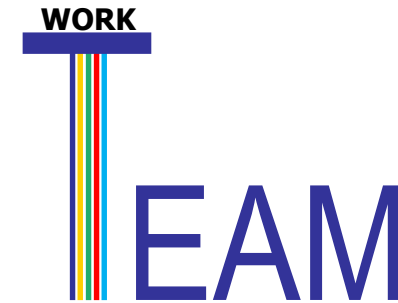
- Reframe cross-disciplinary science as a process of teamwork to be mastered
  - *By understanding the* <u>*teamwork activities*</u> *necessary for success we can make the achievement of cross-disciplinary science more tractable*

WORK
TEAM

Brozek & Keys in *Science*, 1944

"In the training program three points deserve emphasis: (1) facilities for **getting acquainted with the problems and methods of the neighbor fields**, (2) **study of the 'science of science'** which provides the necessary philosophical perspective, and (3) development of **social skills required for a stimulating and efficient scientific cooperation.**"

Josef Brozek and Ancel Keys. 1944. General Aspects of Interdisciplinary Research in Experimental Human Biology. *Science* 100(2606):507-512.

Preparing for and Leading Team Science: Are You Ready?

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Preparing for Team Science

- **Are YOU ready to be a**
  - Team Member?
  - Team Leader?

Preparing Yourself for Team Science

- **Contexts of communication in Team Science**

- **What kind of communication is needed for effective collaboration?**

Constructive Feedback

Sharing of Data & Credit

Leadership

Decision Making

Conflict Management

Communication Is Malleable

- **Communication skills can be learned and practiced**
- **Personal insight and self-awareness**
- **Awareness of impact you have on other people.**

Recall ... Quote from *Science*

"The interdisciplinary approach is becoming one of the prominent characteristics of [science] ... Psychologically, interdisciplinary research requires not only abstract, theoretical intelligence..., but also 'social intelligence.' Cooperative work is a social art and has to be practiced with patience."

- Brozek & Keys, 1944

Preparing Yourself for Team Science

- **Tips**
  - **Recognize that others have a different understanding or perception**
  - **Ask questions to understand how others perceive an experience**
  - **Appreciate that different perspectives contribute to creativity, innovation, and problem-solving**
  - **Remind yourself that different disciplines have different perspective, methods, conceptual frameworks, and perhaps norms and values.**

Preparing for Team Science

- **Are YOU ready to be a**
  - Team Member?
  - Team Leader?

What is Leadership?

- **the art of motivating a group of people to act toward achieving a common goal**

  - https://www.thebalancesmb.com/leadership-definition-2948275

Vision + **Relationships** + **Tasks**

Enable Others to Act

"A leader sees greatness in other people. You can't be much of a leader if all you see is yourself."
–Maya Angelou

hbr.org Lissa Gotwals

Tuckman Model of Team Formation & Performance

Hersey & Blanchard's Situational Leadership

- **Which style fits each stage of team development?**

Hersey & Blanchard's Situational Leadership

- **Maturity, or evolution, of the individual or team from dependence to independence**
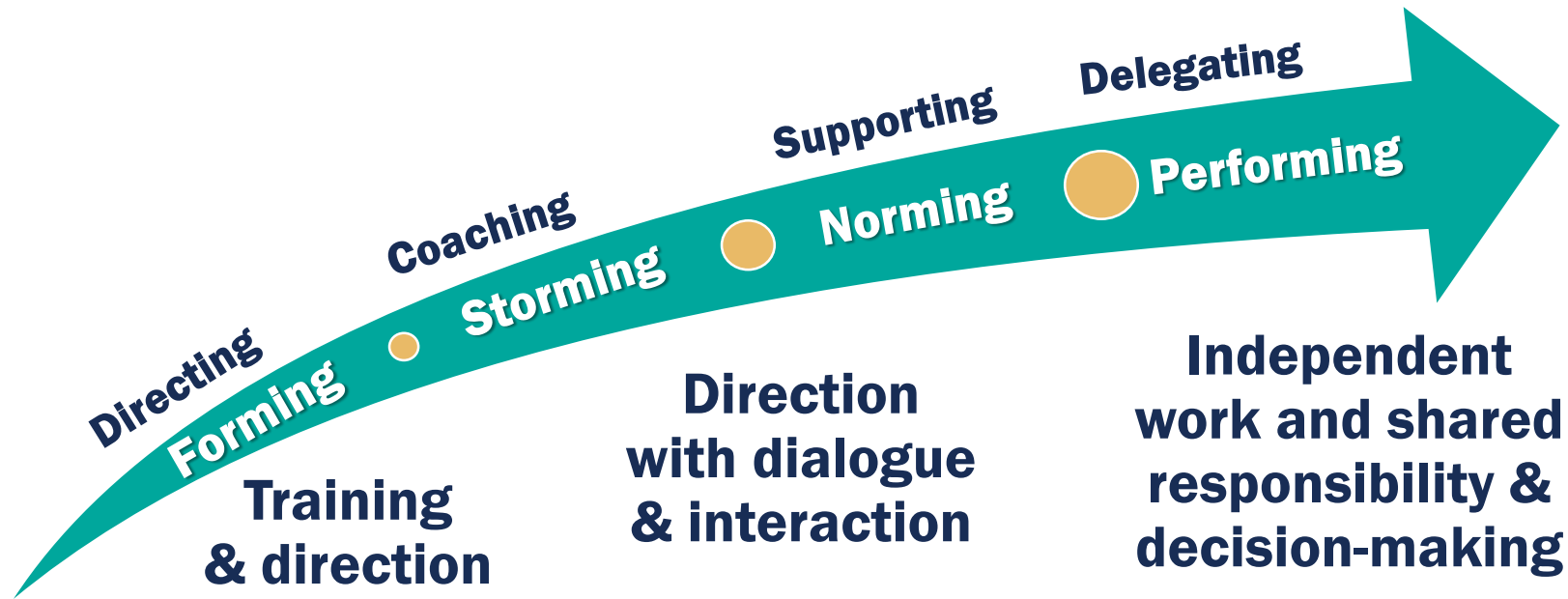
Directing
Forming
Coaching
Storming
Supporting
Norming
Delegating
Performing

