EVALUATION OF TEAM SCIENCE

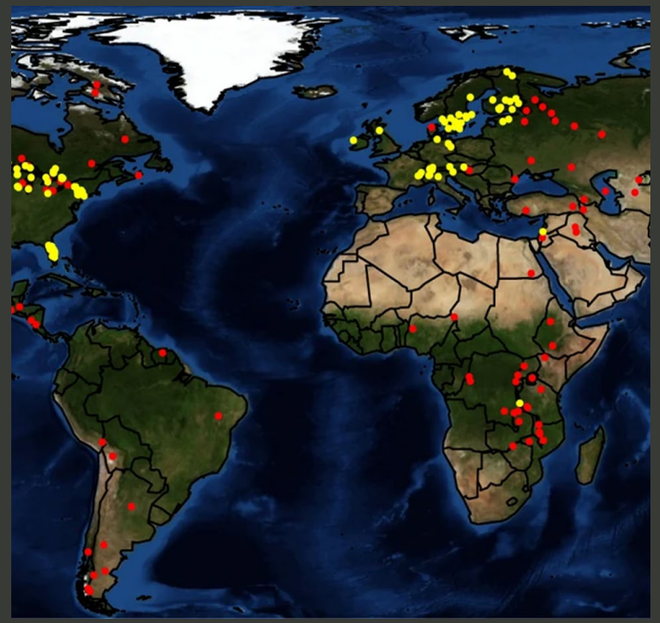
Jeni Cross, PhD

NASEM | Research and Application in Team Science 2

April 10, 2024

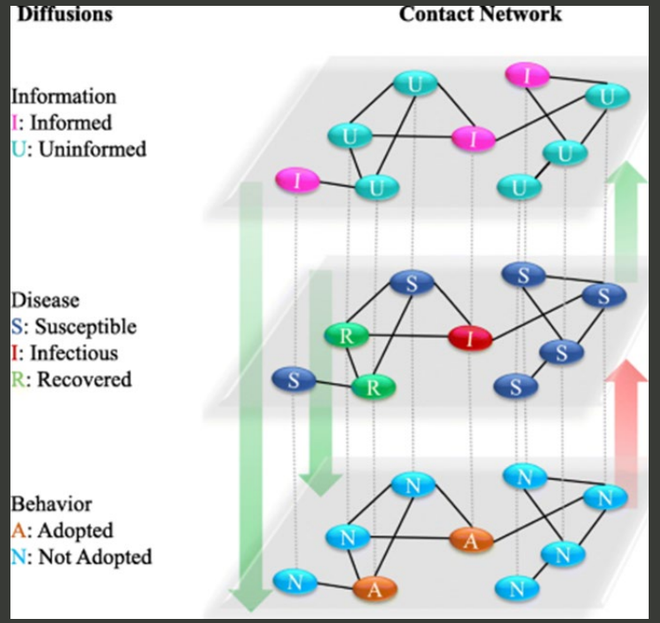
INSTITUTE FOR RESEARCH IN THE SOCIAL SCIENCES
COLORADO STATE UNIVERSITY

PURPOSE OF TEAM SCIENCE



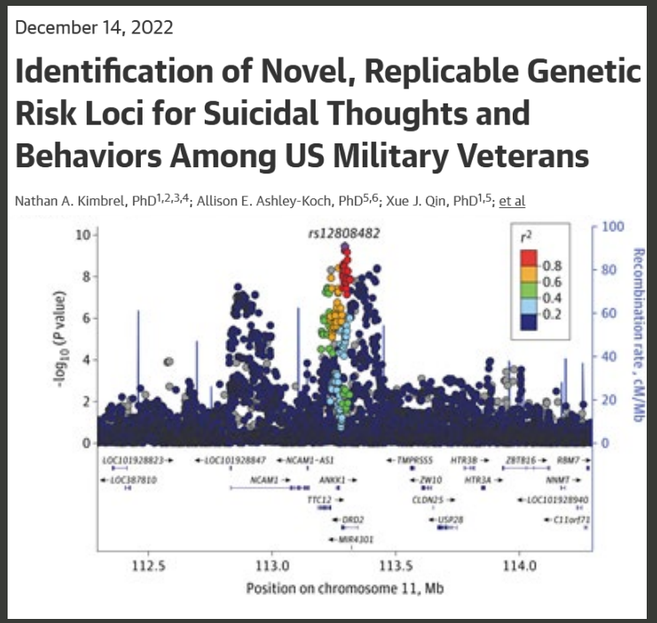
Answer Bigger Questions

(Sharma et al. 2015)



Understand Complexity

(Hammoud and Kramer 2020)



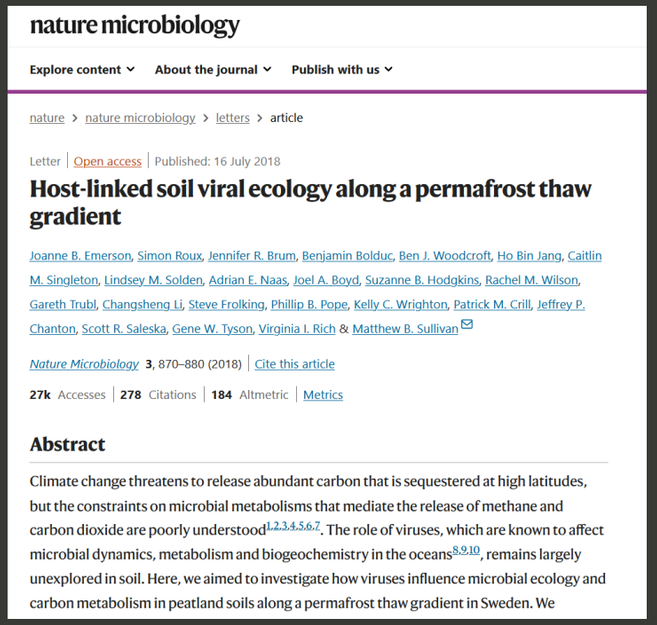
Solve Multifaceted Problems

(Kimbrel et al. 2022)

WHAT MATTERS IN TEAM SCIENCE?

HOW: Processes

WHO: People



nature microbiology

Explore content | About the journal | Publish with us

nature › nature microbiology › letters › article

Letter | Open access | Published: 16 July 2018

Host-linked soil viral ecology along a permafrost thaw gradient

Joanne B. Emerson, Simon Roux, Jennifer R. Brum, Benjamin Bolduc, Ben J. Woodcroft, Ho Bin Jang, Caitlin M. Singleton, Lindsey M. Solden, Adrian E. Naas, Joel A. Boyd, Suzanne B. Hodgkins, Rachel M. Wilson, Gareth Trubl, Changsheng Li, Steve Frolking, Phillip B. Pope, Kelly C. Wrighton, Patrick M. Crill, Jeffrey P. Chanton, Scott R. Saleska, Gene W. Tyson, Virginia I. Rich & Matthew B. Sullivan

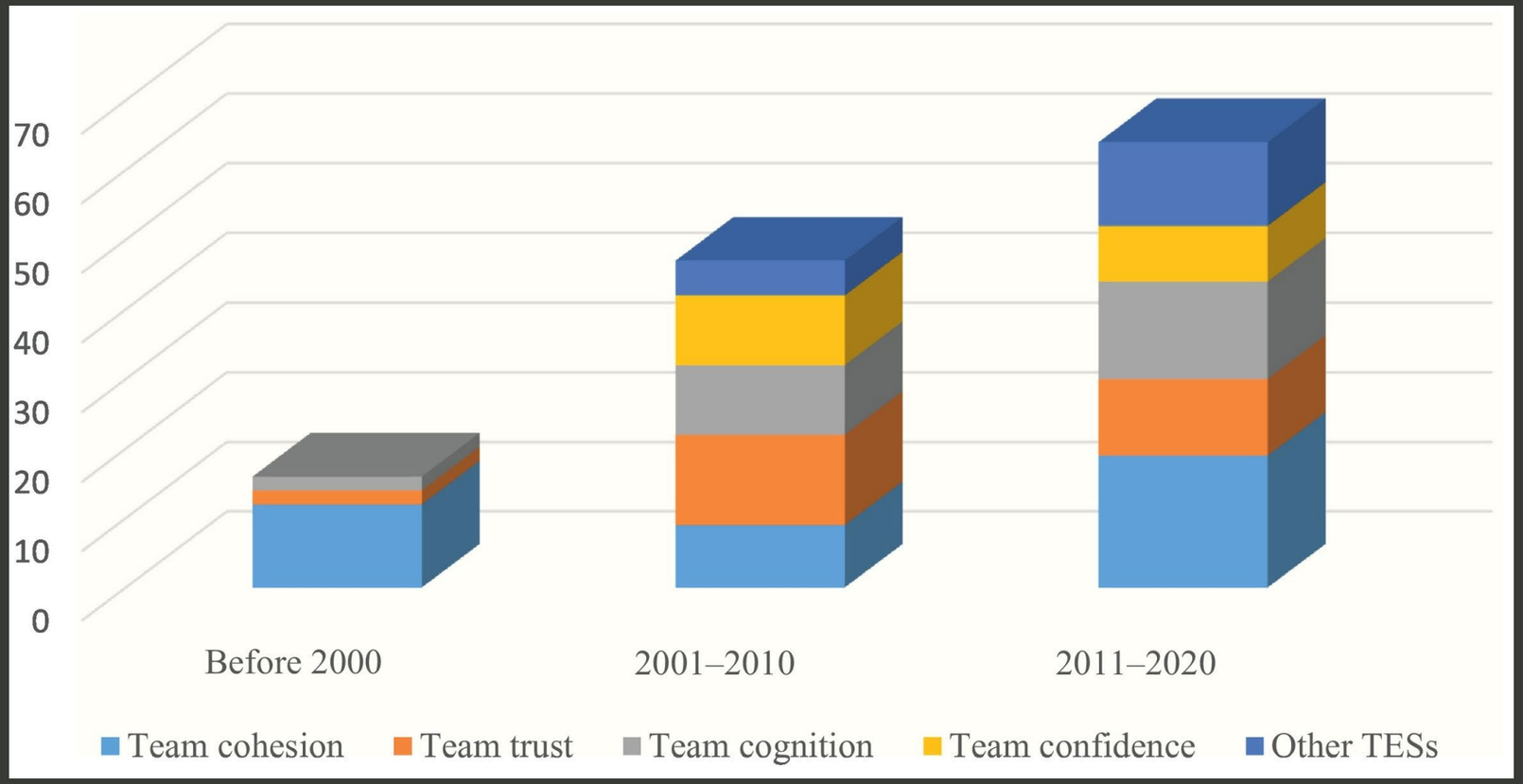
Nature Microbiology **3**, 870–880 (2018) | Cite this article

27k Accesses | **278** Citations | **184** Altmetric | Metrics

Abstract

Climate change threatens to release abundant carbon that is sequestered at high latitudes, but the constraints on microbial metabolisms that mediate the release of methane and carbon dioxide are poorly understood[1,2,3,4,5,6,7]. The role of viruses, which are known to affect microbial dynamics, metabolism and biogeochemistry in the oceans[8,9,10], remains largely unexplored in soil. Here, we aimed to investigate how viruses influence microbial ecology and carbon metabolism in peatland soils along a permafrost thaw gradient in Sweden. We

