

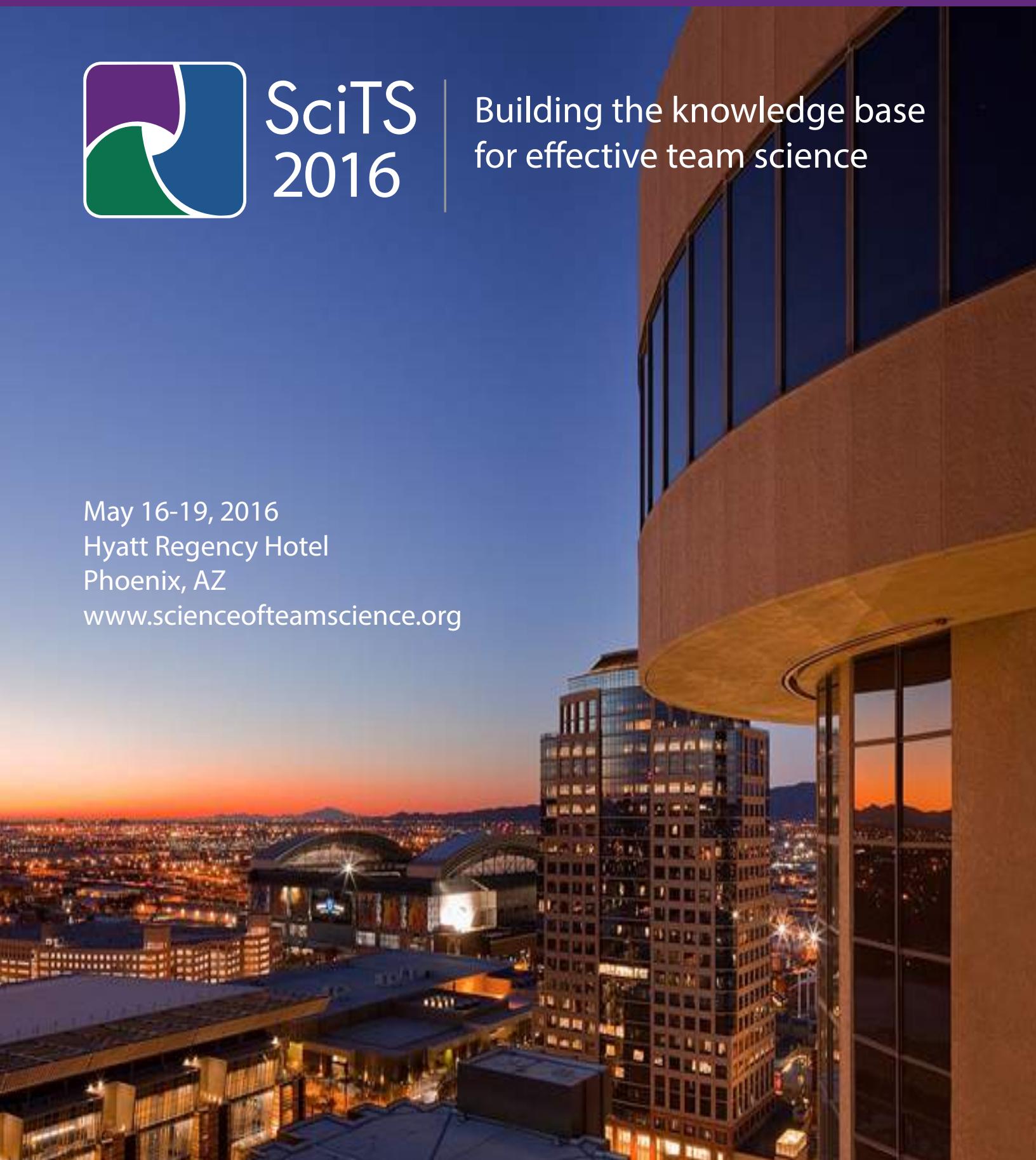
Conference Program



SciTS
2016

Building the knowledge base
for effective team science

May 16-19, 2016
Hyatt Regency Hotel
Phoenix, AZ
www.scienceofteamscience.org



Science of Team Science (SciTS) 2016 Conference

Conference Schedule At-a-Glance

Day 1: Monday, May 16, 2016

8:00–8:30 am	Registration & Continental Breakfast <i>Foyer Entrance in front of Regency Ballroom</i>		
8:30–12:00 pm Morning Workshop Sessions	Workshop 1: SciTS 101: Fundamentals of the Science of Team Science <i>Regency AB</i>	Workshop 2: Using Network Analysis to Evaluate Team Science <i>Ellis West</i>	Workshop 3: Immunity to Change (ITC) for Academic Scientists <i>Ellis East</i>
12:00–1:00 pm	Lunch Buffet (<i>Regency Ballroom CD</i>)		
1:00–4:30 pm Afternoon Workshop Sessions	Workshop 4: Establishing a Professional Community: Interdisciplinary Executive Scientist, Integration and Implementation Sciences Specialist, Research Development Professional, or... <i>Regency AB</i>	Workshop 5: The Difference - How to Reap the Benefits of Interdisciplinary Research Teams <i>Ellis West</i>	Workshop 6: A New Dimension for Team Science: Individual and System Elements in Collaboration <i>Ellis East</i>
4:30-6:00 pm	Break		
6:00-6:15 pm	Welcome and Keynote Introduction <i>Regency Ballroom AB</i>		
6:15-7:15 pm	Opening Keynote: Expanding Science at the University: Defeating the Isomorphic Model for the Benefit of Humanity <i>Regency Ballroom AB</i>		
7:15-9:00 pm	Taste of Arizona - Evening Networking Event <i>Regency Ballroom CD</i>		

Day 1: Monday, May 16

Conference Schedule At-a-Glance

Day 2: Tuesday, May 17, 2016

Day 2: Tuesday, May 17

8:00–9:00 am	Registration & Continental Breakfast <i>Foyer Entrance in front of Regency Ballroom</i>			
9:00–9:30 am	Welcome & Introduction <i>Regency Ballroom AB</i>			
9:30–11:30 am	Featured Panel: Teams and Technology: Augmenting and Externalizing Cognition to Advance Team Science <i>Regency Ballroom AB</i>			
11:30–11:45 am	Break (<i>Regency Ballroom CD</i>)			
11:45–12:30 pm	Featured Speaker: Group Creativity: Lessons from Synthesis Centers <i>Regency Ballroom AB</i>			
12:30–2:00 pm	Buffet Lunch & Table Topic Networking Event (<i>Regency Ballroom CD</i>)			
2:00–3:30 pm Thematic Paper Sessions and Panels (submitted)	Panel: New Strategies to Enhance Translational Research Team Performance: The CTSA Perspective <i>Sundance</i>	Papers: Institutional Support & Recognition for Team Science <i>Ellis West</i>	Papers: Biotech Teams for Translational Research & Development <i>Ellis East</i>	
3:30–3:45 pm	Break (<i>Regency Ballroom CD</i>)			
3:45–5:15 pm Thematic Paper Sessions (submitted)	Papers: Communication in Team Science <i>Regency AB</i>	Papers: Team Science Training & Education <i>Sundance</i>	Papers: New Approaches to Stimulate Innovation <i>Ellis West</i>	Papers: Publishing Team Science: Challenges & Opportunities <i>Ellis East</i>
5:15 pm	Adjourn			
6:00–8:00 pm	Special Evening Event (<i>Advance registration required</i>) <i>ASU Decision Theater, Tempe, AZ</i>			

Conference Schedule At-a-Glance

Day 3: Wednesday, May 18, 2016

8:00–9:00 am	Registration & Continental Breakfast <i>Foyer Entrance in front of Regency Ballroom</i>			
9:00 am	Welcome Back <i>Regency Ballroom AB</i>			
9:00–9:45 am	Featured Speaker: Analogies as the Workhorse of Multidisciplinary Creativity & Problem Solving <i>Regency Ballroom AB</i>			
9:45–10:45 am	2016 SciTS Recognition Award: Threads, Milestones, & Visions: Intersections of Team Science & Interdisciplinarity <i>Regency Ballroom AB</i>			
10:45 –11:00 am	Break (<i>Regency Ballroom CD</i>)			
11:00-12:30 pm Thematic Paper Sessions and Panels (submitted)	Papers: Evidence-Based Strategies for Success <i>Regency AB</i>	Panel: Creating the Next Gen Team Science Workforce: Lessons Learned in Tennessee <i>Sundance</i>	Papers: Network Analyses & Data Visualizations <i>Ellis West</i>	Papers: International Perspectives & Considerations <i>Ellis East</i>
12:30-2:00 pm	Buffet Lunch (<i>Regency Ballroom CD</i>)			
2:00–3:30 pm Thematic Paper Sessions and Panels (submitted)	Panel: A Feminist Approach to Facilitating Interdisciplinary Collaboration <i>Regency AB</i>	Papers: Biotech & Healthcare Teams <i>Sundance</i>	Papers: Collaboration & NIH Supported Center Initiatives <i>Ellis West</i>	Papers: Lessons Learned from Multi-Disciplinary Organizations & Fields: From Design to Ecology <i>Ellis East</i>
3:30-3:45 pm	Break (<i>Regency Ballroom CD</i>)			
3:45-5:15 pm	Panel: Communicating a Value Proposition... <i>Regency AB</i>	Papers: Conceptual Models & Theory <i>Sundance</i>	Papers: Team Training in the Trenches <i>Ellis West</i>	Papers: Shared Resources & Collaboration: Events, Data, & Documents <i>Ellis East</i>
5:15 pm	Adjourn			