Training & direction

Direction with dialogue & interaction

Independent work and shared responsibility & decision-making

Conflict Management

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Conflict Management Strategies

Conflict Management Strategies

Conflict Management Strategies
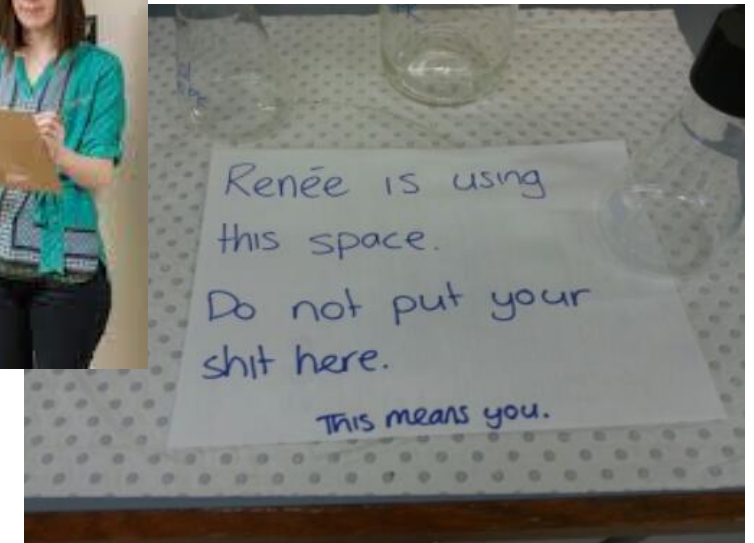
2 minute breakout

Conflict Management Strategies

- **Disagreement or difference**
  - **Science**
  - **Interpersonal**

JOIN MWU | GAMES | BROWSE THESAURUS | WORD OF THE DAY | WORDS AT PLAY

Merriam-Webster SINCE 1828

conflict

DICTIONARY | THESAURUS

conflict *noun*

con·flict | \ ˈkän-ˌflikt 🔊 \

Definition of *conflict* (Entry 1 of 2)

1 : <u>FIGHT</u>, <u>BATTLE</u>, <u>WAR</u>
// an armed *conflict*

2 a : competitive or opposing action of incompatibles : antagonistic state or action (as of divergent ideas, interests, or persons)
// a *conflict* of principles

b : mental struggle resulting from <u>incompatible</u> or opposing needs, drives, wishes, or external or internal demands
// His conscience was in *conflict* with his duty.

Managing Difference

- "Team science is an exercise in diversity."

- "Differences are at the core of the research team's strength and ... a challenge to their successful functioning ..."
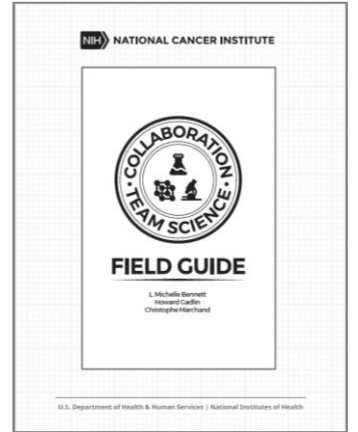
Categories & Types of Diversity

Think about your teams ...

COLLABORATION TEAM SCIENCE FIELD GUIDE

NIH NATIONAL CANCER INSTITUTE

L. Michelle Bennett
Howard Gadlin
Christophe Marchand

U.S. Department of Health & Human Services | National Institutes of Health
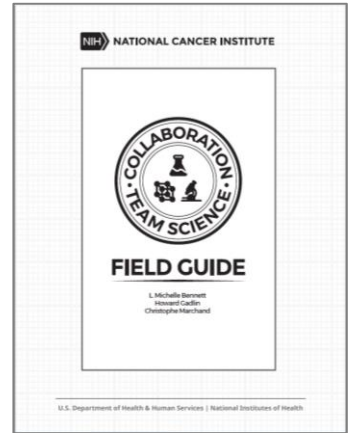
KNOWLEDGE/SKILLS
- Education
- Functional Knowledge
- Information or Expertise
- Training
- Experience
- Abilities

SOCIAL/CATEGORY
- Race
- Ethnicity
- Gender
- Age
- Religion
- Sexual Orientation
- Physical Abilities

VALUES/BELIEFS
- Cultural Background
- Ideological Beliefs

PERSONALITY
- Cognitive Style
- Affective Disposition
- Motivational Factors

ORGANIZATIONAL/STATUS
- Tenure or Length of Service
- Title
- Relationship with Organization Leaders

SOCIAL/NETWORK TIES
- Work-Related Ties
- Friendship Ties
- Community Ties
- In-Group Memberships

Managing Conflict
Be Aware of Yourself & Boundaries

Self Examine

Why is this issue important to you?