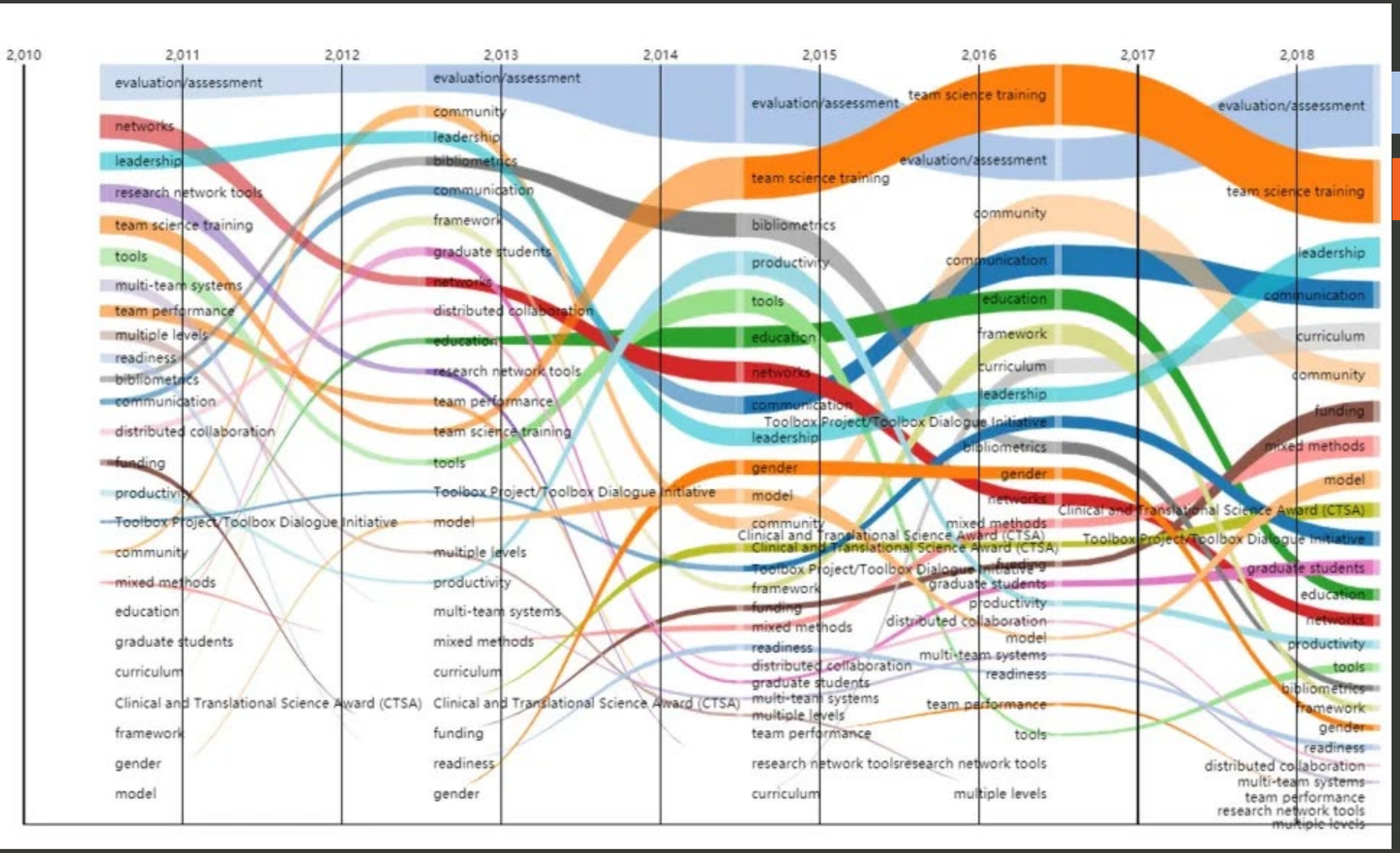
WHAT: Products



TEAM EMERGENT STATES

(Fyhn et al. 2023)

GREATER INVESTMENT IN TEAM ASSESSMENT & DEVELOPMENT IS NEEDED



Evaluation/Assessment

Team Science Training

https://i2insights.org/2020/07/21/hot-topics-in-team-science/

DEVELOPMENTAL EVALUATION

INCREASING THE CAPACITY OF TEAMS TO SELF-EVOLVE

Executive Coaching

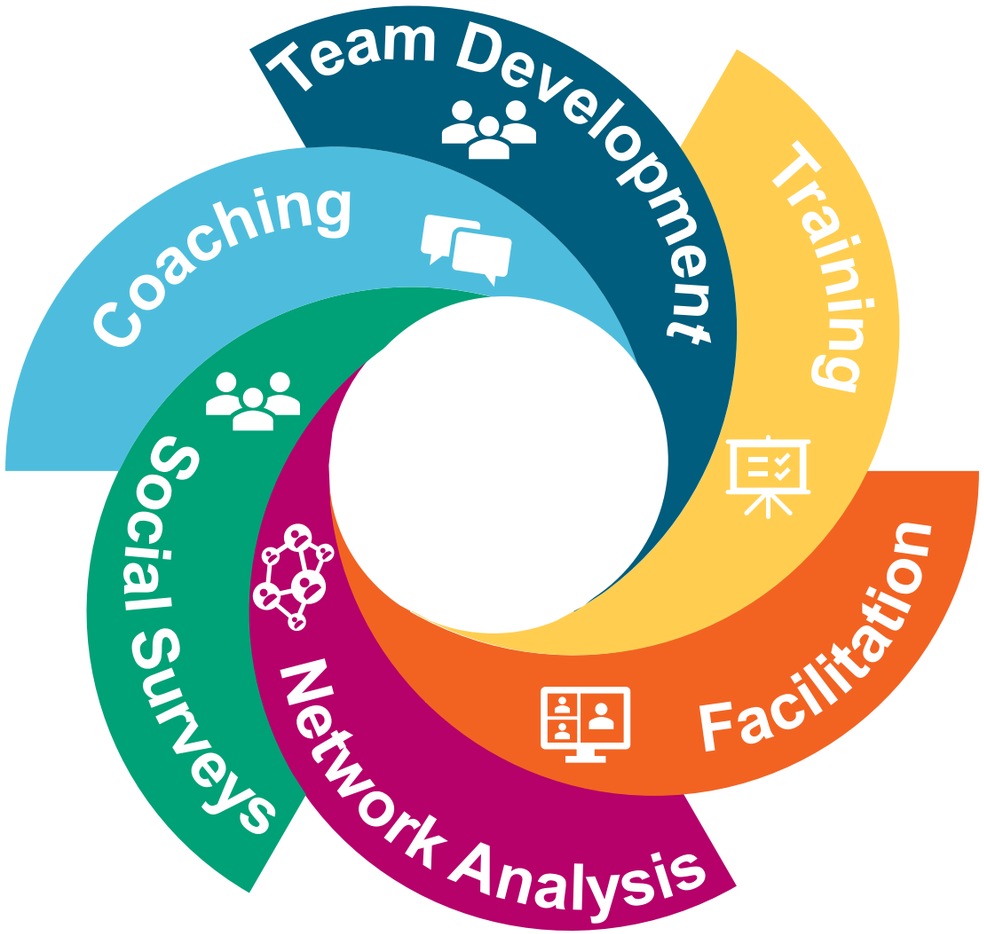
Consultations with team leaders and sub-teams allow us to provide specific and targeted interventions to address team needs as they arise.

Social Surveys & Interviews

Social surveys assess team readiness and progress. We specifically measure team collaboration readiness, teaming practices, and measures of psychological safety.

Social Network Analysis

Social Network Analysis models how teams and networks grow and evolve over time.



Evidence-Based Interventions

The field, science of team science, continues to document team activities and strategies that increase team integration and maturation.

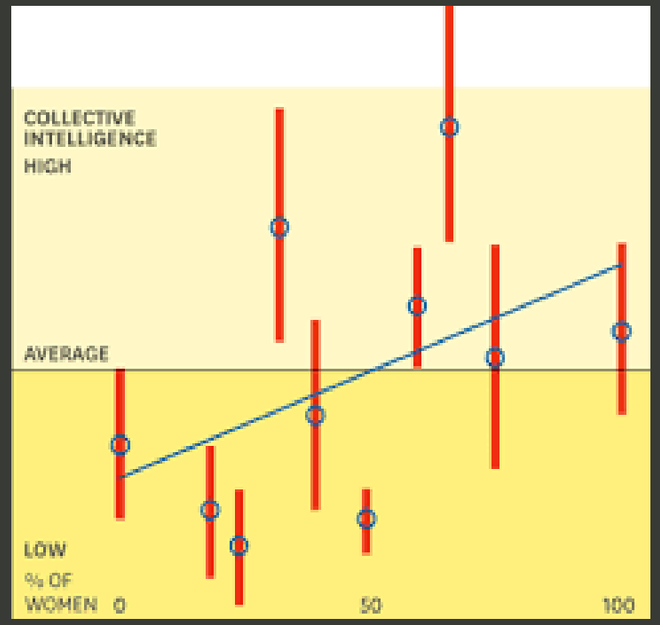
Training

Education and training sessions focus on building **individual** and **team** competencies, including evidence-based interventions.

Facilitation

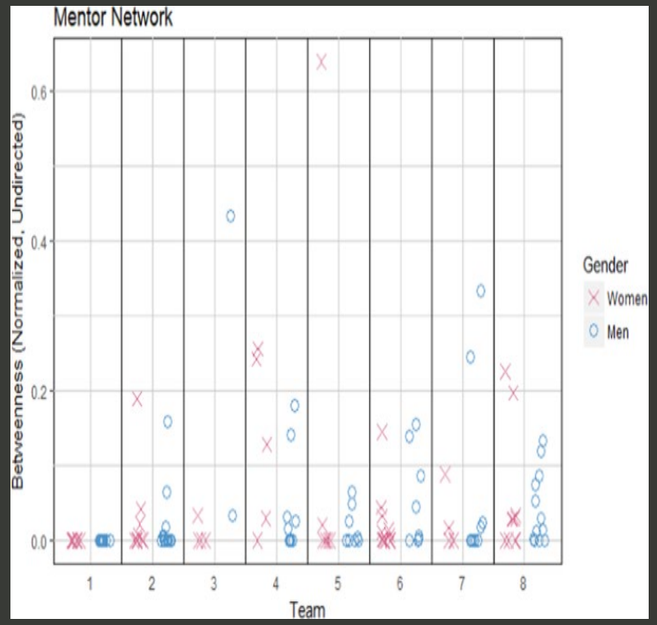
Large and complex teams improve their performance when they bring in a third-party facilitator. Team Science Facilitators act as integration specialists, paying attention to group dynamics and using the science of collaborative decision-making to enhance team performance.

FROM THEORY TO APPLICATION AND BACK AGAIN



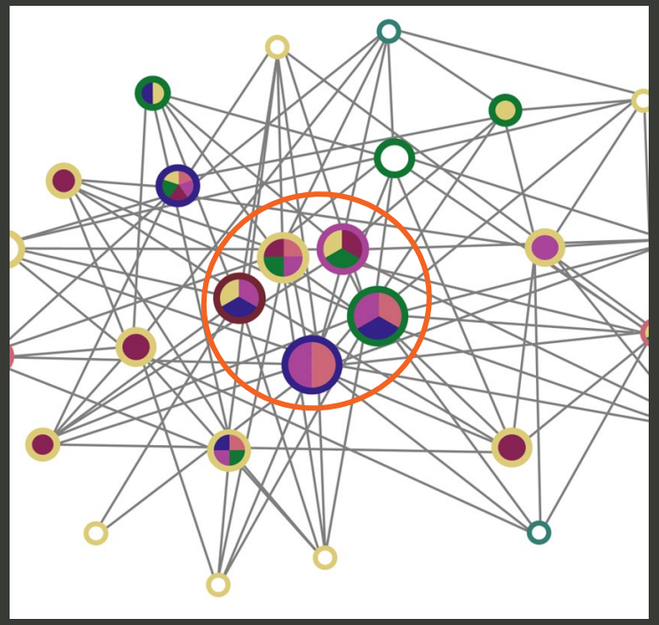
Proportion of women increases Collective Intelligence

(Woolley et al. 2010)