Day 3: Wednesday, May 18

Conference Schedule At-a-Glance

Day 4: Thursday, May 19, 2016

8:00–8:30 am	Registration <i>Foyer Entrance in front of Regency Ballroom</i>
8:30 am	Welcome Back <i>Regency Ballroom AB</i>
8:30–9:15 am	Featured Speaker: Partnership Approaches to Solving Big Problems: The Promise of Stewardship Teams & the Transformation of Health <i>Regency Ballroom AB</i>
9:15 –10:00 am	Featured Speaker: Research Collaboration Effectiveness & the Science of Team Science: A Summary of a 15-year Research Program <i>Regency Ballroom AB</i>
10:00–11:15 am	Scientific & Collaborative Poster Session & Brunch <i>Regency Ballroom CD</i>
11:15-12:00 pm	Closing Session: Future Directions Panel <i>Regency Ballroom AB</i>
12:00 pm	Adjourn

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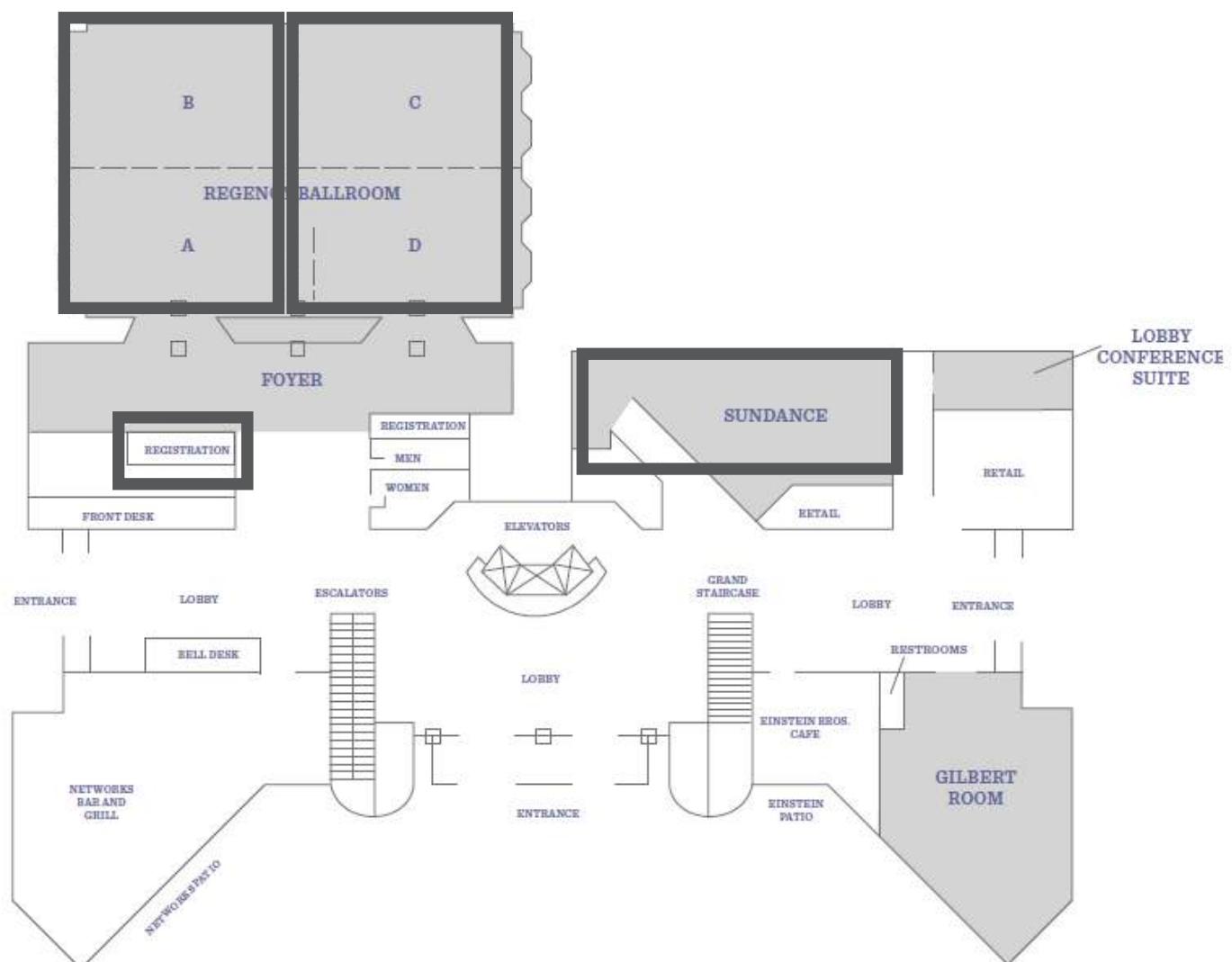
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Hyatt Regency Phoenix - Conference Locations

The opening and closing sessions, along with all featured speaker talks, will be held in Regency Ballroom AB. Concurrent sessions will be held in Regency Ballroom AB, Ellis West, Ellis East, and Sundance rooms. The Thursday morning poster session will be held in Regency Ballroom CD. All food and the exhibitor tables will be located in Regency Ballroom CD throughout the conference.

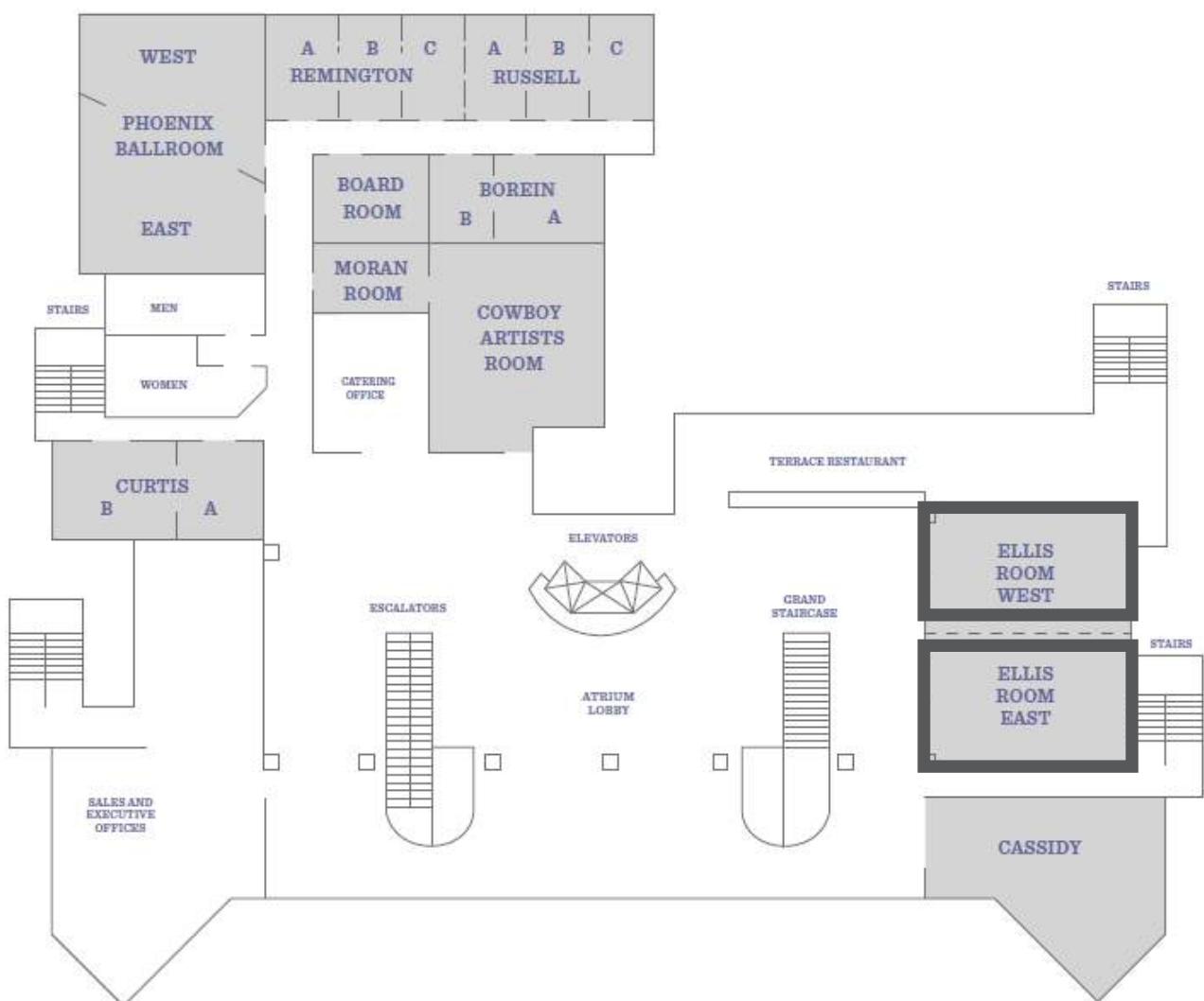
Conference rooms are indicated on the following maps of the Hyatt Regency Phoenix by the dark gray boxes.

