

# **Managing Collaboration in Team Science:**

## **Concepts**

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# Why are we here?



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Why I'm here

Why are you here

Team Science become the model for breakthrough research

- Publications – more multi-author and more disciplines
- NAS

# The Challenge of Collaboration



Thought leader:  
Brad Allenby, ASU

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## **WICKED PROBLEMS:**

There's no stopping rule.

Solutions aren't right or wrong.

Every wicked problem is novel and unique.

Brad Allenby – coupled socio-technical systems

## **4 Dimensions to answer the questions**

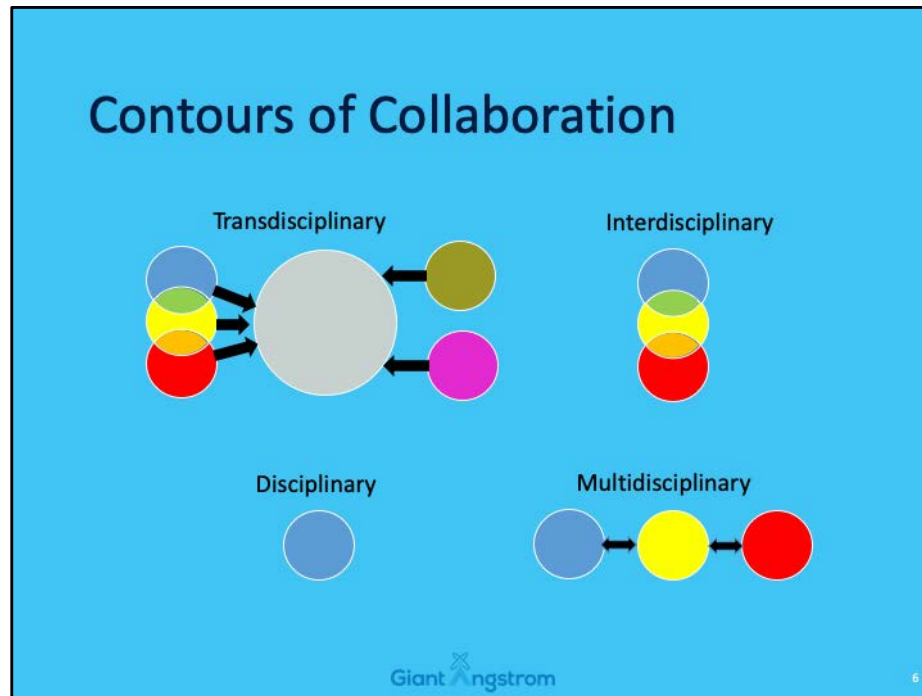
- Commensurability
- Divisibility
- Need for Collaboration
- Methods of Collaboration

# Agenda

**THE CHALLENGE OF COLLABORATION**  
The Contours of Collaboration  
Commensurability of Knowledge  
Divisibility of Tasks  
Modes of Knowledge Exchange



# Collaboration



Disciplinary (within scope of a single expertise)

Multidisciplinary (a divisible problem that requires multiple expertise)

Interdisciplinary (problem requires communication across disciplines)

- Watch out for people trying to respond to this with a multidisciplinary approach

Transdisciplinary (problem requires developing a new approach that transcends existing expertise)

- Often involves creation of a new kind of expertise – example of neuroeconomics

## What does the problem require?

Subject Matter Expertise  
Technical Expertise

## What does the sponsor require?

Explicit in the RFP  
Implicit in Strategic Plan, Culture, etc.

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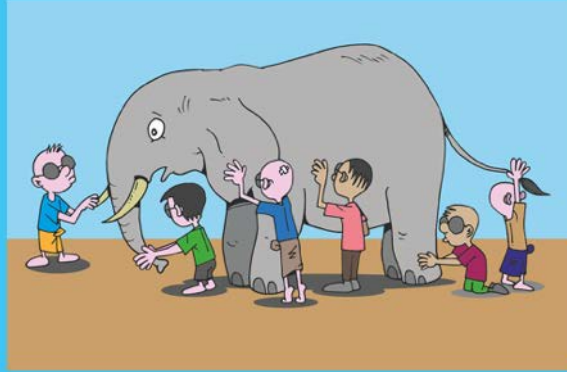
### SPONSOR EXPLICIT REQUIREMENTS

- products (NASA, NIH)
- outcomes (NSF Research Traineeship)
- members (translational, industry partners)

### Example from an NIH FOA

Each Center in the HTMID CRC program must establish and manage a multidisciplinary research program focused on development of a specific human tissue model(s) for infectious disease(s). Each Center will comprise a team of researchers with demonstrated expertise in infectious diseases and tissue engineering/biology as well as applicable expertise in immunology, microbiome biology, biomedical imaging, and/or assay development that is crucial for the development and utilization of the proposed tissue model(s).

# Commensurability



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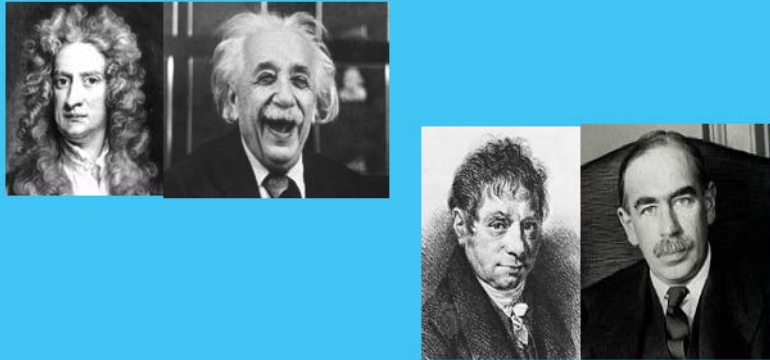
How important is it for expertise with very different perspectives to understand one another (commensurability)

How do we assess whether we have the right team?