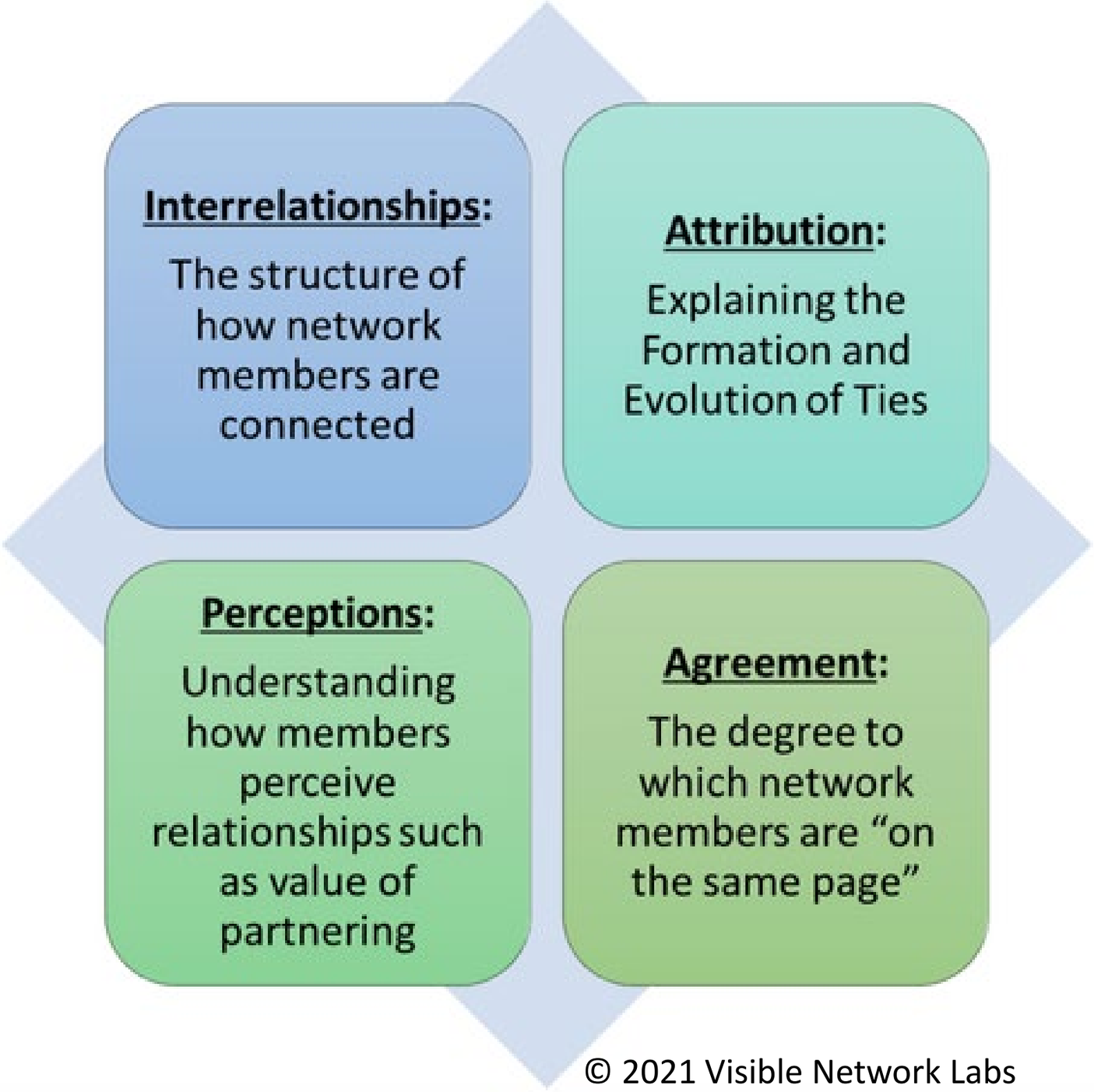
Centrality of women increases team performance

(Love et al. 2021)



Roles of central women improves team performance

(Cross et al. 2022)

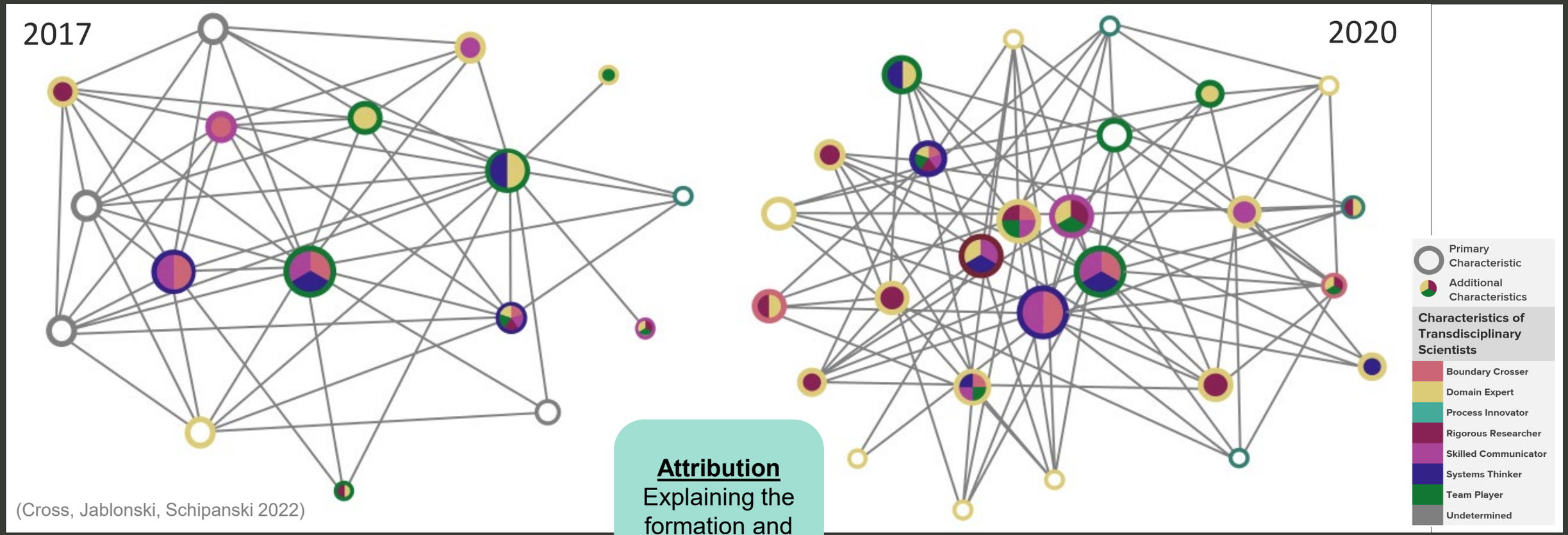


INSIGHTS FROM NETWORK SCIENCE

Evaluation should be linking

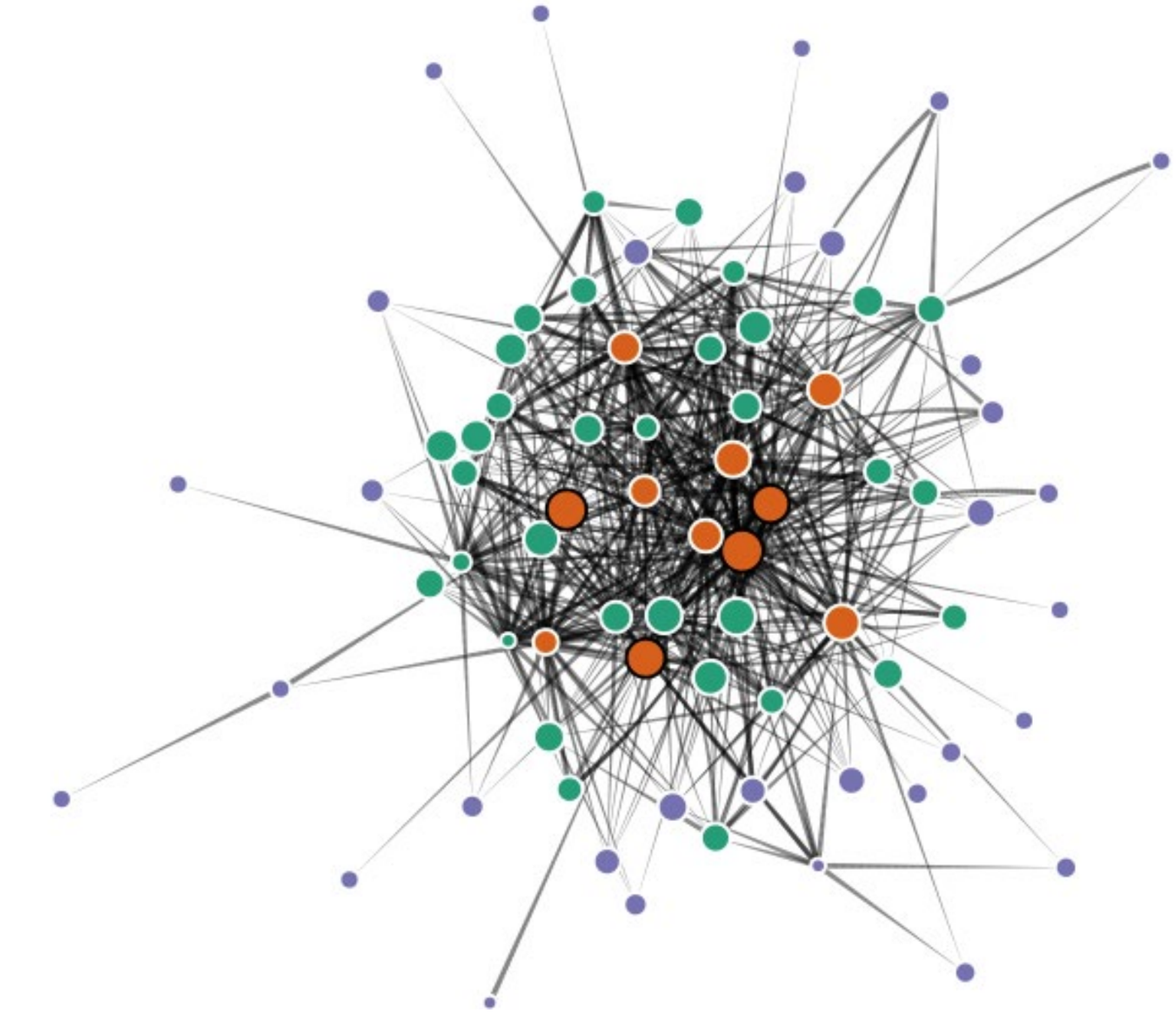
- People
- Products
- Process

TEAM PROGRESSION



(Cross, Jablonski, Schipanski 2022)

Attribution
Explaining the formation and evolution of ties

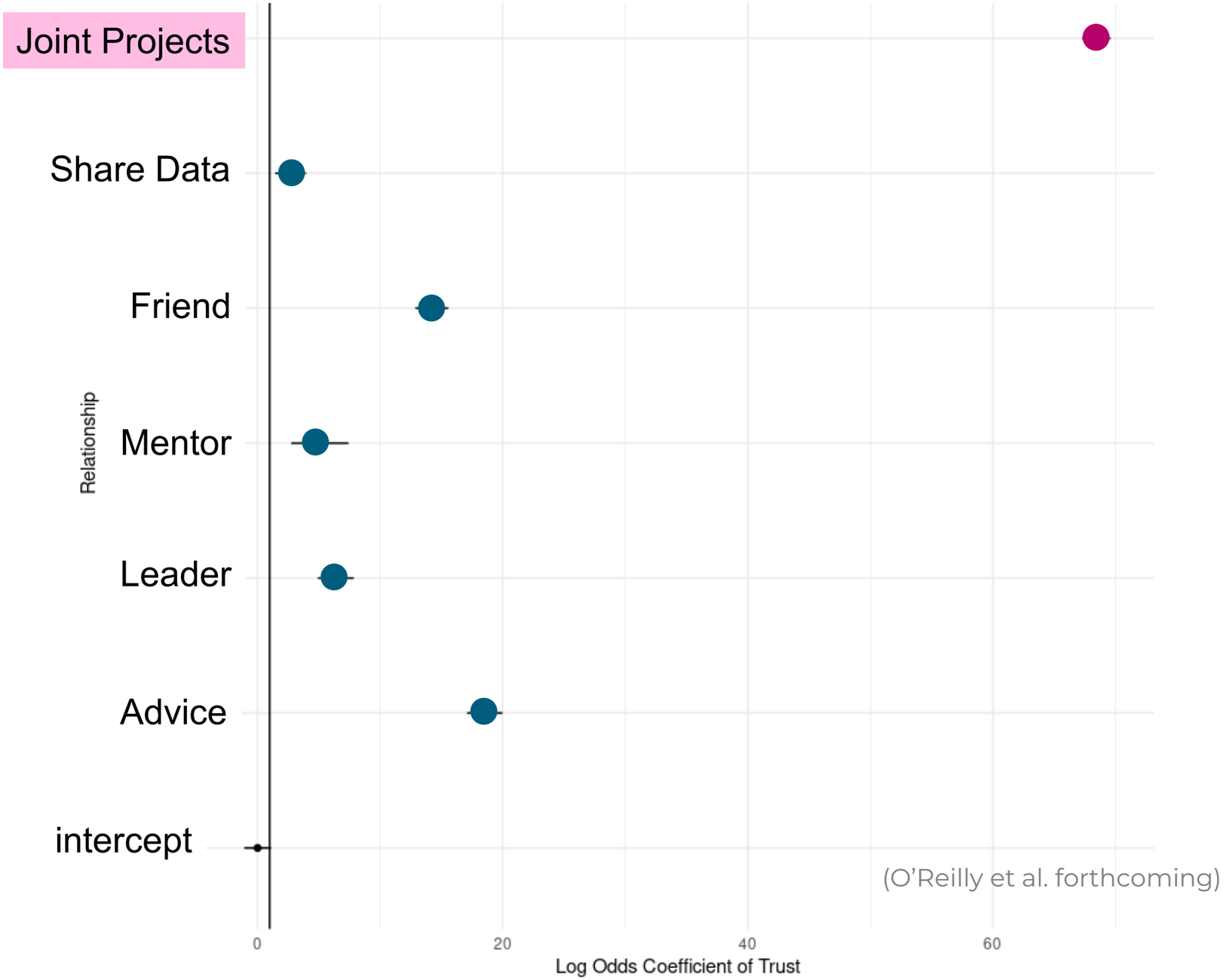


(O'Reilly et al. forthcoming)

60+ CO-AUTHORS

What makes them willing to share data to write a global ecology paper?