FLOOR PLAN *First Floor*



Hyatt Regency Phoenix - Conference Locations

FLOOR PLAN
Second Floor



SciTS 2016 Conference Planning Committee and Support

Conference Co-Chairs

Kara L. Hall, PhD
Director, Science of Team
Science Team
Behavioral Research Program
National Cancer Institute

Scott J. Leischow, PhD
Professor of Health Services Research
Office of Health Disparities Research
Mayo Clinic

Program Chair

Janet Okamoto, PhD
Assistant Professor
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Mayo Clinic

Conference Manager

Chara Chamie, MPH
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Conference Planning Committee

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Professor, National Centre for
Epidemiology & Population Health
Australian National University

Heather Billings, PhD
Director, Faculty Development
Center for Clinical & Translational
Sciences (CCaTS)
Mayo Clinic

Noshir Contractor, PhD
Professor
Industrial Engineering & Management
Sciences,
Communication Studies,
Management & Organizations
Northwestern University

Stephen Crowley, PhD
Associate Professor
Department of Philosophy
Boise State University

Holly J. Falk-Krzesinski, PhD
Vice President
Global Academics &
Research Relations
Elsevier

Stephen M. Fiore, PhD
Associate Professor and
Director, Cognitive Sciences Laboratory
University of Central Florida

Julie Thompson Klein, PhD
Professor of Humanities Emerita,
Faculty Fellow for Interdisciplinary
Development in Division of Research
Wayne State University

Michael O'Rourke, PhD
Professor of Philosophy,
AgBioResearch
Michigan State University

Maritza Salazar, PhD
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Organizational Behavior
Division of Behavioral &
Organizational Sciences
Claremont Graduate University

Bonnie J. Spring, PhD
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Psychology, Psychiatry, & Behavioral
Sciences
Northwestern University

Daniel Stokols, PhD
Research Professor and Chancellor's
Professor Emeritus
University of California, Irvine

Amanda Vogel, PhD
Senior Behavioral Scientist
National Cancer Institute

Conference Planning & Registration Support

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Research Coordinator
Mayo Clinic

Amy Woof, MPH
Research Analyst
Mayo Clinic

Danielle Wright, MSW
Administrative Assistant
Mayo Clinic

Conference Communications

Julie Janovsky-Mason
Communications Specialist
Mayo Clinic

On behalf of the SciTS 2016 Conference Planning Committee, welcome to Phoenix, AZ and the Science of Team Science (SciTS) 2016 Conference!

The SciTS 2016 Conference maintains the theme of "Building the Knowledge Base for Effective Team Science." During the conference, a rich set of invited panels, oral presentations, and scientific posters will support this theme, highlighting the latest conceptual and empirical advances in our understanding of key topics related to advancing team-based science. Furthermore, this year we have a robust offering of practical workshops and presentations aimed at translating evidence into practice; for instance, highlighting strategies for educating and training our scientific workforce as well as implementing institutional supports for team-based research.

To kick off the week's events, we offer a broad array of **workshops on Monday** which aim to: provide greater understanding of key SciTS topics, enhance methodological strategies for conducting SciTS studies, promote culture change and professional development, support the development and advancement of new roles in science, and provide guidance for increasing collaborative success.

New this year, attendees will come together for an exciting **Monday evening networking session**, "Taste of Arizona," with appetizers and refreshments! **Arizona State University President, Michael Crow** will share his leading-edge views on re-envisioning the academic enterprise to kick off the networking event.

We've organized the conference so that mornings feature sessions that give a broad overview of SciTS topics relevant to all attendees, while afternoons allow attendees to focus more deeply on topics of particular interest to them.

Highlights from the morning sessions include:

- **Tuesday's** featured panel focuses on **strategies to enhance team cognition** to advance team science. Cutting edge uses of technology, as well as high accessible techniques, will be shared by speakers, including: Jeremy Lasky, Perception; John Miller, Arizona State University; Deana Pennington, University of Texas at El Paso; Reiko Yajima, Stanford University; and Steve Fiore, University of Central Florida. Additionally, former ASU professor Ed Hackett (now at Brandeis University), will share **insights on group creativity** from studying National Science Foundation Synthesis Centers.
- **Wednesday's** featured speaker, Christian Schunn, from the University of Pittsburgh, will discuss the role of **analogies for multidisciplinary creativity and problem solving**. The second annual SciTS Recognition Award will be presented to Dr. Julie Thompson-Klein, Wayne State University. Her talk will focus on conceptual, historical, and practical aspects of the **intersection of team science and interdisciplinarity**.
- **Thursday's** featured Speaker, Ruth Wageman from Harvard University, will highlight **approaches to assess challenges and improve effectiveness in partnerships assembled to solve big problems**. Our final featured speaker, Barry Bozeman from Arizona State University, will provide his perspective on **research collaboration effectiveness and the SciTS** across a 15 year program of research.

Welcome Letter

This year, attendees will be well nourished throughout the conference! Come early each day for a light breakfast, join colleagues each day for lunch, and enjoy our opening evening appetizers. Tuesday lunch will include round table discussions and our Thursday Poster session will be paired with brunch!

Each year the SciTS conference has leveraged a unique partnership with the host institution, providing new collaborators and new perspectives. This year our host organization, the **Mayo Clinic**, brings a strong practice perspective and rich connections with clinical and research institutions around the country. We anticipate that the dialogue fostered by this year's conference—among administrators who influence policies in academia, researchers who engage in team-based research, and scholars who study team science—will enrich the quality of the scientific enterprise.

After your exciting days with colleagues at the SciTS 2016 Conference, we hope you have the opportunity to enjoy the wonderful cuisine in Phoenix, join fellow sports fans at a Diamondbacks vs. Yankees game, or experience the city's history, arts, and culture.

Enjoy the SciTS 2016 Conference!



A handwritten signature in black ink, appearing to read "Kara L. Hall".

Kara L. Hall, PhD
National Cancer Institute
SciTS 2016 Conference Co-Chair



A handwritten signature in black ink, appearing to read "Scott J. Leischow".

Scott J. Leischow, PhD
Mayo Clinic
SciTS 2016 Conference Co-chair



A handwritten signature in black ink, appearing to read "Janet Okamoto".

Janet Okamoto, PhD
Mayo Clinic
SciTS 2016 Conference Program Chair

Moderators

We would like to extend special thanks to our moderators for facilitating discussion at the conference:

Arsev Aydinoglu

Gabriele Bammer

Heather Billings

Stephen Crowley

Holly Falk-Krzesinski

Sarah Hohl

Julie Thompson Klein

Sharon Ku

Gaetano Lotrecchiano

Alina Lungeanu

Michael O'Rourke

Marshall Scott Poole

Dayan Ranwala

Maritza Salazar

Daniel Stokols

Amanda Vogel



Building the knowledge base
for effective team science

SciTS Recognition Award

2016 Recipient: Dr. Julie Thompson Klein, PhD

To recognize her vision, dedication, and leadership in helping to establish and continue to advance the Science of Team Science field.



Dr. Julie Thompson Klein is Professor of Humanities Emerita at Wayne State University. She has also been a Visiting Foreign Professor at Shimane University in Japan, a Fulbright professor in Nepal, Foundation Visitor at the University of Auckland in New Zealand,

and Mellon Fellow in Digital Humanities at the University of Michigan. She is the holder of a Ph.D. in English from the University of Oregon. Dr. Klein is the past president of the Association for Interdisciplinary Studies, former editor of its journal and a recipient of the Kenneth Boulding Award for outstanding scholarship on interdisciplinarity. Her books include *Interdisciplinarity* (1990), *Interdisciplinary Studies Today* (1994), *Crossing Boundaries* (1996), *Transdisciplinarity* (2001), *Interdisciplinary Education in K-12 and College* (2002), *Humanities, Culture, and Interdisciplinarity* (2005), *Creating Interdisciplinary Campus Cultures* (2010), and *Interdisciplining Digital Humanities* (2015). She was also Associate Editor of the Oxford Handbook on Interdisciplinarity (2010) and co-editor of the University of Michigan Press series *Digital Humanities@digitalculturebooks*.

Featured Speakers



Michael M. Crow, PhD
President
Arizona State University

Michael M. Crow became the 16th president of Arizona State University on July 1, 2002. He is guiding the transformation of ASU into one of the nation's leading public metropolitan research universities, an institution that combines the highest levels of academic excellence, inclusiveness to a broad demographic, and maximum societal impact—a model he terms the "New American University." Under his direction the university pursues teaching, research, and creative excellence focused on the major challenges of our time, as well as those central to the quality of life, sustainable development, and economic competitiveness of Arizona and the nation. He has committed the university to sustainability, social embeddedness, and global engagement, and championed initiatives leading to record levels of diversity in the student body.



Ed Hackett, PhD
Vice Provost for Research & Professor, Heller School of Social Policy & Management
Brandeis University
Professor Emeritus
Arizona State University
Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability

Dr. Hackett's research focuses on how the social organization and conduct of science influence the knowledge that is produced. He has written about collaboration, leadership, peer review, environmental justice, and other topics. At the National Science Foundation he has directed the Division of Social and Economic Sciences (2006-08) and the Science and Technology Studies Program (1996-98). Dr. Hackett teaches courses on inequality and sustainability (from a global perspective), technology and society, social dimensions of science (grad) and research design and methodology (grad).

Stay Connected: Twitter and More

Stay involved during and after the SciTS Conference...