Does it matter in the larger scheme of things?

Is it likely to self-resolve?

Given time, will it work itself out without confrontation or argument?
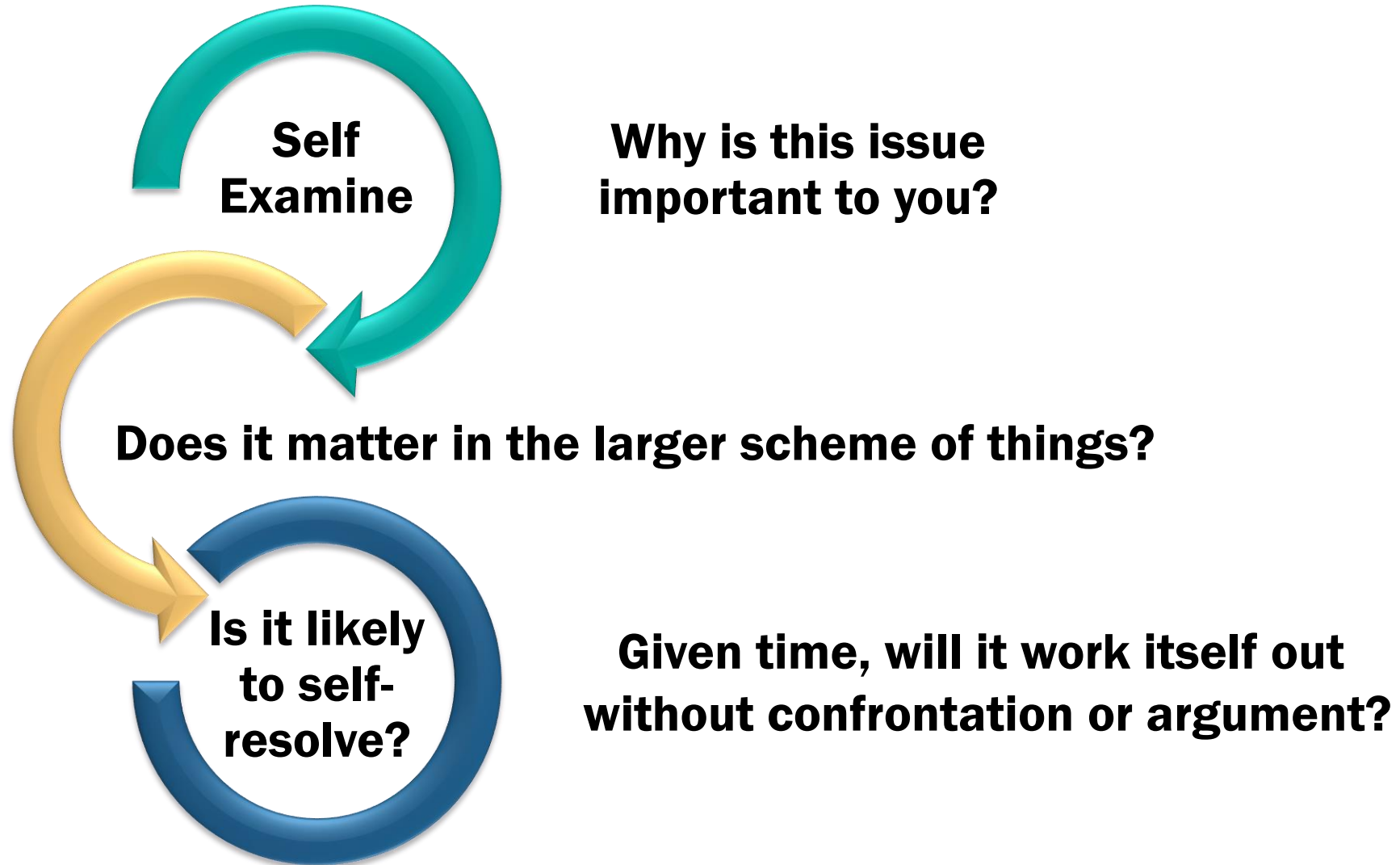
A Cooperative Approach

The Most Important Question

    1. **"What do you want?"**

Once you've gotten the answer to this, there are three follow-up questions:

    2. **What are you doing to get what you want?**

    3. **Is what you are doing working?**

    4. **Do you want to figure out another way?**

Strategic Team Science

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We are facing tangled challenges and complex contexts