Attribution
Explaining the formation and evolution of ties



(O'Reilly et al. forthcoming)

TRUST

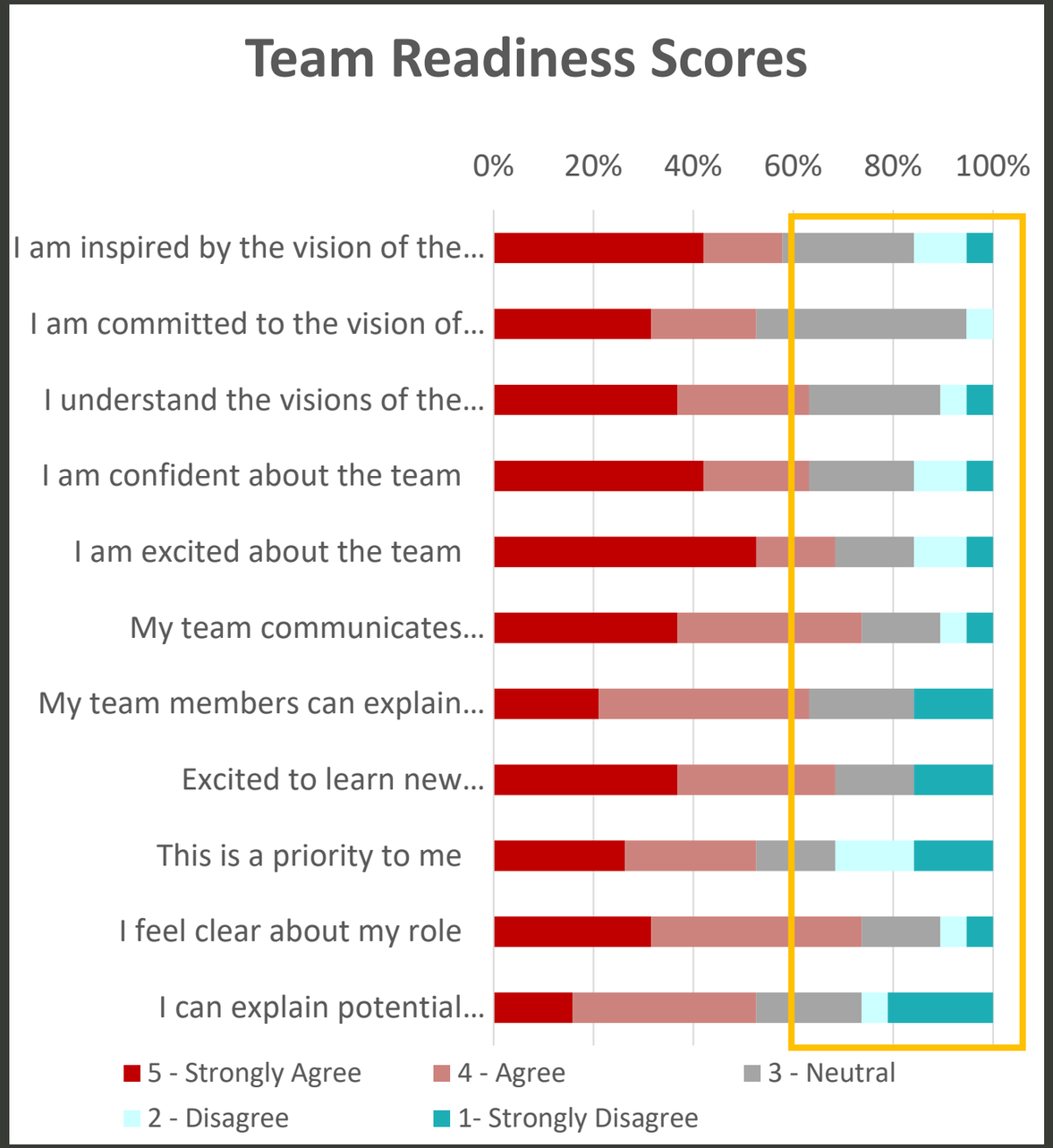
Grows through collaboration and working together

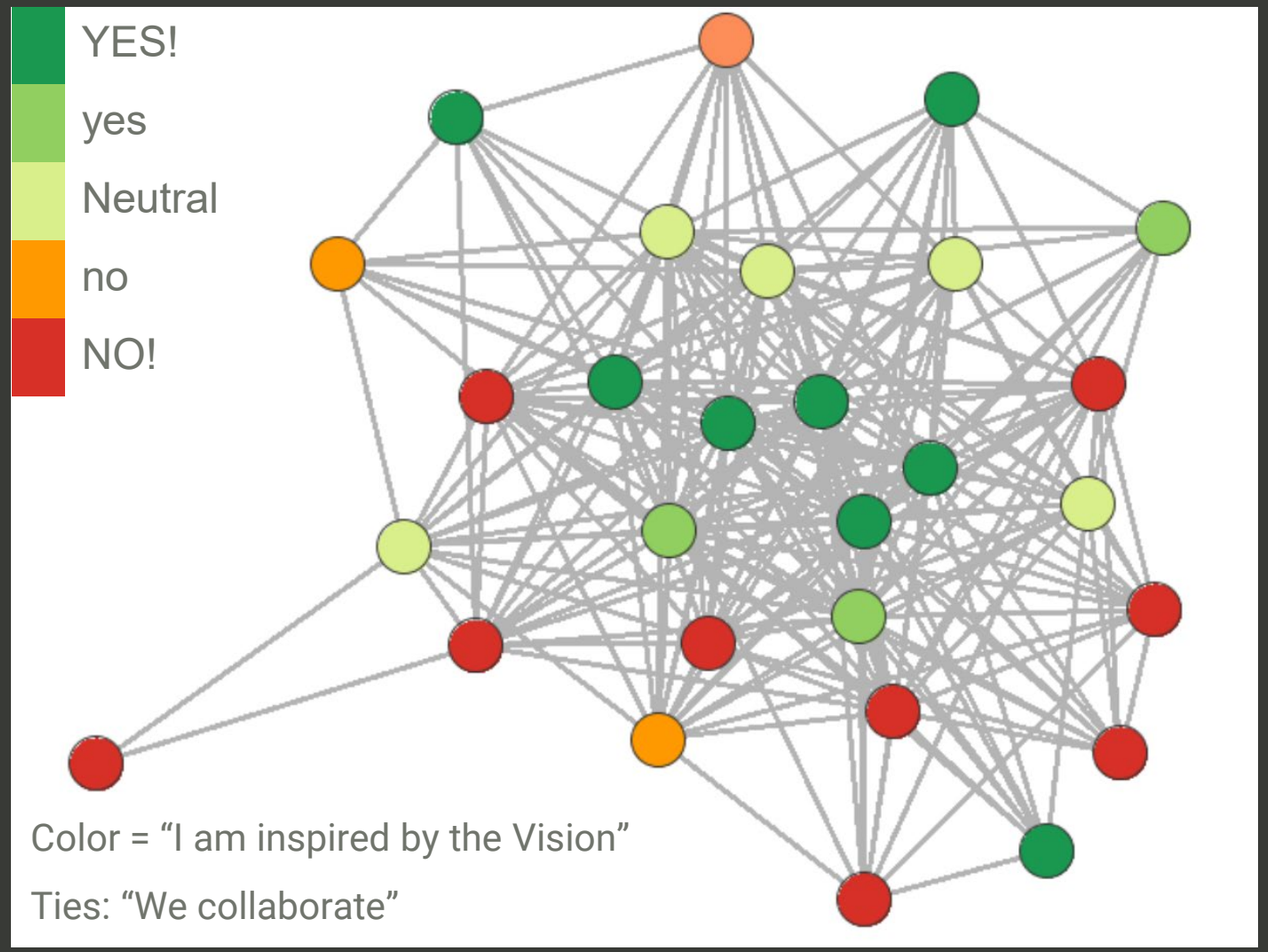
Attribution
Explaining the formation and evolution of ties

AGREEMENT & PERCEPTIONS

SHARED VISION
TEAM COMMITMENT
ROLE CLARITY

Agreement
The degree to which members are “on the same page”