On Twitter at: #SciTS2016

On the conference website at: www.scienceofteamscience.org

Featured Speakers



Christian Schunn, PhD
Professor, Psychology, Learning Science & Policy, & Intelligent Systems
Senior Scientist, Learning Research & Development Center
University of Pittsburgh

Christian Schunn is a Senior Scientist at the Learning Research and Development Center and a Professor of Psychology, Learning Sciences and Policy, and Intelligent Systems at the University of Pittsburgh. He directs a number of research projects studying engineering and science teams from cognitive and

social psychology perspectives to produce new tools that increase innovation. He also leads research projects that apply this knowledge to building innovative technology-supported STEM curricula, and studying factors that influence student and teacher STEM learning. He is a Fellow of AAAS, APA, and APS.



Ruth Wageman, PhD
Associate Faculty in Psychology
Harvard University

Dr. Wageman is Associate Faculty in Psychology at Harvard University and Director of Stewardship with ReThink Health. She specializes in the field of Organizational Behavior, studying and teaching the design and leadership of task performing teams—especially the particular challenges faced by leadership teams. Professor Wageman researches the conditions under which people are

able to accomplish great things, especially in collaboration with one another. She studies and works with groups of leaders who work together across organizations to lead the transformation of health and health care in the US.



Barry Bozeman, PhD
Center Director (ACD) & Professor, School of Public Affairs
Arizona State University

Barry Bozeman is Arizona Centennial Professor of Public Management and Technology Policy and Director of the Center of Organizational Research and Design. Previous positions include Regents' Professor and Ander Crenshaw Endowed Chair of Public Policy, University of Georgia; Regents Professor of Public Policy at Georgia Tech and Professor of Public Administration, Law and

Affiliate Professor of Engineering at Syracuse University where he was founding director of the Maxwell School's founding director of the Center for Technology and Information Policy. Bozeman's research focuses on science and technology policy, organization theory, design of research institutions, and innovation.

Featured Panel



Panel Chair: Stephen M. Fiore, PhD
Associate Professor of Cognitive Sciences
Department of Philosophy
University of Central Florida

Dr. Fiore is Director of the Cognitive Sciences Laboratory and faculty in the University of Central Florida's Cognitive Sciences Program in the Department of Philosophy and Institute for Simulation & Training. He is President of the Interdisciplinary Network for Group Research and a founding Program Committee member for the annual Science of Team Science Conference. He maintains

a multidisciplinary research interest that incorporates aspects of the cognitive, social, organizational, and computational sciences in the investigation of learning and performance in individuals and teams. His primary area of research is the interdisciplinary study of complex collaborative cognition and the understanding of how humans interact socially and with technology.



Jeremy Lasky
Co Founder/Partner
Perception

Jeremy was hired right out of school as Art Director at the acclaimed design-house-turned-interactive-agency R/GA (R/Greenberg Associates), where he designed and animated hundreds of commercial graphics and feature film titles. In 2001, Lasky teamed with his former colleague, Danny Gonzalez, to found Perception. Lasky's work has been featured in dozens of design and industry publications and he has garnered many of the most prestigious awards in the

design world. Lasky has lectured on design and has been a guest speaker at OTIS, SCAD, Carnegie Mellon's ETC and NYU ITP.



Jon Miller, PhD
Director
Decision Theater
Arizona State University

As Director, Decision Theater, Jon leads efforts to model, simulate, and visualize complex problems leading to informed policy discussions through better understanding and the ability to forecast the outcomes of policy decisions. He leverages the skills and experiences of a 34 year military career, executive leadership positions in private sector aerospace firms, and responsibilities as a Senior Executive Service member of the Department of Homeland Security. MG(ret) Miller is a graduate of the United States Military Academy and holds graduate degrees from Central Michigan University (Business), and the US Army War College (Strategic Studies).

Featured Panel



Deana Pennington, PhD
Associate Professor, Department of Geological Sciences
University of Texas at El Paso

Dr. Deana Pennington, Associate Professor in Geological Sciences at the University of Texas at El Paso, is a physical geographer with cross training in learning sciences. Her research focuses on how changes in climate and land structure impact natural processes, especially focused on geospatial approaches to analyzing land change and socio-environmental systems. These studies have dictated that she also gain expertise in knowledge integration and synthesis in interdisciplinary teamwork, and emerging technologies for science, including cyberinfrastructure and informatics approaches. Hence, most of her work is at the boundaries between socio-environmental science, interdisciplinary teamwork, and emerging technologies.



Rieko Yajima, PhD
Center for Design Research
Stanford University

Rieko Yajima is a biochemist with interests that lie at the intersection of science and society—which include design and policy. She is currently a Visiting Research Scholar at the Center for Design Research at Stanford University to investigate how Design Thinking Paradigms can catalyze scientific research and innovation. Previously, she worked for the American Association for the Advancement of Science (AAAS), in Washington, DC, where she advised the scientific community on research strategy and capacity building, and in the use of informed decision-making for funding research. She holds a doctorate degree in integrative biosciences from The Pennsylvania State University and served as a science policy fellow at the National Academy of Sciences.

Contribute to a unique Science of Team Science Visioning Exercise:

Throughout the conference we invite conference participants to contribute to an online Visioning Exercise aimed at imagining what SciTS should look like in the future. Instructions for this exercise will be given during the Welcome & Introductions on both Monday evening and Tuesday morning. You will also find instructions in your conference bag and handouts at the Registration desk.

Join your colleagues in envisioning the future of SciTS!

ADVANCING SCIENCE & SHARING KNOWLEDGE

At Mayo Clinic we constantly pursue medical advancements and develop new procedures so that every patient receives exactly the care they need. And we freely share our knowledge with the scientific community. We place a high priority on team-based science and we are currently seeking to collaborate with others on research projects. Contact us if you would like to work with us.



ROCHESTER, MINNESOTA

PHOENIX / SCOTTSDALE, ARIZONA

JACKSONVILLE, FLORIDA

Monday, May 16, 2016

8:00–8:30 am

Registration and Continental Breakfast

Foyer Entrance in front of Regency Ballroom

8:30–12:00 pm

Workshop 1: SciTS 101 - Fundamentals of the Science of Team Science

Regency Ballroom AB

Stephen M. Fiore, PhD

Associate Professor of Cognitive Sciences

Department of Philosophy

University of Central Florida

This workshop is designed to serve as a primer in team science for those who are new to the field and want to enter the conference with a deeper understanding, or as a refresher in team science fundamentals for those with prior exposure. The workshop will provide participants with foundational knowledge of the SciTS field, including commonly used terminology and conceptual frameworks, a review of the state of the science and key emerging issues, and an introduction to tools and resources available to support, manage, and conduct effective collaborative research.

This half-day workshop is being organized and facilitated by Stephen M. Fiore, PhD, Associate Professor of Cognitive Sciences in the Department of Philosophy, University of Central Florida, Director of the Cognitive Sciences Laboratory at UCF's Institute for Simulation & Training, and President of the Interdisciplinary Network for Group Research. The workshop will include didactic, Q&A, and interactive break-out sessions with presentations from internationally recognized leaders in the SciTS field. This is an ideal opportunity for those interested in learning more about team science and to interacting with leaders in the SciTS field.

Workshop 2: Using Network Analysis to Evaluate Team Science

Elliis West

Eric W. Welch, PhD

Professor & Director,

Center for Science, Technology, & Environmental Policy
Studies
School of Public Affairs
Arizona State University

Mary K. Feeney, PhD

Associate Professor & Lincoln Professor of Ethics

School of Public Affairs

Associate Director, Center for Science, Technology, &
Environmental Policy Studies
Arizona State University

Michael D. Siciliano, PhD

Assistant Professor

Public Policy & Public Administration

University of Illinois at Chicago

While individual and organizational networks are recognized as critical components of Team Science they are often difficult to measure empirically. Social network analysis provides a set of tools and analytic techniques that enable us to investigate the structure, antecedents, and consequences of these networks. Through the use of social network analysis, we can explore how individual and organizational networks represent and describe collaborative science and also how team science can create, expand, or reshape individual and organizational relationships. Drawing on a variety of studies including evaluations of small scale funding for encouraging interdisciplinary research and training (e.g. NSF IGERT; NIH MARC), evaluations of large scale funding for advancing team science (e.g. NIH CTSA; NSF EPSCoR), and research looking at how scientists use collaborative networks to navigate regulatory restrictions, we will illustrate the ways that we have used network analysis to understand team science and investigate the outcomes of team science. We will then facilitate break-out sessions to guide participants through the technical aspects of using network analysis to evaluate team science including: research design, instrument design, data collection, network analysis techniques, and presenting network analysis results.

This half-day workshop is being organized and sponsored by the ASU Center for Science, Technology and Environmental Policy Studies whose researchers have extensive experience designing instruments to collect network data and analyzing networks as both a driver and consequence of team science. The workshop will be facilitated by CSTEPS Director and Professor Eric W. Welch; Mary K. Feeney, CSTEPS Associate Director and Associate Professor and Lincoln Professor of Ethics in Public Affairs; and Michael Siciliano, Assistant Professor at the University of Illinois at Chicago.

Workshop 3: Immunity to Change (ITC) for Academic Scientists

Ellis East

Cheryl D. Vaughan, PhD

Managing Director, Skills Development Center

Boston Biomedical Innovation Center, an NIH Center for Accelerated Innovation (NCI)

Erica Lawlor, PhD

Director of Education Programming

Harvard Catalyst

The Harvard Clinical & Translational Science Center

Successful teamwork in all professions depends upon behaviors that promote team building and collaborative thinking. Scientists may find it difficult to acquire new behaviors that are fundamental to a team science approach for a variety of reasons (e.g. personality, behaviors developed during early stages of training, or traditional requirements for academic promotion). The Immunity to Change method is designed to help adults identify and change behaviors that, despite being essential in one environment, can prevent progress toward new personal and professional goals. This workshop will explain the ITC process, provide examples of how it is being used by global business leaders for themselves and for their teams, lead participants through their own ITC maps, and discuss how we can best implement ITC as a developmental tool for the scientific research community.