Stokols, D., Hall, K. L., Taylor, B. K., & Moser, R. P. (2008). The science of team science: overview of the field and introduction to the supplement. *American journal of preventive medicine*, *35*(2), S77-S89.
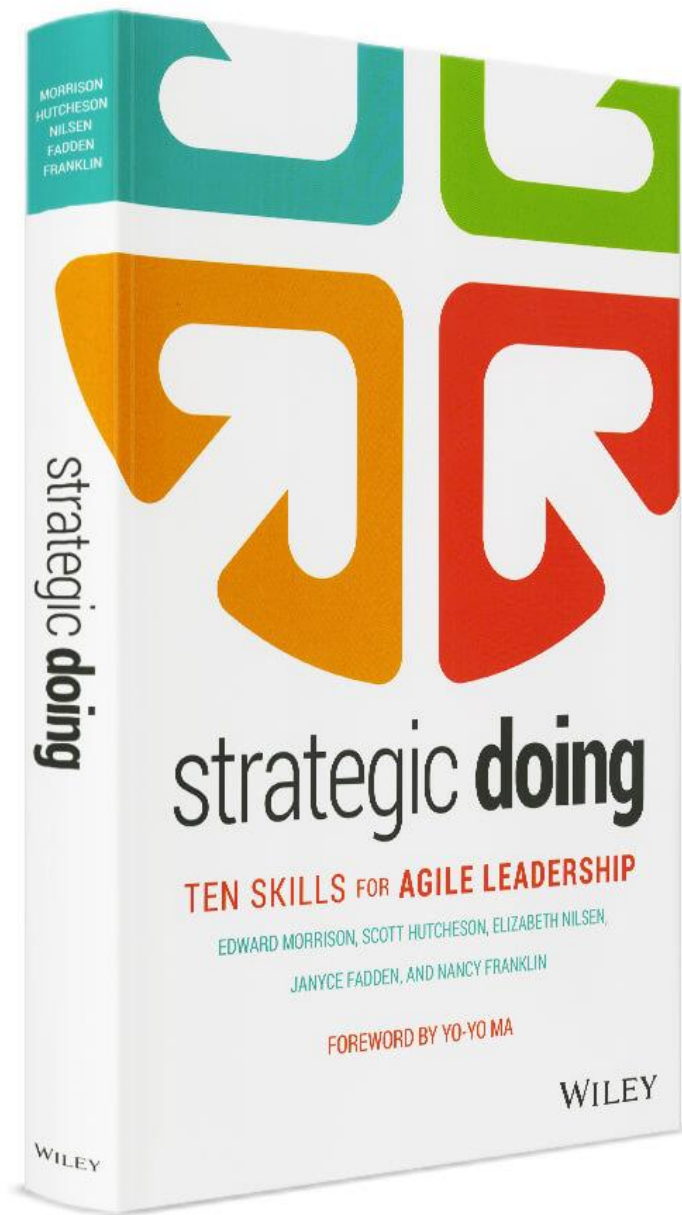
Morrison, E., Hutcheson, S., Nilsen, E., Fadden, J., & Franklin, N. (2019). *Strategic Doing: Ten Skills for Agile Leadership*. John Wiley & Sons.
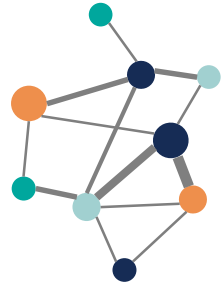
Strategic Team Science

Strategic **Team Science** is a research strategy designed for open, loosely connected networks