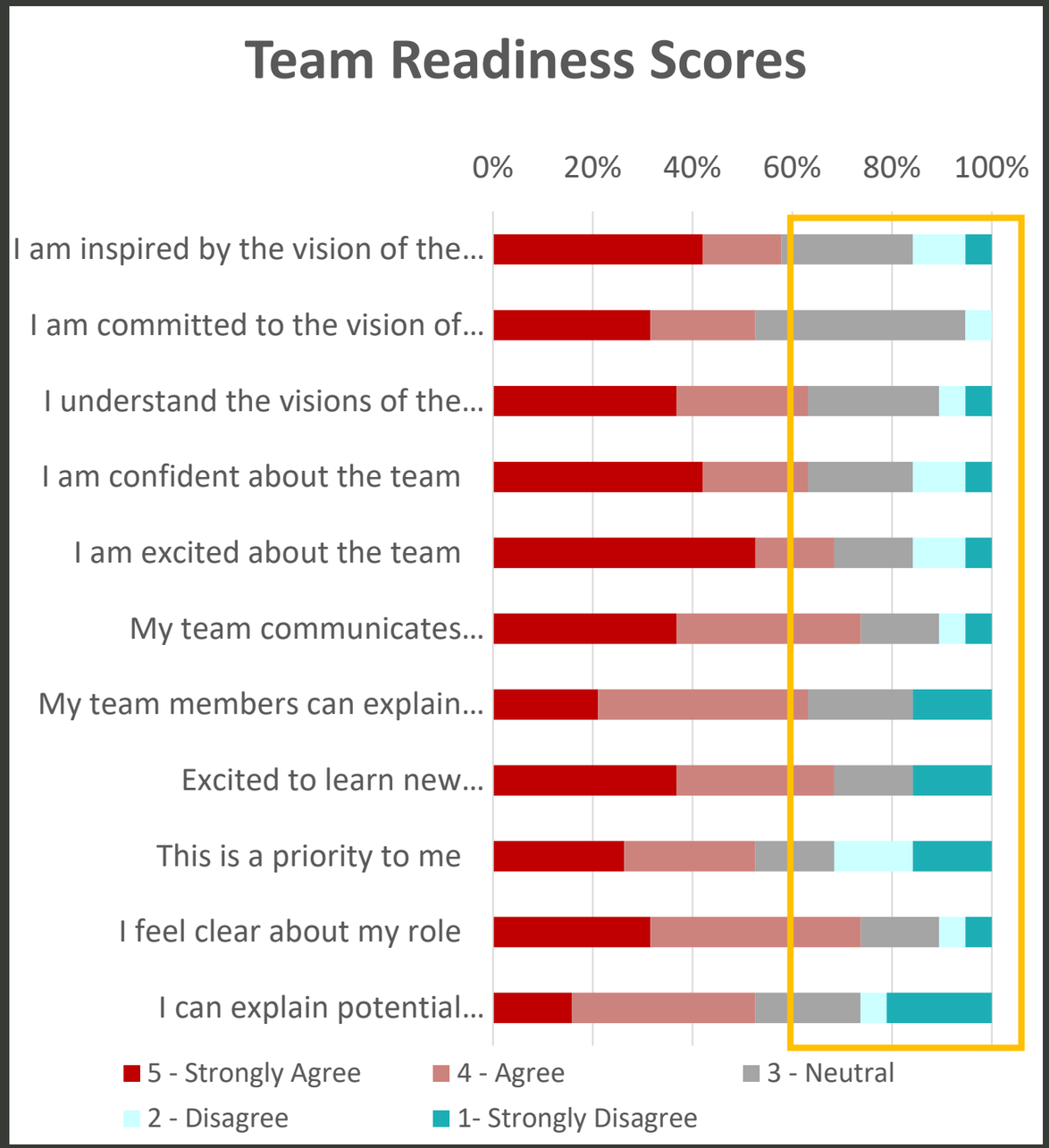




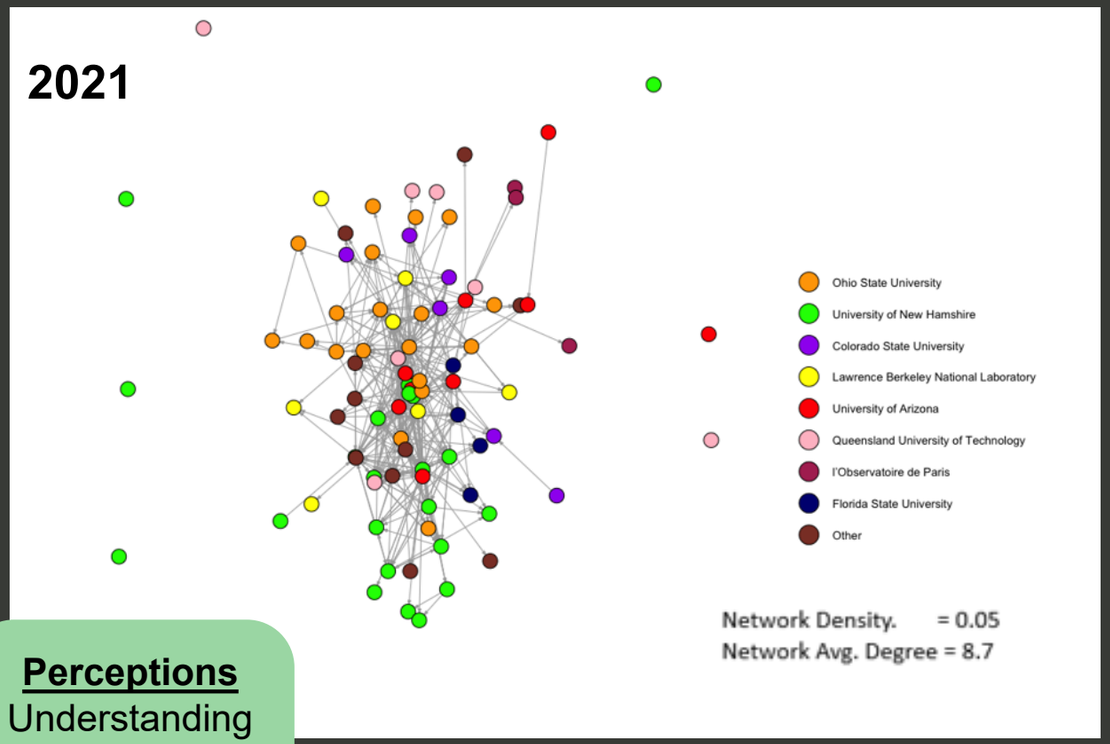
AGREEMENT & PERCEPTIONS

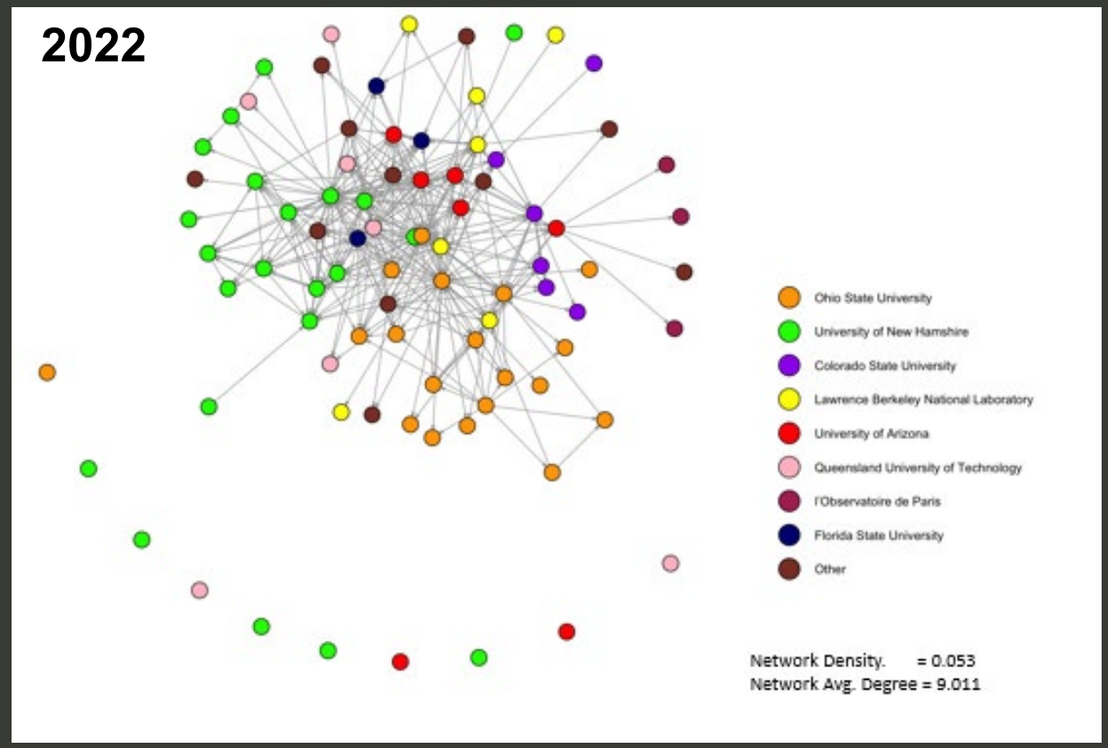
SHARED VISION
TEAM COMMITMENT
ROLE CLARITY

Interrelationships
The structure of how networks members are connected

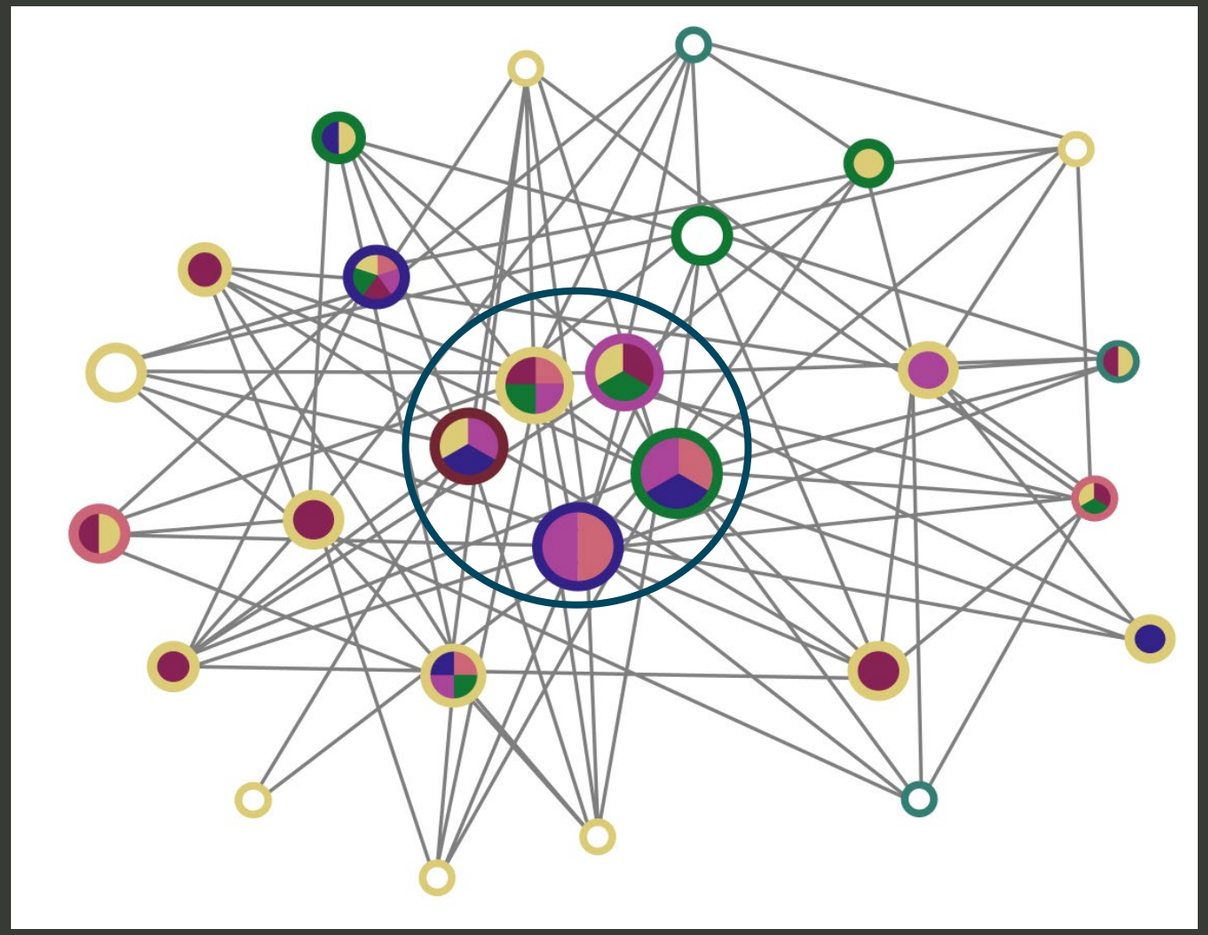


ENERGIZE



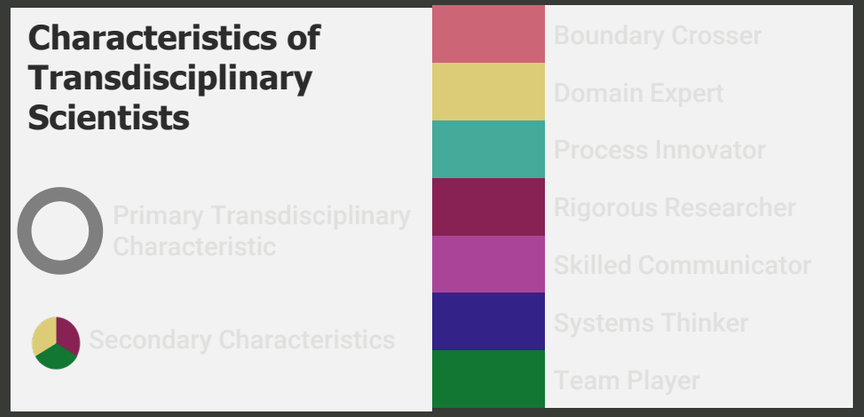


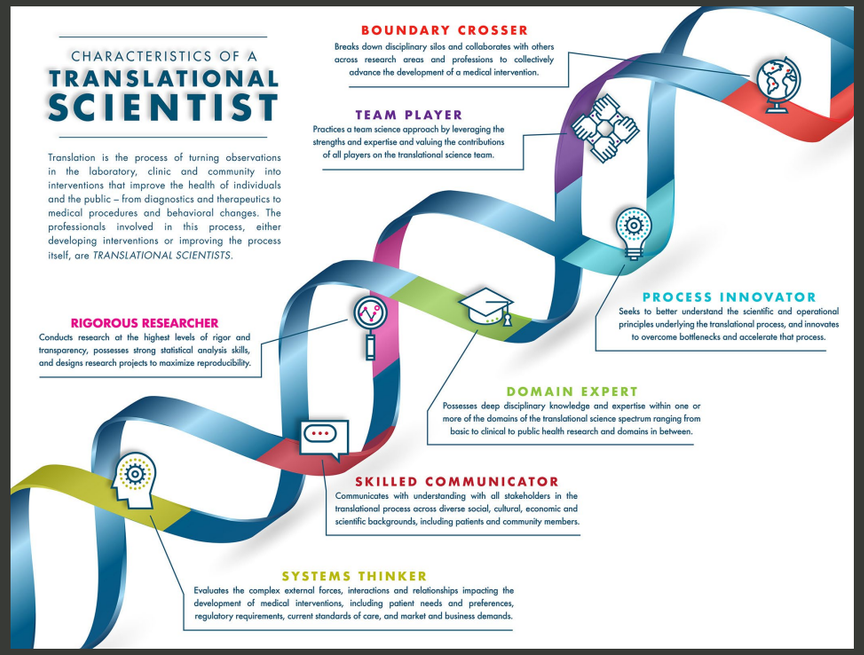
Perceptions
Understanding how members perceive quality of relationships