Detailed Guide to the Conference

We strongly believe the ITC method, with buy-in from academic leaders, could become the centerpiece of professional development for faculty and promote a cultural change in how science is done. Conference attendees will benefit personally from the ITC experience by completing their own ITC maps. In addition, attendees will take away all slides, handouts, and literature necessary to bring the ITC method back to their home institutions.

12:00-1:00 pm

Complimentary Lunch Buffet

Regency Ballroom CD

1:00-4:30 pm

Workshop 4: Establishing a Professional Community - Interdisciplinary Executive Scientist, Integration and Implementation Sciences Specialist, Research Development Professional or...

Regency Ballroom AB

Christine Ogilvie Hendren, PhD

Executive Director,

Center for the Environmental Implications of

NanoTechnology

Duke University

Holly J. Falk-Krzesinski, PhD

Vice President

Global Academics &

Research Relations

Elsevier

Gabriele Bammer, PhD

Professor, National Centre for Epidemiology &

Population Health

Australian National University

To address complex problems and effectively engage diverse knowledge bases, it has been proposed that a new type of expertise is needed to work at the interfaces between disciplines in order to translate, facilitate, and optimize research outcomes. This active interest is shared by team science practitioners, researchers, and institutional supporters alike, with this concept being introduced by a variety of different names, including: Interdisciplinary Executive Scientist (IES), Integration and Implementation Sciences (I2S) specialist, and Research Development Professional (RDP). The I2S and RDP communities are already established and more than 30 people have signed up to join an "IES community of interest". This half-day workshop will serve as a first opportunity to explore this fertile ground, identifying similarities and differences among the groups, brainstorming common goals and group objectives, and working toward defining ourselves to the extent this is useful in advancing those goals and objectives.

Workshop 5: The Difference - How to Reap the Benefits of Interdisciplinary Research Teams

Ellis West

Karin Grasenick, PhD

Managing Partner

Convelop Cooperative Knowledge Design

Renate Handler

Scientific Staff Member

Convelop Cooperative Knowledge Design

Interdisciplinary research teams combine various perspectives and heuristics and are capable of creating innovative solutions. However, differences are also a potential source of conflict. In this workshop, we will introduce and apply practical tools and guidelines that help to deal effectively with the challenges of interdisciplinary research teams. We will focus on three selected aspects: publication strategies, different definitions of research quality, and equal opportunities and career perspectives for all team members. Participants are invited to contribute their own experiences and examples, and will learn to:

- Deal with the various facets of team diversity in different phases of research projects
 - Identify and address potential sources of conflicts and thus increase productivity
 - Consider equal opportunities and career perspectives for all team members
-

Workshop 6: A New Dimension for Team Science - Individual and System Elements in Collaboration

Ellis East

Celeste Blackman, LHEP

Co-Founder

The Green Zone Culture Group

Ian Fore, PhD

National Cancer Institute

Katherine Skinner, PhD

Executive Director

Educopia Institute

This workshop will

- Introduce techniques which help at the individual level and prepare individuals to engage more effectively in collaborative efforts.
- Share approaches that encourage thinking at a system level.
- Be an interactive experience designed to give participants information that is cognitive, emotional and actionable.

Detailed Guide to the Conference

- Uncover the gains to be realized by reaching beyond institutional or personal benefit.

Teams for large scale science projects are most often formed from those intellectually equipped in relevant technical expertise, tools and technologies. However, many teams never achieve their full potential because they fail to fully engage the human dimension. Each team member brings their emotional energy to the work at their own discretion. When that element is allowed to flourish the high-trust relationships that are developed bring the team to a new level. True collaboration is a human activity that begins inside the individual and expands outwardly to others; the team, the organization, the system.

The focus of team problems is sometimes placed on particular behaviors and personality types. However, working to embrace all personalities, shifting the focus to systems, and freeing the individuals within them to be flexible in their behavioral options creates a diversity which brings wholly unexpected results.

4:30-6:00 pm

Break

6:00-6:15 pm

Welcome and Keynote Introduction

Regency Ballroom AB

Kara L. Hall, PhD
Director, Science of Team
Science Team
Behavioral Research Program
National Cancer Institute

Scott J. Leischow, PhD
Professor of Health Services Research
Office of Health Disparities Research
Mayo Clinic

6:15-7:15 pm

Opening Keynote: Expanding Science at the University - Defeating the Isomorphic Model for the Benefit of Humanity

Regency Ballroom AB

Michael M. Crow, PhD
President
Arizona State University

7:15-8:30 pm

Taste of Arizona - Evening Networking Event

Regency Ballroom CD

Detailed Guide to the Conference

Tuesday, May 17, 2016

8:00–9:00 am

Registration and Continental Breakfast

Foyer Entrance in front of Regency Ballroom

9:00–9:30 am

Welcome and Introduction

Regency Ballroom AB

Kara L. Hall, PhD
Director, Science of Team
Science Team
Behavioral Research Program
National Cancer Institute

Diane F. Jelinek, PhD
Dean of Research
Mayo Clinic

9:30–11:30 am

Featured Panel: Teams and Technology - Augmenting and Externalizing Cognition to Advance Team Science

Regency Ballroom AB

Panel Chair: Stephen M. Fiore, PhD
Associate Professor of Cognitive Sciences
Department of Philosophy
University of Central Florida

Jeremy Lasky
Co Founder/Partner
Perception

Jon Miller, PhD
Director
Decision Theater
Arizona State University

Deana Pennington, PhD
Associate Professor, Department of Geological Sciences
University of Texas at El Paso

Rieko Yajima, PhD
Center for Design Research
Stanford University

Collaborative cognition in service of scientific problem solving is an increasingly complex endeavor. As teams become more interdisciplinary, and as the nature of the problems get more complicated, the Science of Team Science must work to identify and expand research on technology that can augment cognition and collaboration in science teams. Towards this end, this panel provides a forum for discussing cutting edge approaches and technologies designed to 'externalize cognition' and help team scientists better manage complex information processing.

Detailed Guide to the Conference

Day 2: Tuesday, May 17

11:30-11:45 am

Break

Regency Ballroom CD

11:45-12:30 pm

Featured Speaker: Group Creativity - Lessons Learned from Synthesis Centers

Regency Ballroom AB

Ed Hackett, PhD

Vice Provost for Research & Professor, Heller School of Social Policy & Management

Brandeis University

Professor Emeritus

Arizona State University

Senior Sustainability Scientist, Julie Ann Wrigley Global Institute of Sustainability

12:30-2:00 pm

Buffet Lunch & Table Topic Networking Event

Regency Ballroom CD

2:00-3:30 pm

Thematic Paper Sessions and Panels (submitted)

Panel: New Strategies to Enhance Translational Research Team Performance - The CTSA Perspective

Sundance

Authors: Cathleen T. Kane, Damayanthi (Dayan) Ranwala, Karen B. Demby, Beth B. Tigges, Kevin C. Wooten, Allan R. Brasier

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Thematic Paper Session: Institutional Support and Recognition for Team Science

Ellis West

Paper 1: Incenting & Rewarding Team Science in the Appointment & Promotion Process at Mayo Clinic

Authors: Timothy Beebe

Paper 2: Ensuring Institutional Recognition of Interdisciplinary Team-Based Research

Authors: Kathryn Plaisance & Robert Gorbet

Detailed Guide to the Conference

Paper 3: Inspiring Teams in Computational Science
Authors: Sawsan Khuri, Stefan Wuchty, & Nicholas Tsinoremas

Paper 4: Is Everything Awesome When You're Part of a Team?
Authors: Kevin Kniffin & Andrew Hanks

Thematic Paper Session: Biotech Teams for Translational Research and Development

Ellis East

Moderator: Sarah Hohl

Paper 1: Research Obstacles and Problem Solving in Scientific R&D Teams

Authors: David J. McBee

Paper 2: Open Innovation and Collaborative Models for Translation into Practice through Multidisciplinary Team-Based Science at the Mayo Clinic

Authors: Thomas Chung, Andrew Bradley, & Jeff Anderson

Paper 3: Working at the Bioinformatics Crossroads - A Management Perspective on Interdisciplinarity

Authors: Andrew Ritchenson

Paper 4: An Ethnography of Team Science

Authors: Anna Jabloner & Sandra Lee

3:30-3:45 pm

Break

Regency Ballroom CD

3:45-5:15 pm

Thematic Paper Sessions and Panels (submitted)

Session Sponsored by  Trellis | AAAS

Thematic Paper Session: Communication in Team Science

Regency Ballroom AB

Paper 1: Enabling Innovation Across Fields - Facilitating Dialogue and Collaboration with STEAM Researchers

Authors: Stephanie Vasko

Paper 2: Micro-Integration in Dialogue - How Communication Drives Interdisciplinary Integration

Authors: Stephen Crowley, Chad Gonnerman, Michael O'Rourke, & Brian Robinson

Paper 3: Facilitating Collective Decision-Making in Climate Resiliency Planning

Authors: Michael O'Rourke, Bryan Cwik, Chad Gonnerman, & Brian Robinson

Paper 4: Testing Methods for the Co-Production of Target Knowledge in Transdisciplinary Teams