How do we improve team performance?



## Paradigm Shifts



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Thomas Kuhn 1962 *The Structure of Scientific Revolutions*

Science doesn't progress by accumulation of knowledge  
insurgencies interspersed with periods of "normality"

The old paradigms are incommensurable with the new one, which means those  
trained in "normal" scientists in the old can't or won't understand

Before shift, incompatible findings are treated as the researcher's fault – poor  
methods, incomplete models, etc.

## Paradigms may be incommensurable with respect to

- Objects of study
- Methodology
- Epistemology



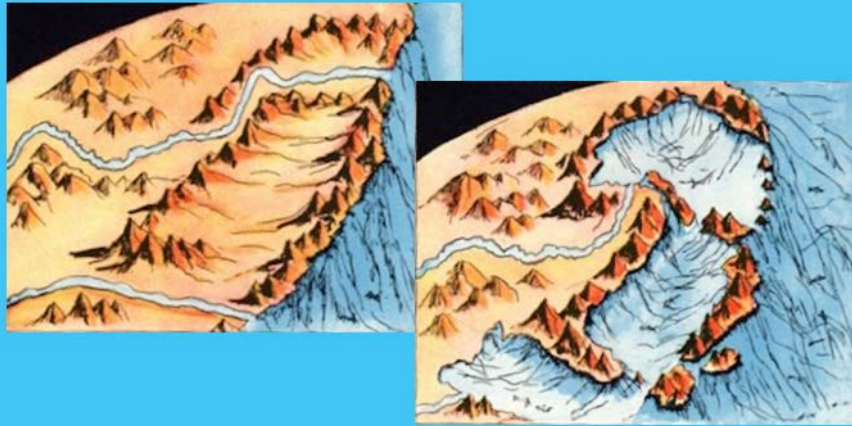
## Incommensurability can also be an attitude

- Disciplinary Capture
- Sectoral Capture



Disciplinary capture – hierarchical approach that devalues other disciplines.  
Sectoral capture – when one community (industry, academia, government, physicians, etc.) Takes control of the project.

## Before Continental Drift: Van Loon's Geography of the World



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Alfred North Wegener's  
Straight paradigm incommensurability plus Disciplinary Capture  
Until we had evidence of sea floor spreading



# Divisibility

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To what extent is the task divisible into disciplinary parts?  
How important is it for expertise with very different perspectives  
to understand one another (commensurability)  
How do we assess whether we have the right team?  
How do we improve team performance?

# A Taxonomy of Tasks

## *Separability*

- Divisible vs. Unitary

## *Focus*

- Maximizing vs. Optimizing

## *Dependence*

- Additive, Conjunctive, Disjunctive



Thought leader:  
Ivan Steiner

## **SEPARABILITY**

Study Group Outlines vs. Jury Verdict

## **FOCUS**

Objective measures (Quantity, Time) vs. Subjective (Quality)

## **DEPENDENCE**

**Additive** – all members perform same/similar task

- Relay race

**Conjunctive** -- group performance depends on weakest link

- Mountain climbing

**Disjunctive** -- group performance depends on strongest link

- Trivia Bowl

## Some Ramifications for Design

### *Divisible and Conjunctive*

- Subtask Assignments
- The Köhler Effect

### *Unitary and Disjunctive*

- Performance *improves* with group size
- Productivity *decreases* with group size

### *Additive*

- Need to emphasize group goals
- Personality traits highly correlated with performance



### **DIVISIBLE AND CONJUNCTIVE**

weakest members can be given the easiest subtasks, most capable members given more difficult ones

### **UNITARY AND DISJUNCTIVE**

easiest subtasks,

### **ADDITIVE**



# Knowledge Exchange



## Three Theoretical Models

Interactional expertise

Trading zones

Boundary Objects

## Interactional Expertise



Thought Leader:  
Harry Collins

Sociologist at University of Cardiff

# Interactional expertise

Sociology

“T-shaped” expertise is Wide *and* Deep



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Stages in development of expertise on a project outside your area:

1. Start with No Expertise, then recognize how your subject matter knowledge can contribute (“Contributory Expertise”)
2. Interactional Expertise develops over time – you learn what questions are relevant and can even answer some questions

You don’t actually become an expert in the sense of being able to do the work – but you can direct other peoples’ contributory expertise in the right direction

## Trading Zones



Thought Leader:  
Peter Galison

Galison-- scientists and engineers develop an interlanguage (jargon to pidgin to creole) to communicate when designing systems like  
Radar in airplanes  
particle accelerators  
resilient coastal infrastructure

# Trading zones

Anthropology

Language of Trade



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## Language

- Translators
- Creoles – form around specific needs when translation isn't enough
  - Example: Plasticity in engineering versus neuroscience

# Boundary Objects



Thought Leaders:  
James Griesemer & Susan Leigh Star

Different meanings in different social worlds but common structure that makes them recognizable to all, a means of translation.

Examples they gave looking at a museum: specimens, field notes, and maps of particular territories

## Boundary Objects

Philosophy

“Meaning-Makers”



Neuroengineers story – “plasticity” has completely opposite meanings in neuroscience and engineering.

# The Wicked Problem

Contours of Collaboration  
Modes of Exchange  
Commensurability  
Divisibility



Lead into Scenario