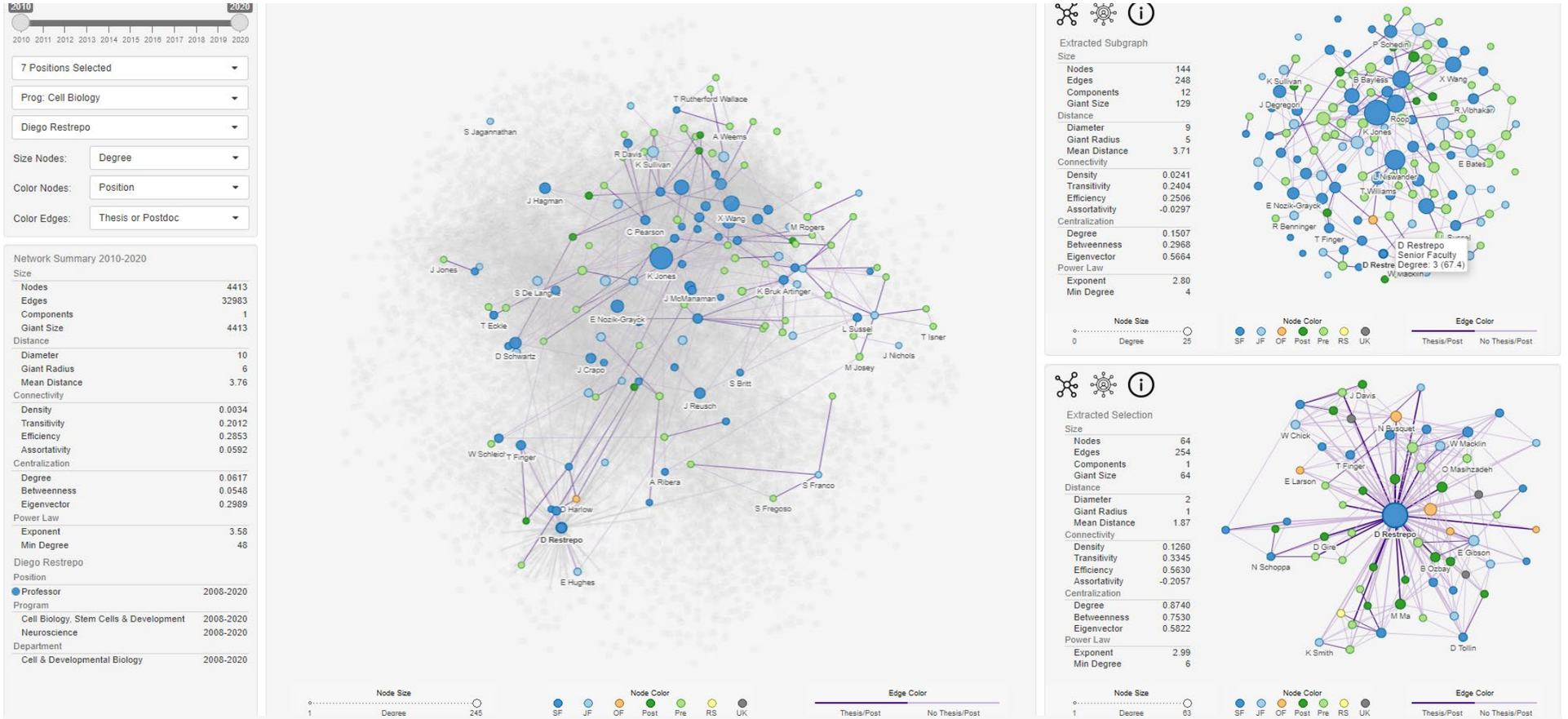
FOOD SYSTEMS TEAM (Cross, Jablonski, Schipanski 2022)

Interrelationships
The structure of how networks members are connected





NEW METRICS FOR TEAM SCIENCE

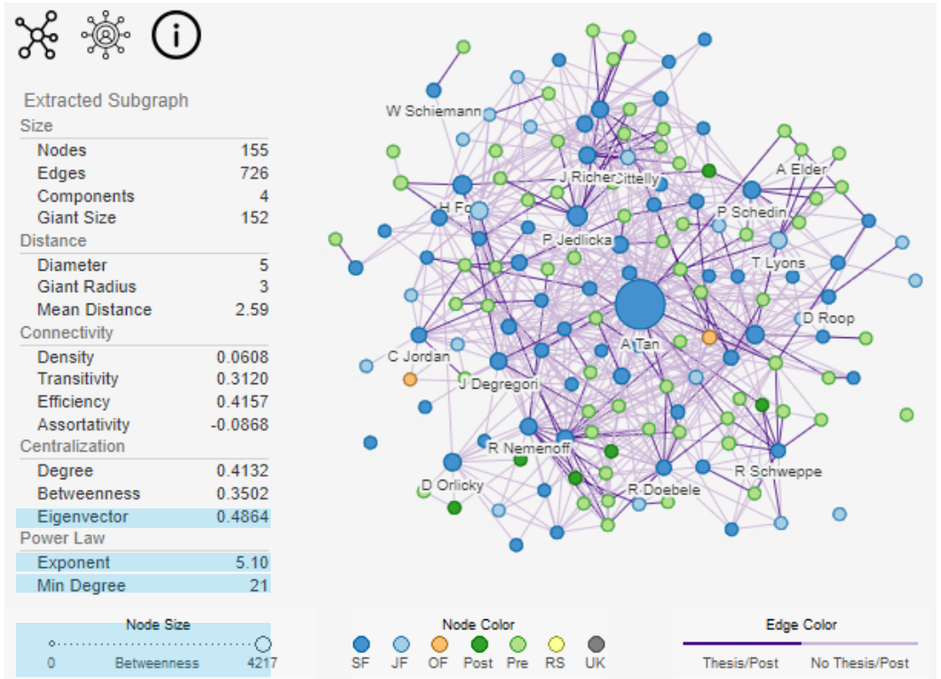


KaleidoNet (Kanaster et al. 2022)

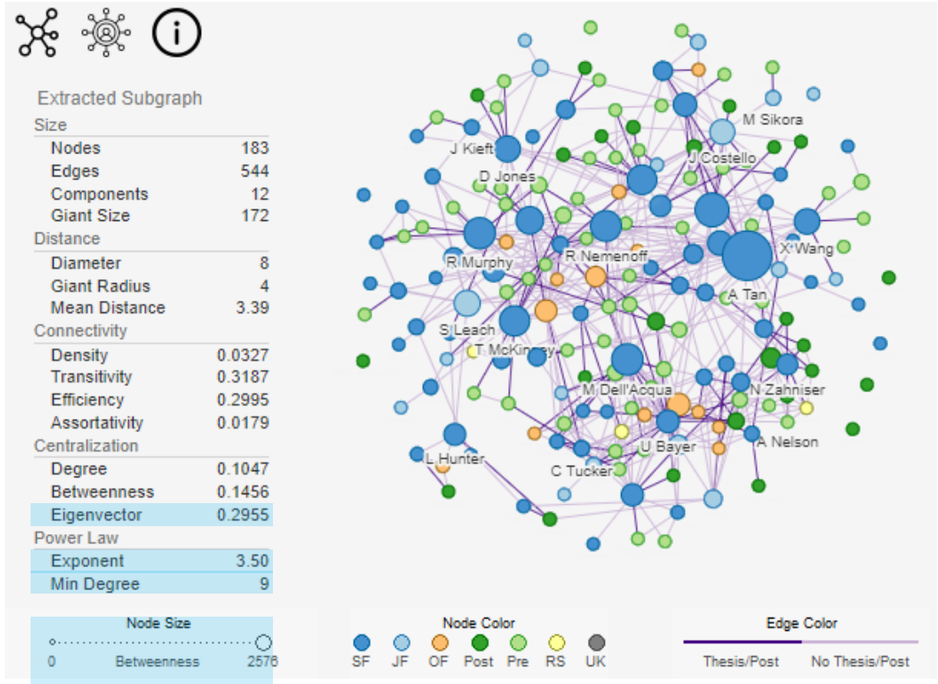
Program Comparison

Nodes colored by position and sized by betweenness
Edges colored by thesis or postdoctorate connection
Primary Task: Compare network subsets

Cancer Biology



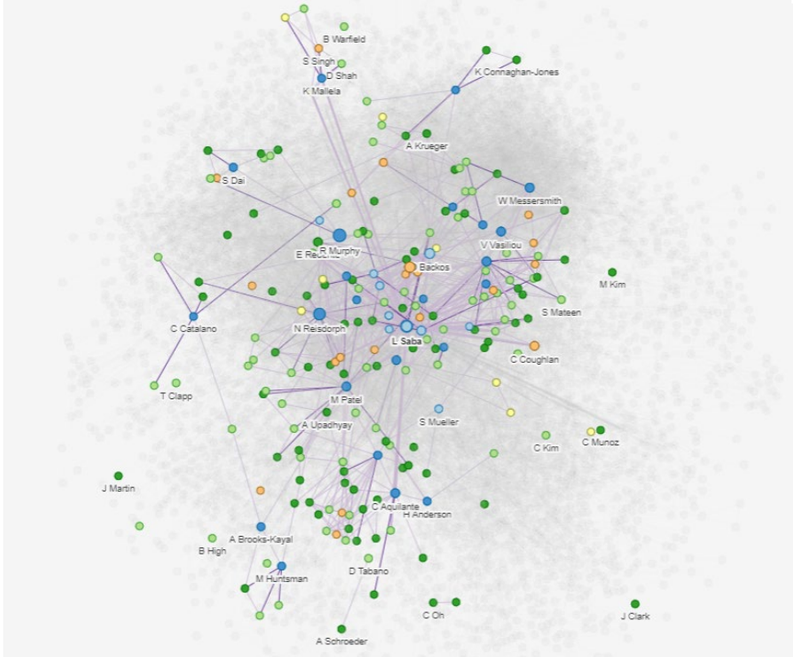
Pharmacology



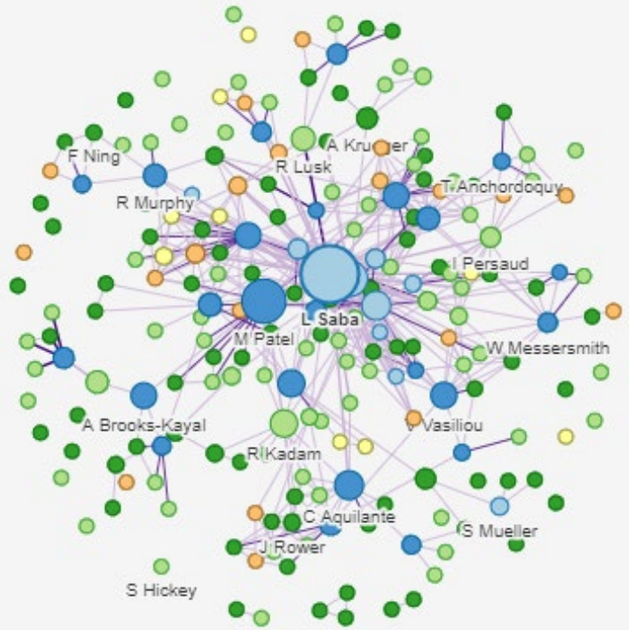
KaleidoNet (Kanaster et al. 2021)

Low Global, High Local Betweenness

GLOBAL FILTER



PHARMACY



KaleidoNet (Kanaster et al. 2021)

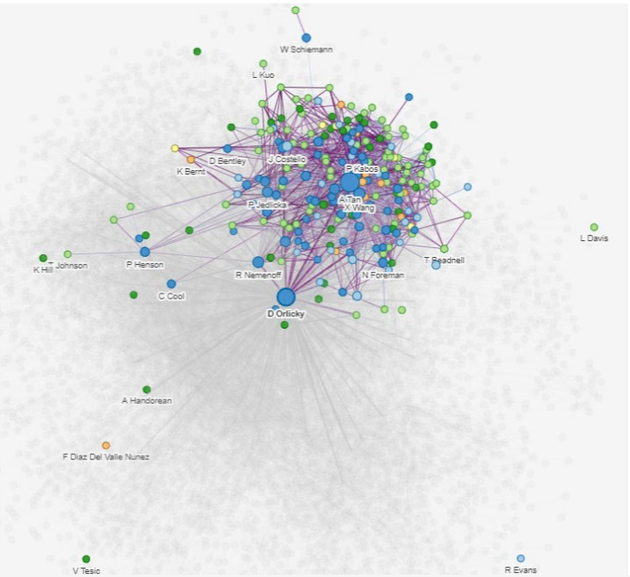
Global view filtered by Skaggs School of Pharmacy