Authors: Tobais Buser & Silvia Tobias

Detailed Guide to the Conference

Thematic Paper Session: Team Science Training and Education

Sundance

Moderator: Gaetano Lotrecchiano

Paper 1: Learning Interventions for Collaborative Team Science - Preparing Health and Biomedical Workers for Success in Collaborative Teaming through Reflective Sensemaking

Authors: Gaetano Lotrecchiano, Yianna Yovides, Trudy Mallinson, Holly Falk-Krzesinski, Laurie Lyons Ma, Colleen Roche, & Jesse Pines

Paper 2: Teaching Teamwork to Undergraduate Students - A Case Study in Applied Collaborative Pedagogy

Authors: Kathryn Plaisance, Georgia Lamarre, Akanksha Madan, & Shane Morganstein

Paper 3: A Model for Team-Based Interdisciplinary Doctoral Education

Authors: Nilda Bosque-Perez, Jo Ellen Force, Lisette Waits, Sanford Eigenbrode, JD Wulffhorst, Kate Cleary, Joseph Holbrook, Sara Galbraith, Amanda Bentley Brymer, Zion Klos, Paul Rhoades, Michael O'Rourke, Bryan Finegan, & Nicole Sibelet

Day 2: Tuesday, May 17

Session Sponsored by  **ASU Knowledge Enterprise Development**
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Thematic Paper Session: New Approaches to Stimulate Innovation

Ellis West

Paper 1: Increasing the Performance of Interdisciplinary Research Teams

Authors: Hannah & Jennifer Cross

Paper 2: An Epigenetic Model of Team-Driven Innovation

Authors: Morton Tavel & Devin Markovits

Paper 3: Evidence-Based Organizational Change to Support Women's Careers in Research

Authors: Vaness McKean

Thematic Paper Session: Publishing Team Science - Challenges & Opportunities

Ellis East

Moderator: Holly Falk-Krzesinski

Paper 1: The Dark Side of "Inclusivity" - Problematizing Authorship Practices in Interdisciplinary Teams

Authors: Isis Settles, Sheila Brassel, Kendra Cheruvellil, Kevin Elliot, Georgina Montgomery, & Patricia Soranno

Paper 2: Scientific Publishing and Team Science - How the Publishing Process Can Be Used to Foster Effective

Scientific Collaboration

Authors: Emily Warner & Sarah Greene

Paper 3: Bringing Team Science to Research Publishing and Science Communities

Authors: Eric Olson

Ideas Grow Here



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Detailed Guide to the Conference

Wednesday, May 18, 2016

8:00–9:00 am

Registration and Continental Breakfast

Foyer Entrance in front of Regency Ballroom

9:00 am

Welcome Back

Regency Ballroom AB

Kara L. Hall, PhD
Director, Science of Team
Science Team
Behavioral Research Program
National Cancer Institute

Scott J. Leischow, PhD
Professor of Health Services Research
Office of Health Disparities Research
Mayo Clinic

9:00-9:45 am

Featured Speaker: Analogies as the Workhorse of Multidisciplinary Creativity and Problem Solving

Regency Ballroom AB

Christian Schunn, PhD
Professor, Psychology, Learning Science & Policy, & Intelligent Systems
Senior Scientist, Learning Research & Development Center
University of Pittsburgh

9:45-10:45 am

2016 SciTS Recognition Award: Threads, Milestones, and Visions - Intersections of Team Science and Interdisciplinarity

Regency Ballroom AB

Julie Thompson Klein, PhD
Professor of Humanities Emerita
Wayne State University

10:45-11:00 am

Break

Regency Ballroom CD

Detailed Guide to the Conference

11:00-12:30 pm

Thematic Paper Sessions and Panels (submitted)

Session Sponsored by



Thematic Paper Session: Evidence-Based Strategies for Success

Regency Ballroom AB

Paper 1: Team Science Challenge Busters

Authors: Nancy L. Dianis & Tracy Wolbach

Paper 2: Radical Transdisciplinarity - Using Group Model Building Principles to Develop a Transdisciplinary Team

Authors: Asheley Skinner, Andrew Perrin, Janna Howard, Cary Levine, Anna Bardone-Cone, Jane Brown, Cynthia Bulik, Michael Steiner, & Eliana Perrin

Paper 3: Learning to Be a Science Team

Authors: Catherine Gabelica, Stephen Fiore, & Jacquelyn Chini

Paper 4: Interdisciplinary and Collaborative Development of Scientific Research Proposals - Negotiation of Disciplinary Differences through Boundary Objects

Authors: Laura Paganucci & Louise Wetherbee Phelps

Panel: Creating the Next Gen Team Science Workforce - Lessons Learned from Tennessee

Sundance

Authors: Suzie Allard, Janet Nelson, Danielle Pollock, Kristina Dorsett, Amy Forrester, Robert Partee, & Thomas Waldrupe

Thematic Paper Session: Network Analyses and Data Visualization

Ellis West

Moderator: TBA

Paper 1: Scholar Plot - A Compact and Scalable Visualization Method for Academic Careers

Authors: Kyeongan Kwon, Dinesh Majeti, Brian Uzzi, & Ioannis Pavlidis

Paper 2: What Brings Us Together - Institutions and Linking Behavior in Early Stage Academic Communities

Authors: Katharine Anderson, Eleanor Sayre, & Matthew Crespi

Paper 3: Integration of Peripheral Regions in Collaborative Science - A Bibliometric Analysis of

Scientific Activity and Co-Authorship at American County Level

Authors: Gregoire Cote & David Campbell

Paper 4: Linking Scientometrics of Multidisciplinarity with Analyses of Interdisciplinarity in Order to Detect the Challenges that Face Multi-Expertise Teams

Authors: Kristin Lund, Heisawn Jeong, Grauwin Sebastian, & Pablo Jensen

Detailed Guide to the Conference

Thematic Paper Session: International Perspectives and Considerations

Ellis East

Moderator: Arsev Aydinoglu

Paper 1: Toward Understanding of Low-Overhead, Action Oriented Team Science

Authors: Iftekhar Ahmed, Marshall Poole, Elizabeth Simpson, & Natalie Lambert

Paper 2: Developing Multinational Collaborations to Translate Knowledge - Lessons Learned from a North American Partnership

Authors: Rebecca Lee, Erica Soltero, Lucie Levesque

Paper 3: The Effect of Public Research Funding in China's Context

Authors: Dongbo Shi

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Detailed Guide to the Conference

12:30-2:00 pm

Buffet Lunch

Regency Ballroom CD

2:00-3:30 pm

Thematic Paper Sessions and Panels (submitted)

Panel: A Feminist Approach to Facilitating Interdisciplinary Collaboration

Regency Ballroom AB

Authors: Michael O'Rourke, Kathryn Plaisance, Stephanie Vasko, & Stephen Crowley

Session Sponsored by  MAYO CLINIC

Thematic Paper Session: Biotech and Healthcare Teams

Sundance

Moderator: Amanda Vogel

Paper 1: Novel Collaborative Approaches for Accelerating Pediatric Device Development

Authors: Gwenyth Fischer, Jodi Fenlon Rebuffoni, Karen Kaehler, Tucker Lebien, & Sandra Wells

Paper 2: Functional Characterizations of Novel Somatic Mutations to Define New Therapeutic Strategies - A Translational Team Science Approach

Authors: Jan B. Egan, David L. Marks, Anne M. Vrabel, Ashley N. Sigafoos, Ezequiel J. Tolosa, Stephanie L. Safrgren, Elisa Enriquez Hesles, Luciana L. Almada, Tara L. Hogenson, Paola A. Romecin Durin, Eriko Iguchi, Gavin R. Oliver, Naresh Prodduturi, Eric D. Wieben, Tammy M. McAllister, Konstantinos N. Lazaridis, Karl J. Clark, Eric W.

Klee, & Martin E. Fernandez-Zapico

Paper 3: Collaboration and Proactive Teamwork Used to Reduce Falls

Authors: Katherine Jones, Victoria Kennel, Anne Skinner, Dawn Venema, Joseph Allen, John Crowe, & Roni Reiter-Palmon

Paper 4: Improving Cancer Care Coordination through Team Science

Authors: Nancy Cooke, Sen Ayan, Nathan McNeese, Nandita Khera, Sara Wordingham, Noel Arring, Sharon Nyquist, Amy Gentry, & Brian Tomlinson

Thematic Paper Session: Collaboration and NIH Supported Center Initiatives

Ellis West

Moderator: Heather Billings

Paper 1: Developing a Methods and Measurement Health Disparity Cross-Disciplinary Team

Authors: Nancy Breen & Deborah Duran

Paper 2: CHEAR Planning for a Team Science Evaluation - NIEHS Children's Health Exposure Analysis Resource Program

Authors: Kristianna Pettibone & Jennifer Collins

Detailed Guide to the Conference

Paper 3: Transdisciplinary Outcomes in Two NIH-Funded Center Grant Initiatives - A Qualitative Study of the Transdisciplinary Research on Energetics and Cancer and the Centers for Population Health and Health Disparities

Authors: Sarah Hohl, Health Noble, Meagan Brown, & Beti Thompson

Paper 4: Modeling the Dynamics of Collaboration in the Scientific Workforce - The Case of Clinical and Translational Science Awards Pilot Grant Program

Authors: Alina Lungeanu, Denis Agniel, Kun Lei, Noshir Contractor, & Griffin Weber