Integrative **Dialogue** is a communication strategy that promotes equity and inclusion

Where are we going?
Outcomes
Link, Leverage
& Align

How will we get there?

Pathways

We are here

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Equity of Voice

Power of **Networks**

Framing **Questions**
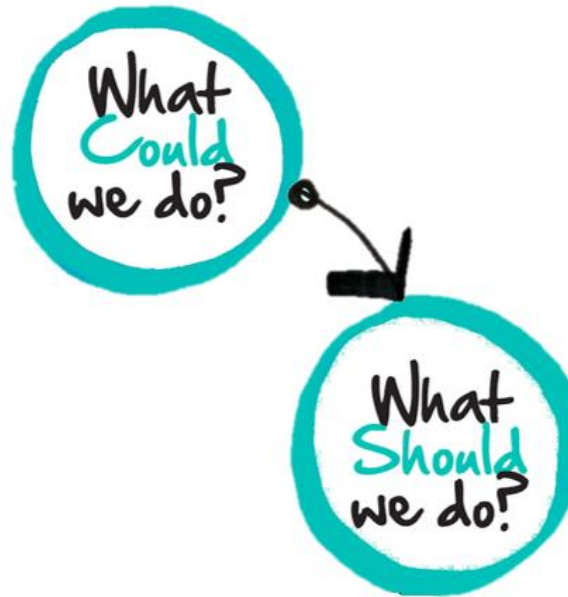
Foundation // Equity of Voice
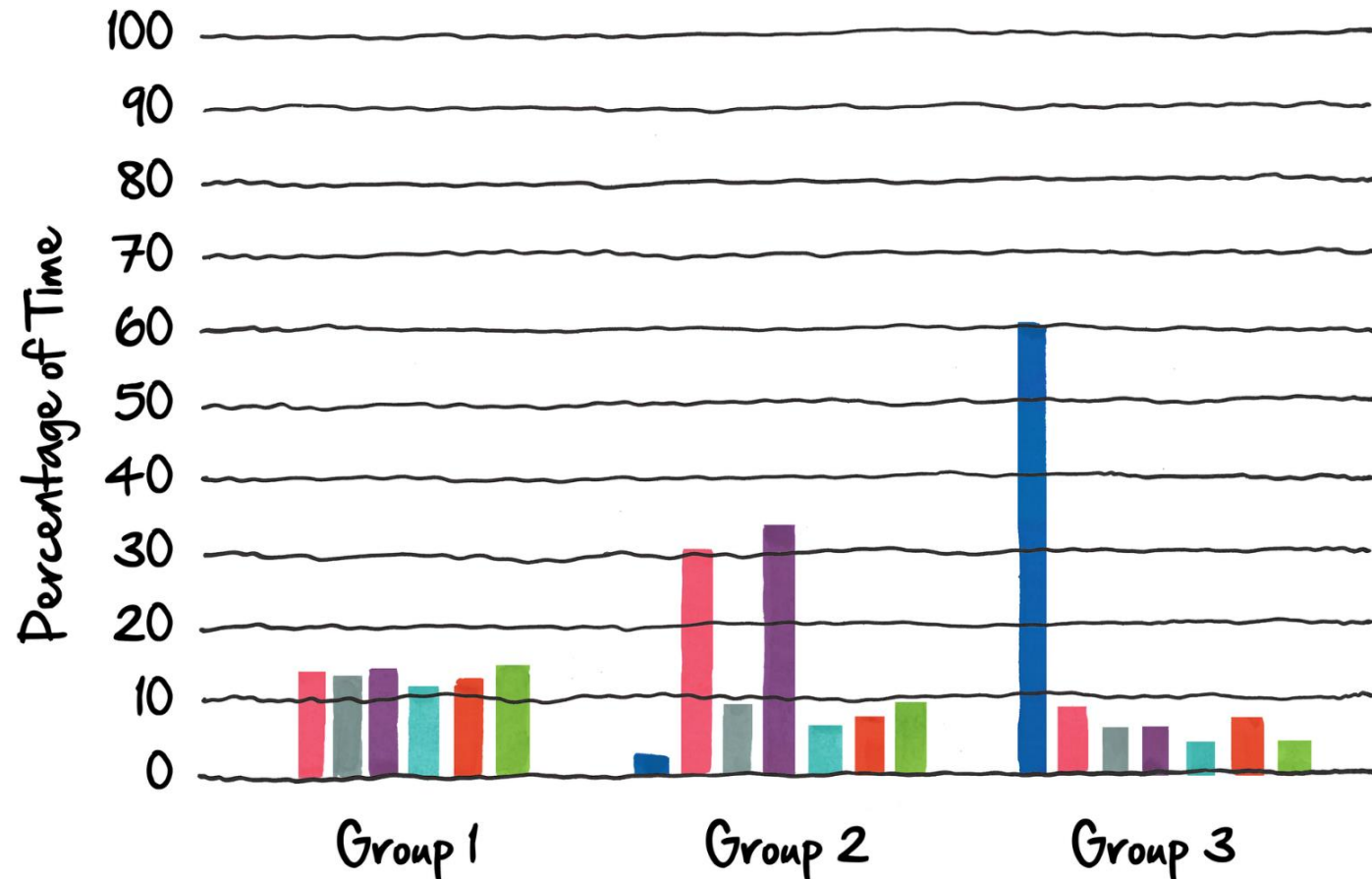
Keil, J., Stober, R. Quinty, E. Molloy. B. Hooker. N. (2015). *Identifying and analyzing actions of effective group work.*