Nodes colored by position and sized by betweenness

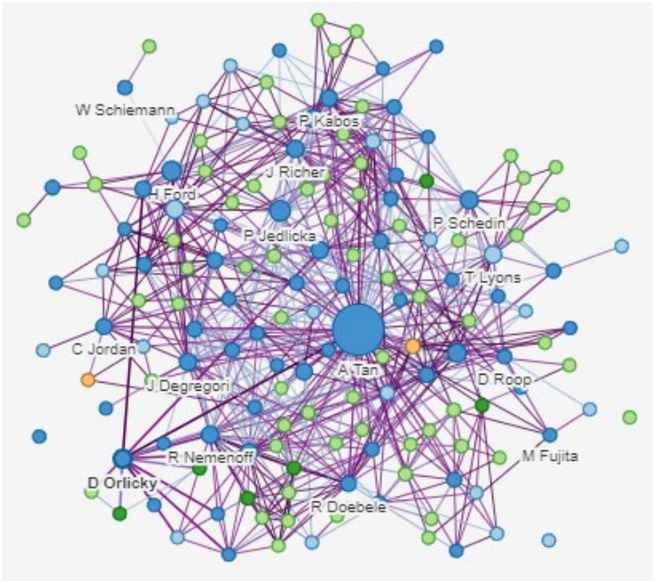
Edges colored by thesis or postdoctorate connection

High Global, Low Local Betweenness

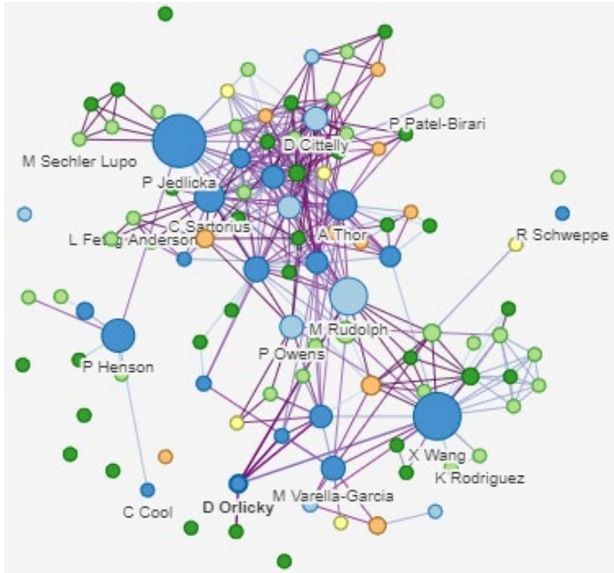
GLOBAL FILTER



CANCER BIOLOGY



PATHOLOGY

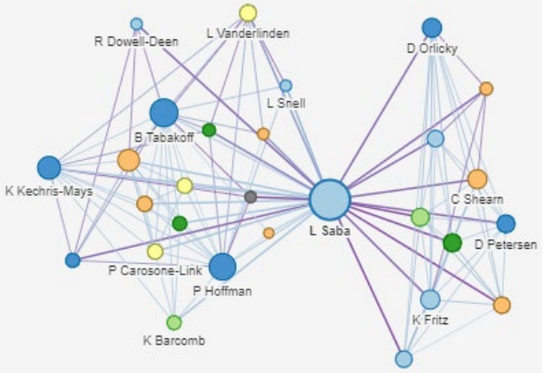


KaleidoNet (Kanaster et al. 2021)

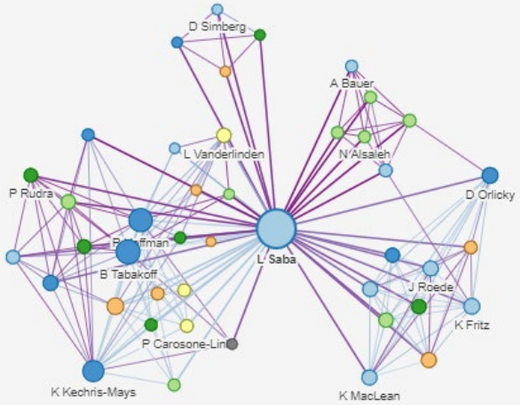
Global view filtered by Cancer Biology and Pathology
Nodes colored by position and sized by betweenness
Edges colored by most recent joint publication year

Egocentric Network Brokerage

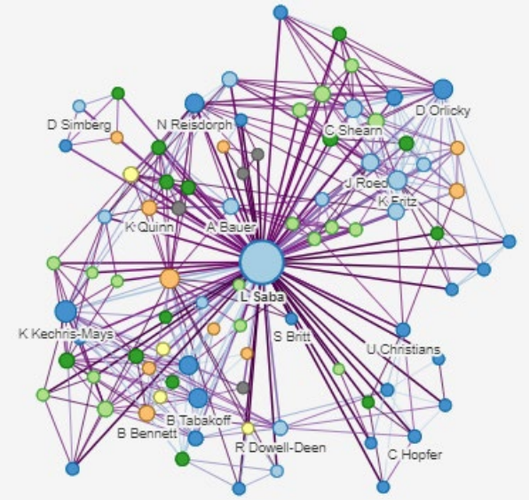
2010-2016



2010-2018



2010-2020



KaleidoNet (Kanaster et al. 2021)

Nodes colored by position and sized by degree

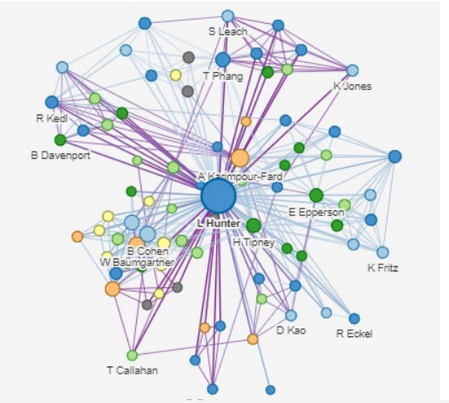
Edges colored by earliest joint publication year

Primary Tasks: Identify neighborhood, compare network across time

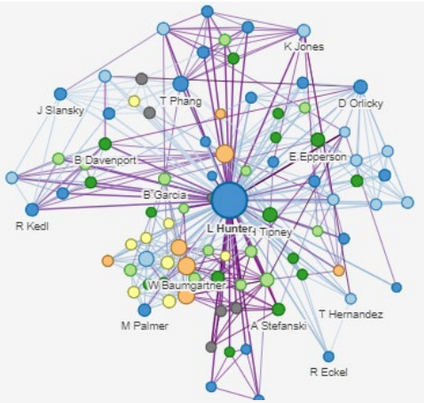
Egocentric Network Matchmaker

2010-2014

2010-2017



2010-2020



KaleidoNet (Kanaster et al. 2021)

Nodes colored by position and sized by degree

Edges colored by earliest joint publication year

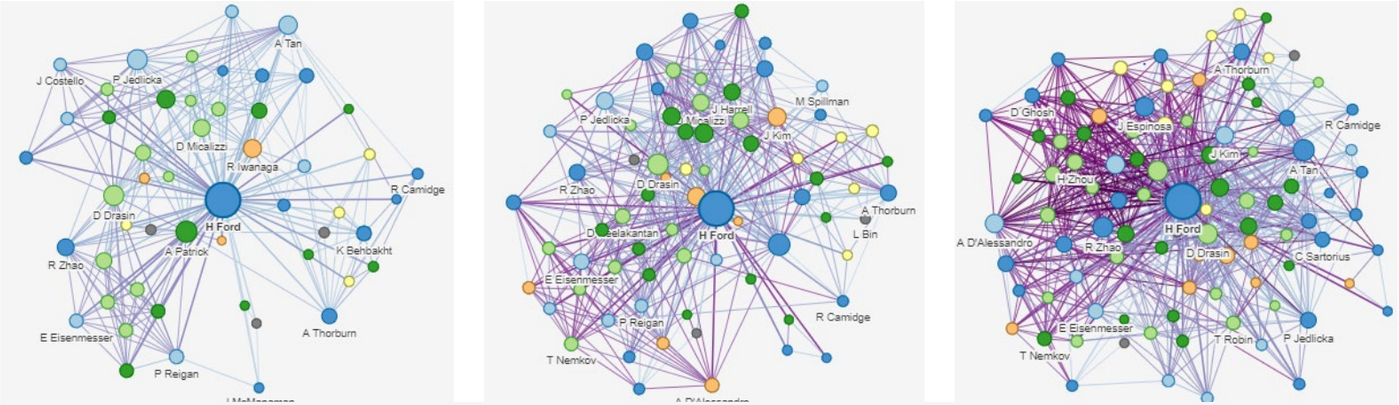
Primary Tasks: Identify neighborhood, compare network across time

Egocentric Network Teamwork

2010-2014

2010-2017

2010-2020

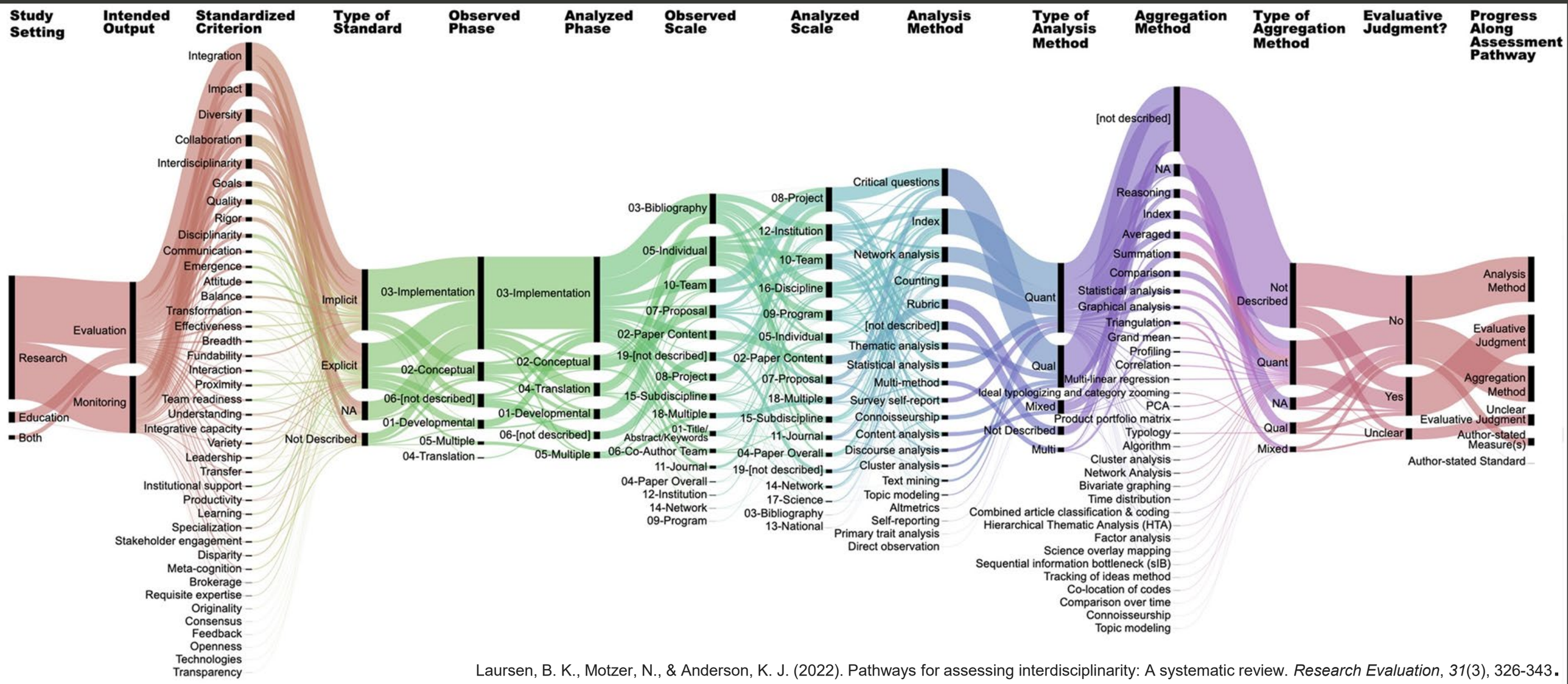


KaleidoNet (Kanaster et al. 2021)

Nodes colored by position and sized by degree

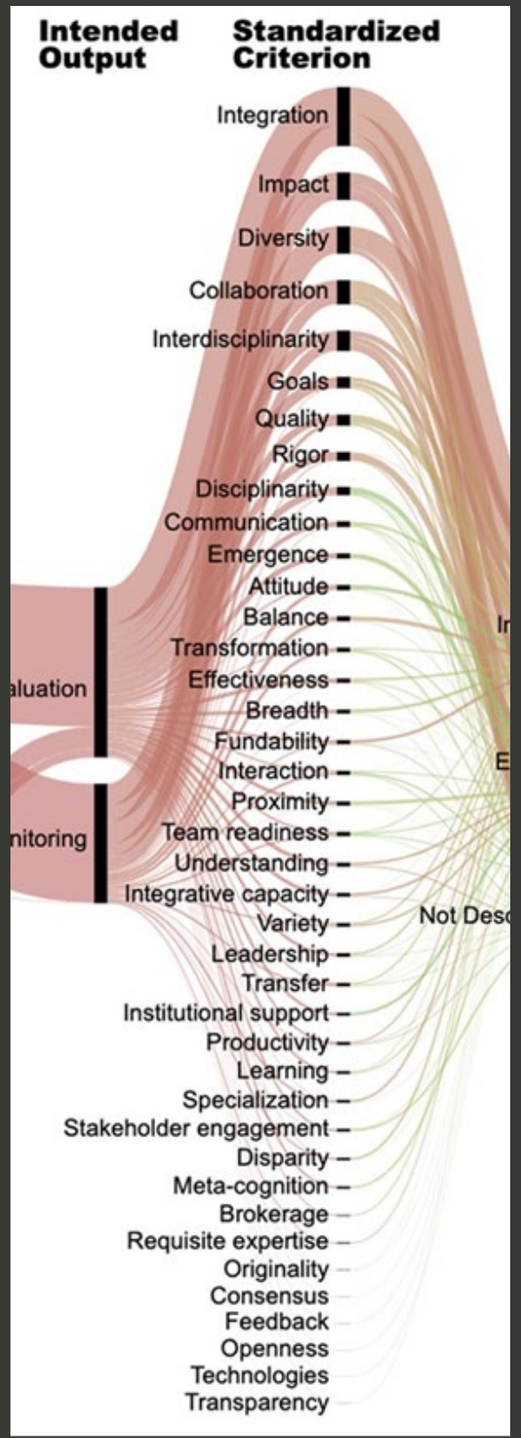
Edges colored by earliest joint publication year

Primary Tasks: Identify neighborhood, compare network across time



Laursen, B. K., Motzer, N., & Anderson, K. J. (2022). Pathways for assessing interdisciplinarity: A systematic review. *Research Evaluation*, *31*(3), 326-343.