Session Sponsored by



Thematic Paper Session: Lessons Learned from Multi-Disciplinary Organizations and Fields - From Design to Ecology

Ellis East

Moderator: Daniel Stokols

Paper 1: Interdisciplinary Collaborative Design Process in an Educational Setting - The Interdisciplinary Design Studio

Authors: Arsev Aydinoglu & Pinar Kaygan

Paper 2: The Prevalence and Interdisciplinarity of Collaborations in Multidisciplinary Institutions - A Case Study of iSchools

Authors: Zhiya Zuo, Xi Wang, Kang Zhao, & David Eichmann

Paper 3: Focus on Them - Applications and Experiences Using Business-Based Assessments to Promote Collaboration, Teamwork, and Leadership

Authors: David Gosselin & Ron Bonnstetter

3:30-3:45 pm

Break

Regency Ballroom CD

3:45-5:15 pm

Thematic Paper Sessions and Panels (submitted)

Panel: Communicating a Value Proposition for Integrating Social Scientists and Natural Scientists/Engineers - A Sales Pitch through Integration Case Studies

Regency Ballroom AB

Authors: Sharon Ku & Christine Hendren

Day 3: Wednesday, May 18

Detailed Guide to the Conference

Thematic Paper Session: Conceptual Models and Theory

Sundance

Moderator: Stephen Crowley

Paper 1: A Thermodynamics of Interdependence - Science, Scientists, and Scientific Teams

Authors: William Lawless

Paper 2: Knowledge Negotiation across Disciplines with Model Based Reasoning

Authors: Deana Pennington

Paper 3: Collective Intentionality and Science of Team Science

Authors: Deborah Tollefson

Paper 4: Joining Forces - Some Issues in Collective Intentionality for Interdisciplinary Teams

Authors: Graham Hubbs, Ian Werkheiser, & Michael O'Rourke

Thematic Paper Session: Team Training in the Trenches

Ellis West

Moderator: Maritza Salazar

Paper 1: Taking Interdisciplinary Team Science to the Next Level - Team Training for Clinical and Translational PhD Scientists

Authors: Wayne McCormack

Paper 2: Enhancing Integrative Capacity and Team Science Effectiveness - The Role of Team Training

Authors: Theresa Lant & Maritza Salazar

Paper 3: Simulations for Team Science Training

Authors: Gia Demichele, Maritza Salazar, Theresa Lant, & Mackenzie Shults

Paper 4: A Team Science Approach to Leadership Development

Authors: Amy Moore

Thematic Paper Session: Shared Resources and Collaboration - Events, Data, and Documents

Ellis East

Moderator: M. Scott Poole

Paper 1: Communities and Common Pool Resources in Science - An Event-Based Social Capital Perspective

Authors: Federica Fusi, Eric Welch, & Selim Louafi

Paper 2: Tracing the Evolution of Collaborative Virtual Research Environments - A Critical Events-Based Perspective

Authors: Ashley Trudeau, Iftekhar Ahmed, & Marshall Scott Poole

Paper 3: A Neglected Site of Interdisciplinary Exchange - Large-Scale Datasets in the Social Sciences

Authors: Erin Leahey, Attila Varga, & Jerry Jacobs

Paper 4: Virtual Chaos, Face-to-Face Confusion - Academics and Document Stewardship in Virtual Collaborations

Authors: Sarika Sharma, Matt Willis, Steve Sawyer, & Carsten Osterlund

Detailed Guide to the Conference

Thursday, May 19, 2016

8:00–8:30 am

Registration (*no refreshments until Brunch*)

Foyer Entrance in front of Regency Ballroom

8:30 am

Welcome Back

Regency Ballroom AB

Kara L. Hall, PhD
Director, Science of Team
Science Team
Behavioral Research Program
National Cancer Institute

Scott J. Leischow, PhD
Professor of Health Services Research
Office of Health Disparities Research
Mayo Clinic

8:30-9:15 am

Featured Speaker: Partnership Approaches to Solving Big Problems - The Promise of Stewardship Teams and the Transformation of Health

Regency Ballroom AB

Ruth Wageman, PhD
Associate Faculty in Psychology
Harvard University

9:15-10:00 am

Featured Speaker: Research Collaboration Effectiveness and the Science of Team Science - A Summary of a 15-Year Research Program

Regency Ballroom AB

Barry Bozeman, PhD
Center Director (ACD) & Professor, School of Public Affairs
Arizona State University

10:00-11:15 am

Scientific and Collaborative Poster Session and Brunch

Regency Ballroom CD

Detailed Guide to the Conference

Thematic Poster Group #1: Practical Resources, Tools, and Training

Poster 1 - UC Team Science Retreats: Promoting and Furthering Research, Excellence and Diversity in Team Science

Authors: Susan Carter, Barbara Walker, John Crockett, & Susan Carlson

Poster 2 - Learning Theory, Operative Model, and Challenges in Developing a Framework for Collaborative, Translational and Implementable Doctoral Research

Authors: Gaetano R. Lotrecchiano, Paige McDonald, Kenneth Harwood, & Mary Corcoran

Poster 3 - Questae: A Game-Like Training Tool to Build Transdisciplinary Teams

Authors: Hala Azzam

Poster 4 - Case Studies in Team Science: Observations and Lessons Learned

Authors: Karen Demby, Mary White, Richard Davis, Rachel Lerner, Thomas Egan, & David Peden

Poster 5 - Team Science Workbook for NIH Program Staff

Authors: Kristi Pettibone

Poster 6 - Multi-CTSA Team Science Training Intervention Pilot Study

Authors: Damayanthi Ranwala, Gwen Baillarger, Allen R. Brasier, Juan J. Cordero, Karen B. Demby, Diazgranados Diazgranados, Cathleen T. Kane, David B. Peden, Angela F. Pfammatter, Bonnie Spring, Beth B. Tigges, William M. Trochim, Lori Wiseman, Kevin C. Wooten, & Fruma Yehiely

Poster 7 - Community Engagement Software Works To Enhance Team Function

Authors: Karen McCord, Laura Dress, David Proctor, & Josefine Engel

Poster 8 - Articles about Interdisciplinarity and Where to Find Them

Authors: Dilyn Corner, Thomas Padilla, & Michael O'Rourke

Thematic Poster Group #2: Virtual Collaboration, Technology, & Citizen Science/Crowdsourcing

Poster 9 - CitSciBio.org- The Biomedical Citizen Science Hub

Authors: Katrina Theisz, Jennifer Couch, & Elizabeth Gillanders

Poster 10 - The Team Science Toolkit: Practical Tools for Success in Team Science

Authors: Amanda Vogel, Kara Hall, David Garner, & Elliot Grant

Poster 11 - EarthCube and the Science of Team Science

Authors: Joshua Young

Poster 12 - Cybersecurity R&D as a Homeland Team Science & Technology Challenge

Authors: Scott Tousley

Thematic Poster Group #3: Collaborative Engagement

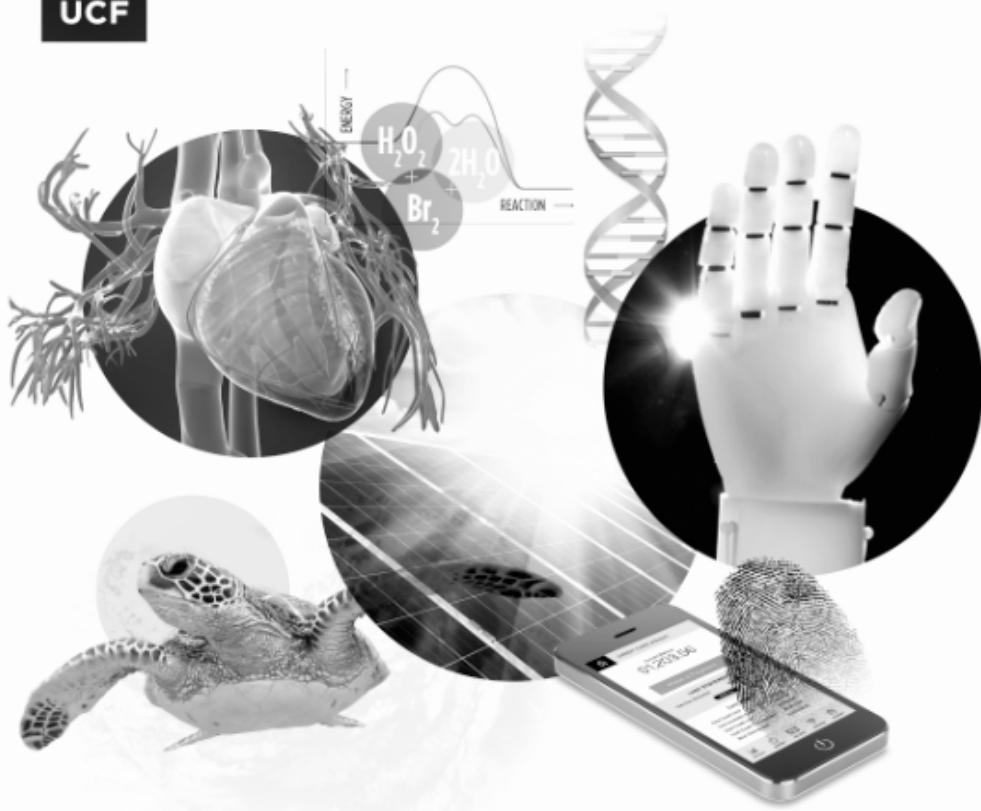
Poster 13 - Building Trust in a Distributed Federal Team: Outperforming the Classical Team Norms