Hierarchy
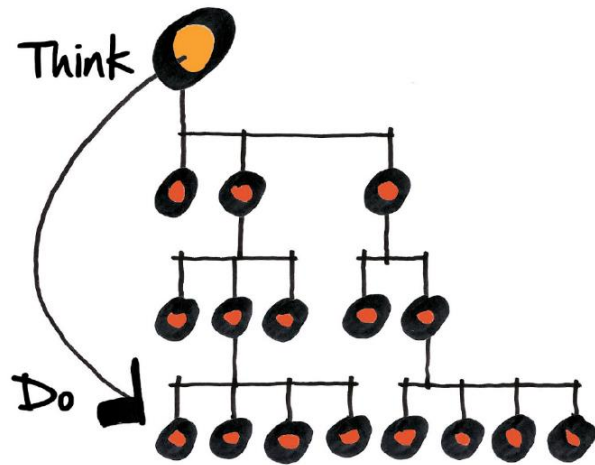
Network
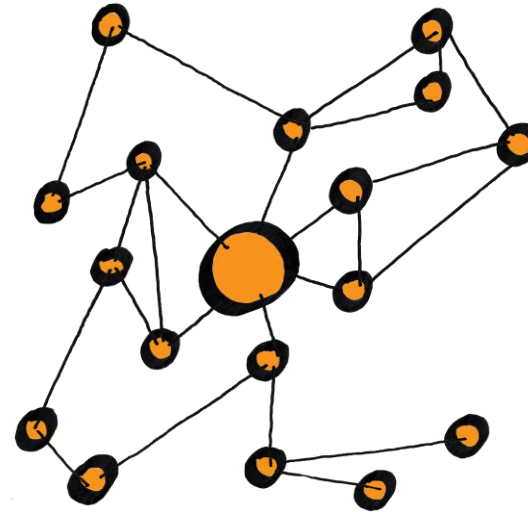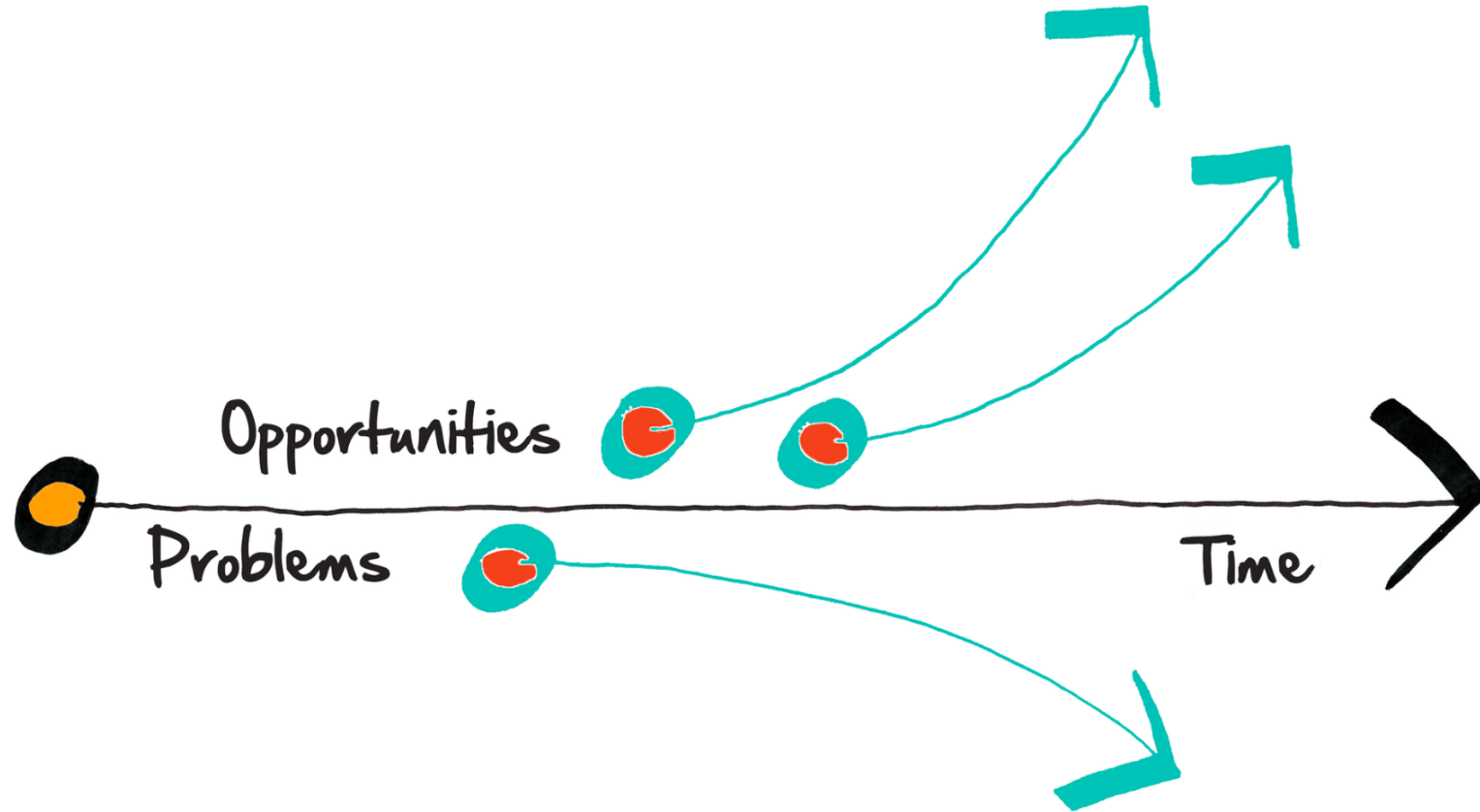
We move in the direction of our conversations