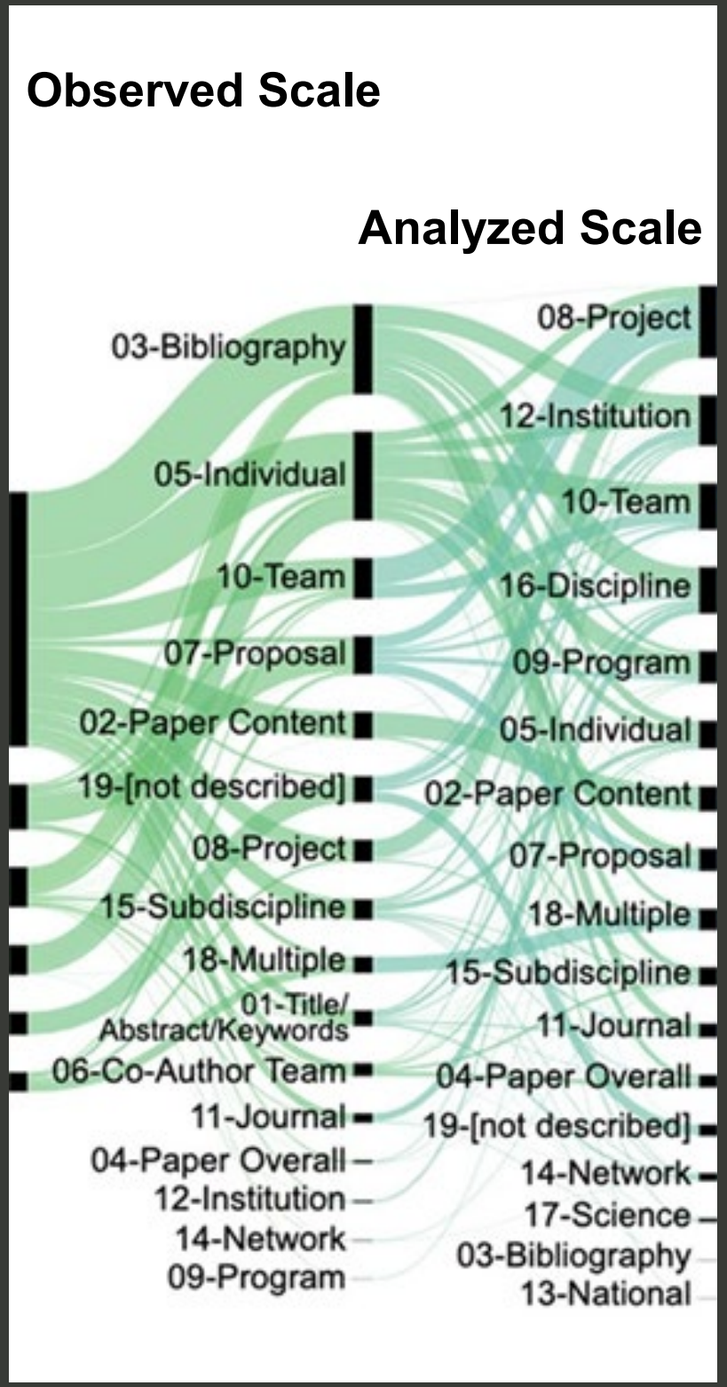
WHAT ARE WE MEASURING?



WHAT ARE WE MEASURING?

(Laursen, Motzer, & Anderson, 2022)

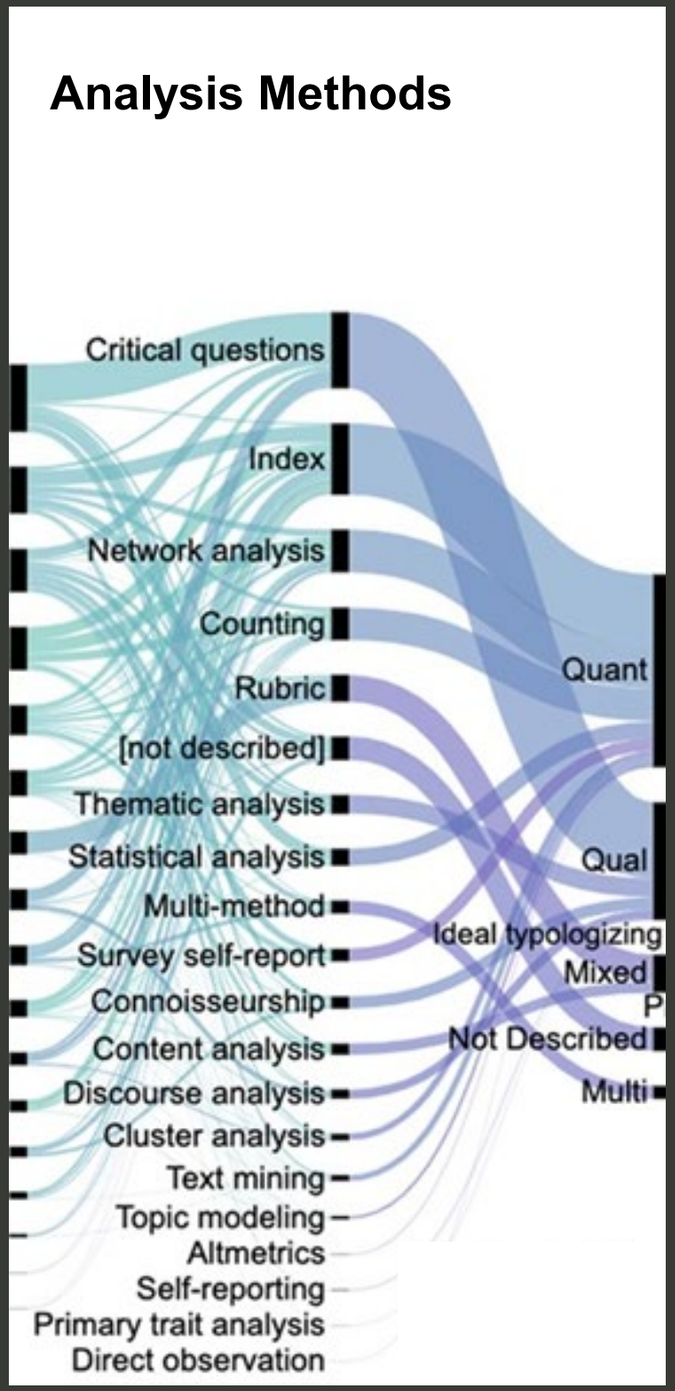
- Impact
- Emergence
- Team Readiness
- Integrative Capacity
- Knowledge Transfer
- Productivity
- Originality
- Meta-cognition



WHAT UNITS?

(Laursen, Motzer, & Anderson, 2022)

- New Fields
- Networks
- Institutions
- Teams
- Projects
- Products
  - Papers
  - Grants



WHAT METHODS?

(Laursen, Motzer, & Anderson, 2022)

- Direct Observation
- Network Analysis
- Self-report Surveys
- Content Analysis
- Discourse Analysis
- Text Mining
- Statistical Analysis
- Rubric

Jeni Cross, PhD

Director
Institute for Research in the Social Sciences

IRISS.colostate.edu

Jeni.Cross@colostate.edu

@drjenicross

Citing this presentation:

Cross JE. “Team Science Evaluation”. 10 April 2024. Presentation, National Academies of Science, Engineering and Medicine. Board on Environmental Change and Society Board on Human-Systems Integration. Webinar: Research and Application in Team Science 2, Webinar, April 10, 2024.

REFERENCES

Cross JE. 2015. “Knowledge Networks and Innovation: How Facilitation Shapes Interaction, Network Structure, and Innovation Outcomes”, International Network for Social Network Analysis, Sunbelt XXXV, International Sunbelt Social Network, Brighton, UK, (June 23-28, 2015)

Cross JE, Jablonski B, Schipanski M. 2022. Ch 15. Inquiry within, between, and beyond disciplines. In Peters C and Thilmany D (Eds.), *Food Systems Modelling* (First Edition, pp. 325-345). Boston: Academic Press/Elsevier Inc.

Fyhn B, Schei V, Sverdrup TE. Taking the emergent in team emergent states seriously: A review and preview. Human Resource Management Review. 2023 Mar 1;33(1):100928.

Gilliland CT, White J, Gee B, Kreeftmeijer-Vegter R, Bietrix F, Ussi AE, Hajduch M, Kocis P, Chiba N, Hirasawa R, Suematsu M. The fundamental characteristics of a translational scientist. ACS Pharmacology & Translational Science. 2019 May 2;2(3):213-6.

Hammoud Z, Kramer F. Multilayer networks: aspects, implementations, and application in biomedicine. Big Data Analytics. 2020 Dec;5(1):1-8.

Ying Huang, Ruinan Li, Yashan Li and Lin Zhang. 2020. Evolution of hot topics in team science. https://i2insights.org/2020/07/21/hot-topics-in-team-science/

Kanaster K, Kaiser A, Cross JE, George C. 2022. Interactive Network Visualization for Exploratory Team Science Analysis. 14th Annual NORDP Research Development Conference.

Kimbrel NA, Ashley-Koch AE, Qin XJ, Lindquist JH, Garrett ME, Dennis MF, Hair LP, Huffman JE, Jacobson DA, Madduri RK, Trafton JA. A genome-wide association study of suicide attempts in the million veterans program identifies evidence of pan-ancestry and ancestry-specific risk loci. Molecular psychiatry. 2022 Apr;27(4):2264-72.

Laursen, B. K., Motzer, N., & Anderson, K. J. (2022). Pathways for assessing interdisciplinarity: A systematic review. *Research Evaluation*, *31*(3), 326-343. https://leadllc.shinyapps.io/evaluation-sankey/

Love HB, Cross JE, Fosdick B, Crooks KR, VandeWoude S, Fisher ER. Interpersonal relationships drive successful team science: an exemplary case-based study. Humanities and Social Sciences Communications. 2021 May 6;8(1):1-0.

O’Reilly C, Cross JE, Fagan J, et al. *forthcoming.* A values-based approach for collaborative team science. *Preprint available upon request.*

Read EK, Cross J, Herman-Mercer N, Oliver SK, O'Reilly CM. Teams, networks, and networks of networks advancing our understanding and conservation of inland waters.

Sharma, S., Gray, D., Read, J. *et al.* A global database of lake surface temperatures collected by *in situ* and satellite methods from 1985–2009. *Sci Data* **2**, 150008 (2015). https://doi.org/10.1038/sdata.2015.8

Woolley AW, Chabris CF, Pentland A, Hashmi N, Malone TW. Evidence for a collective intelligence factor in the performance of human groups. science. 2010 Oct 29;330(6004):686-8.

Visible Network Labs. 2021. The Network Leadership Guidebook. https://visiblenetworklabs.com/guides/guide-to-network-leadership/