How do we reduce the rate of …
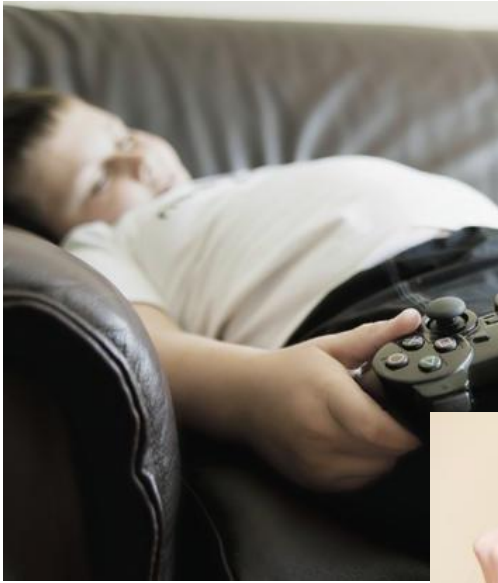
What if our town was the best place on the planet to be a child?

Framing Question

What if we applied team science to promote the role of research professionals in translational research.
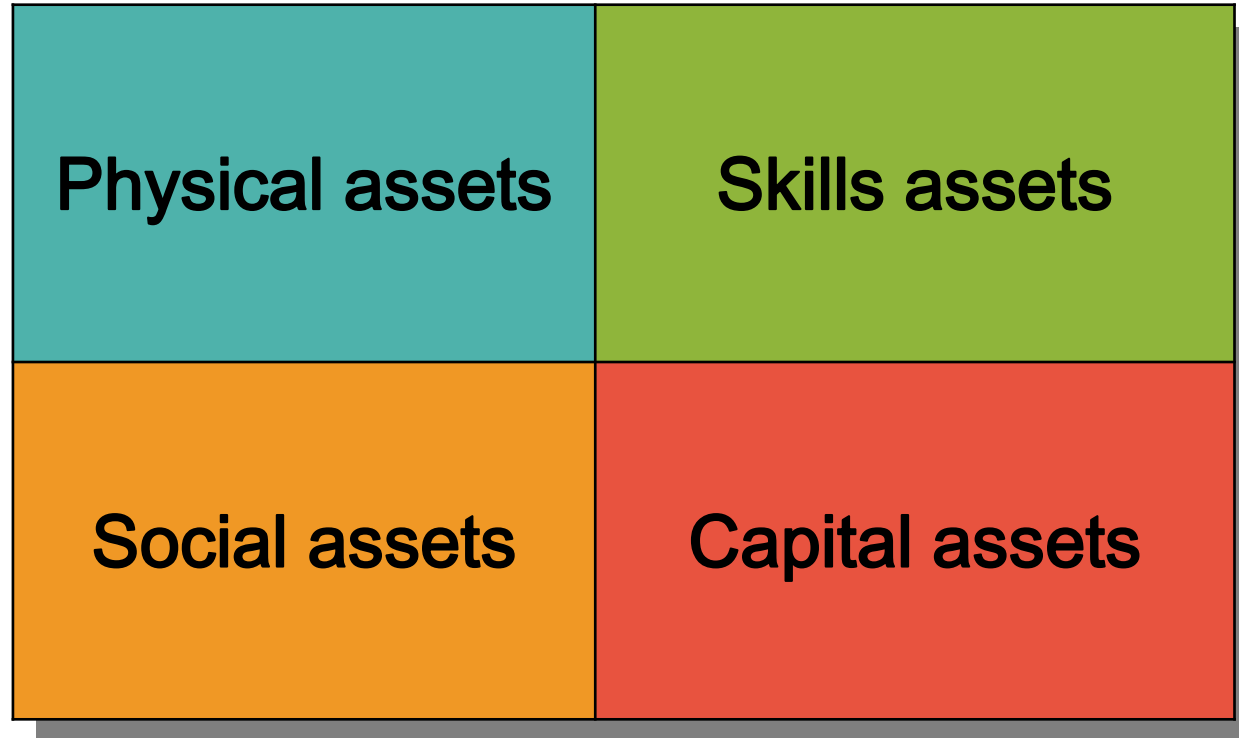
What would it look like?

You will be using an online Action Pack to work as a group.

..but wait, I have a few guidelines

Physical assets	**Skills assets**
Social assets	**Capital assets**

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Group Assets

Spend 2-3 minutes listing your assets

When everyone is done writing, the facilitator will call in for the first person on her/his screen to share **one** asset at a time. Then, for the second person, etc.

Do three rounds of asset sharing.

What COULD we do?

Assets

List your assets that you are willing to share as part of this effort (e.g., physical assets, skills and knowledge assets, social/network assets, capital assets). What organizations do you belong to? What knowledge, skills and abilities do you have?
Is this asset available? How is this asset actionable? If someone contacted you a month from now, would you still be willing to share?

Person	Assets

Fair warning, we may interrupt you to maintain the equity of voice.

**Don't rush to solutions. Learn about the resources available!
Ask how each asset is actionable.**
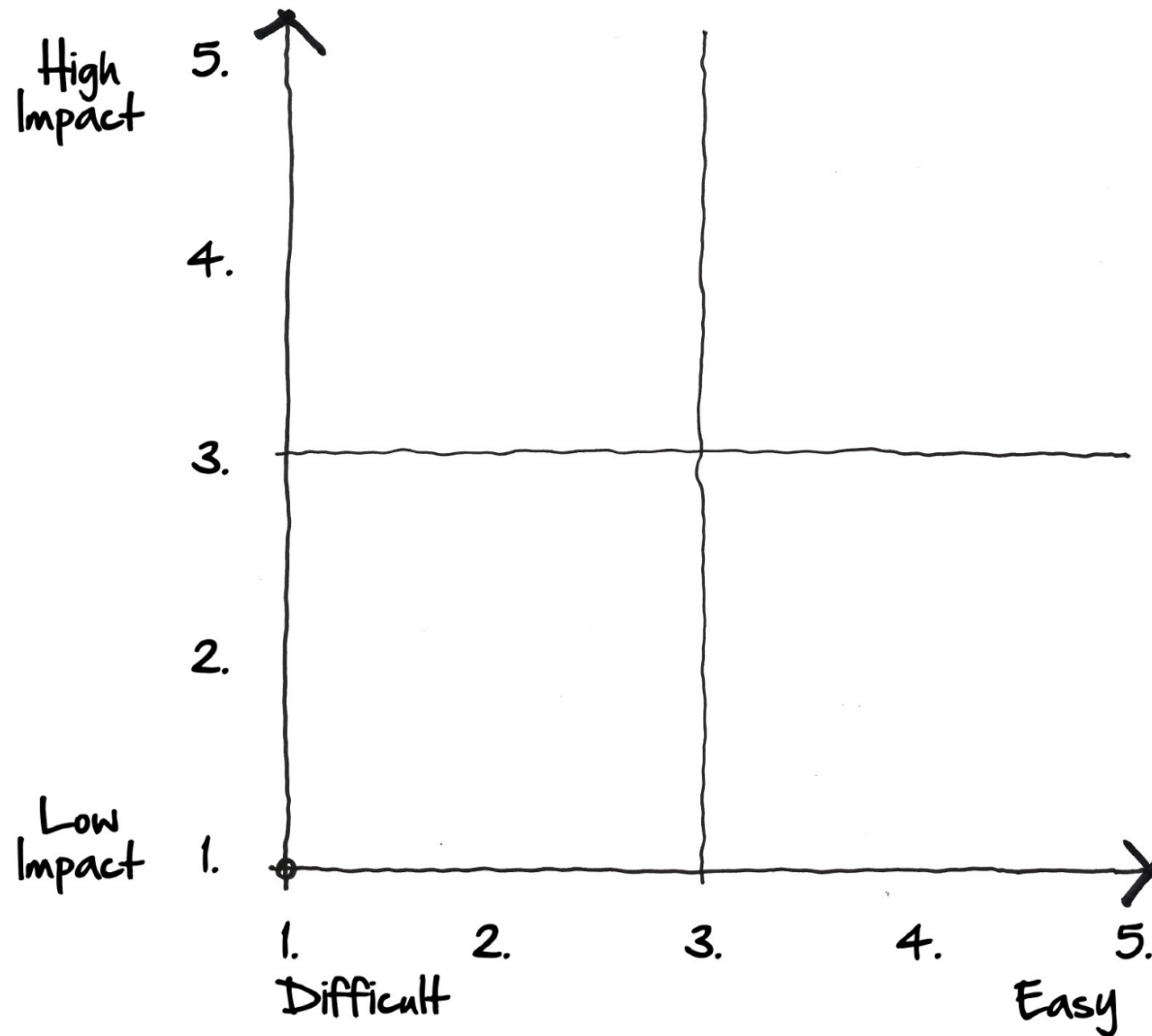
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What are the opportunities?

- Pick one asset
- Look for other assets that are complementary
- Make sure at least one asset for each team member is included
- Record an emerging opportunity on the Action Pack.

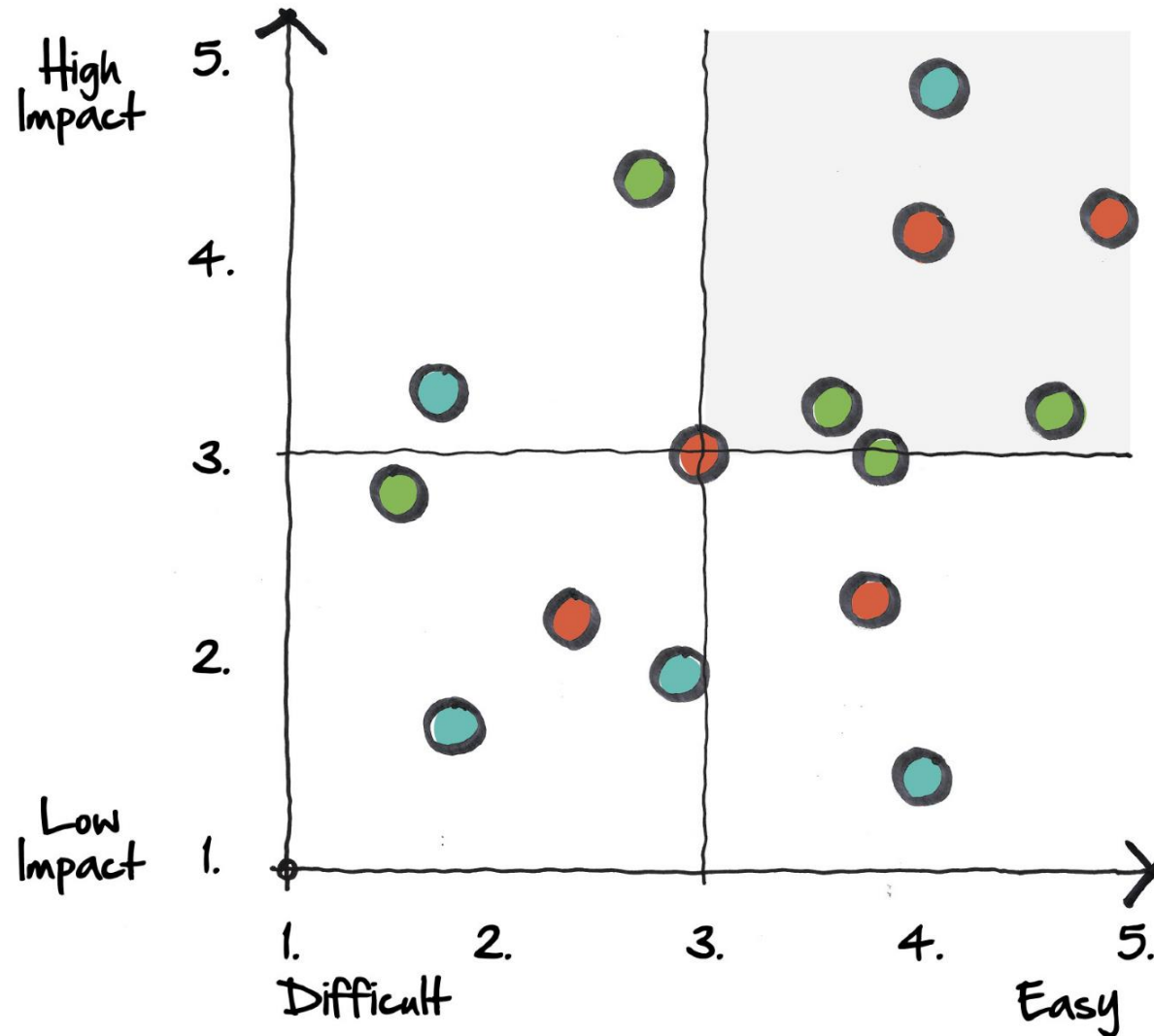- Put another asset in the middle and repeat the process.

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Finding the "Big Easy"

What Is Your Big Easy?

- Do not rank opportunities. Rate each one independently. You can rate all or none "5", "4", "3", "2", or "1".

- Everyone should type your score in the chat and hit submit at the same time.

- For differences in scores, discuss what makes a potential project a "5" or a "1".

- You can change your mind and change your vote after the discussion.

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Framing Question

What if we applied team science to promote the role of research professionals in translational research.

What would it look like?