Authors: Aras Eftekhari

Poster 14 - Project Aquilá: A community engaged

transdisciplinary process to study culture in transnational communities in Massachusetts

Authors: Linda Sprague Martinez, Rosalyn Negron, Cristina Araujo Brinkerhoff, & Eduardo Siqueira



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Detailed Guide to the Conference

Poster 15 - Negotiating Boundaries: Effective Leadership of Interdisciplinary Environmental and Sustainability Programs

Authors: David Gosselin, Deana Pennington, & Shirley Vincent

Poster 16 - Using a Pilot Grant Program and Teamwork Training to Improve the Knowledge and Skills of Science Teams

Authors: Patrick Barlow, Joseph Zabner, Georgeanna

Robinson, Beth Knudson, Gary Rosenthal, & Greg Stewart

Poster 17 - M&S, Mental Models and Collaborative Thinking

Authors: Judith Tavel

Poster 18 - Enhancing Team Composition in Professional Networks: Problem Definitions and Fast Solutions

Authors: Liangyue Li, Hanghang Tong, Nan Cao, Kate Enrlich, Yu-Ru Lin, & Norbou Buchler

Thematic Poster Group #4: Training, Education, and Professional Development in Team Science

Poster 19 - Preparing for a PhD: A Transactivity Approach

Authors: Anthony Hood, Crystal Allman, Zakiyyah Kennedy, & Alicja Foksinska

Poster 20 - Assessment of Professional Social Capital of Doctoral Students: Testing a New Framework of STI Evaluation

Authors: Olena Leonchuk

Poster 21 - Becoming a cross-disciplinary professional

Authors: Robin Adams & Richard Aleong

Poster 22 - Establishing a Professional Community of Practice & Research for Interdisciplinary Science Specialists

Authors: Christine Hendren, Holly J. Falk-Krzesinski, Gabriele Bammer, & Sharon Ku

Poster 23 - Including graduate students in interdisciplinary research

Authors: Jeni Cross & Hannah Love

Poster 24 - The study of multifunctional landscapes in Mexico: a transdisciplinary experience in education of team Science

Authors: Margarita Paras, Silvana Levi, Evangelina Bidegain, Claudia Hernandez, Edurne Bague, Jessica Arellano, Martin Dominguez, & Jessica Contreras

Poster 25 - Insights into Computer Science Academic Careers

Authors: Dinesh Majeti, Salah Taamneh, Muhsin Ugur, Ashik Khatri, & Ioannis Pavlidis

Poster 26 - Developing and Implementing a Contextualized Leadership Training Program for Team Science

Authors: Kevin Wooten, Allan Brasier, Barlon Sukol, Eugene Frazier, Faith Robin, Mark Hellmich, & Lori Wiseman

Poster 27 - Development of an Assessment Center for Team Science Leaders

Authors: Kevin Wooten, Allan Brasier, Marlon Sukol, Eugene Frazier, Faith Robin, Mark Hellmich, & Lori Wiseman

Poster 28 - Community Engagement Model: Diverse Teams Collaborate to Develop a New STEM-C Curriculum in Restoration Science

Authors: Erica Watson-Currie, Michelle Molina, & Lauren Birney

Poster 29 - Transdisciplinary Collaboration for STEM-C Education and Environmental Restoration – The Curriculum + Community Enterprise for Restoration Science (CCERS)

Authors: Michelle Molina, Erica Watson-Currie, & Lauren Birney



¹ Bordone, M., Aparicio, J., & Costas, R. (2012). Heterogeneity of collaboration and its relationship with research impact in a biomedical field. *Scientometrics*, 96(2), 443–466. doi:10.1007/s11192-012-0890-7

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Thematic Poster Group #5: Team Science to Address Health and Improve Healthcare

Poster 30 - Teaming-Up for Patient Safety: A Case Study of Social Interactions Among Team Members

Authors: Michelle Leak

Poster 31 - The Academic Cartography of Sugar Sweetened Beverages: Interdisciplinarity in Research Between Scientific and Legal Fields

Authors: Lexi White

Poster 32 - Ideal Hospital Discharge Process: A Systematic Review

Authors: Fares Alahdab, Shalak Gunjal, Zhen Wang, Jehad Almasri, Lindsey Lehman, Larry Prokop, & M. Hassan Murad

Poster 33 - Data Analysis of Smoking Trends in New York

Authors: Shilpa Balan, Joseph Otto, & Pooja Sarang

Poster 34 - Identifying Successful Inter-Team Communication between the Frozen Section Laboratory and Breast Surgery Team

Authors: Heidi McLeod, Katherine Carroll, Jessica Mesman, Gary Keeney, & Judy C. Boughey

Poster 35 - Systematic evaluation of radiologist performance with reduced dose computed tomography protocols

Authors: Rickey E. Carter, David R. Iii Holmes, Adam C. Bartley, Phillip K. Edwards, Ronald A. Karwoski, Amy K. Hara, Jeff L. Fidler, David Delone, David Levin, Gregory J. Michalak, Tammy A. Drees, Lifeng Yu, Shuai Leng, Cynthia H. McCollough, & Joel G. Fletcher

Poster 36 - The Effects of Organizational Commitment and Employee Empowerment on Patient Safety Culture Using Physician Cohort

Authors: Sujin Horwitz & Irwin Horwitz

Poster 37 - Using Team Science to Demonstrate the Value of a Unique Clinical Practice in Breast Surgery

Authors: Elizabeth Habermann, Gary Keeney, & Judy Boughey

Detailed Guide to the Conference

Thematic Poster Group #6: Innovative Approaches to Team Science

Poster 38 - Team Writing and Institutional Science Documents

Authors: Sara Parks

Poster 39 - Addressing Interdisciplinary Challenges with Emotional Intelligence and Leadership

Authors: Margaret Hinrichs, Thomas Seager, Sarah Tracy, & Mark Hannah

Poster 40 - A Natural Language Processing Approach to Content Analysis of CSR Survey Responses

Authors: Charles Dumais, Mary Ann Guadagno, Calvin Johnson, & Dan Russ

Poster 41 - Closing the Gap between the Rhetoric and Practice: An Analysis of Interdisciplinary Team Science

11:15 - 12:00 pm

Closing Session: Future Directions Panel

Regency Ballroom AB

12:00 pm

Adjourn



Submitted Abstracts

Reviewer Acknowledgement

We would like to extend special thanks to our abstract reviewers:

Gabriele Bammer

Theresa Lant

Christian Pohl

Michelle Bennett

Scott Leischow

Maritza Salazar

Heather Billings

Wayne Lutters

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George Mensah

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Kara Hall

Janet Okamoto

Stefan Wuchty

Grace Huang

Michael O'Rourke

Julie Thompson Klein

Deana Pennington

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Abstracts

Tuesday, May 17, 2016

Thematic Session 1

Panel: New Strategies to Enhance Translational Research Team Performance

2:00-3:30 pm

Authors: Cathleen T. Kane, Cornell University CTSC; Damayanthi (Dayan) Ranwala, South Carolina Clinical & Translational Research Institute (SCTR), Medical University of South Carolina; Karen B. Demby, North Carolina Translational and Clinical Sciences Institute (NC TraCS), UNC School of Medicine, University of North Carolina at Chapel Hill; Beth B. Tigges, University of New Mexico Clinical and Translational Science Center (UNM CTSC) and University of New Mexico College of Nursing; Kevin C. Wooten, University of Houston Clear Lake and Institute for Translational Sciences (ITS); Allan R. Brasier, Institute for Translational Sciences (ITS).

The objective of this panel is to hold a facilitated discussion beginning broadly with an overview of the Clinical Translational Science Award (CTSA) program and its emphasis on team approaches to complex problems spanning research and health systems. We will then describe the work of the national CTSA Team Science Affinity Workgroup and the Multi-CTSA Team Science Training Intervention Pilot Study. Our conversation will conclude by examining a wider view of promising trends in the formal and informal dissemination of new strategies to enhance translational research team performance, including various examples from the NIH and CTSA national leadership as well as our work within our respective centers.

The panelists are all members of the the Multi-CTSA Team Science Training Intervention Pilot Study. This collaboration arose from a national CTSA Team Science Affinity Workgroup composed of team science facilitators, educators, evaluators and implementation experts at seven participating CTSA-funded institutions: the University of Texas Medical Branch at Galveston, Medical University of South Carolina, Northwestern University, University of New Mexico, University of North Carolina, Virginia Commonwealth University and Weill Cornell Medical.

Part I: Panelists discuss translational teams, the CTSA program, and the Multi-CTSA Team Science Training Intervention Pilot Study with a special focus on the evaluation/data.

- Overview: We will describe features of translational teams, challenges of their implementation in academic settings, and examples of strategies used by CTSAs at UTMB, UNC-Chapel Hill, and Cornell to support team science.
- Focus: We will discuss the emphasis on defining team science competencies in making translational research a more formal and rigorous discipline.
- Impact & Area of Inquiry: We will overview some work showing how training improves outcomes of research teams, and unresolved questions in training for translational team science.

Abstracts

- Our Pilot –Objectives: Figure 1 below illustrates the design of the training intervention, which included a pre and post-test, two online team science educational modules (www.TeamScience.net), and two face-to-face sessions involving experiential exercises about collaboration and communication, as well as team diagnosis, needs assessment, and action planning.

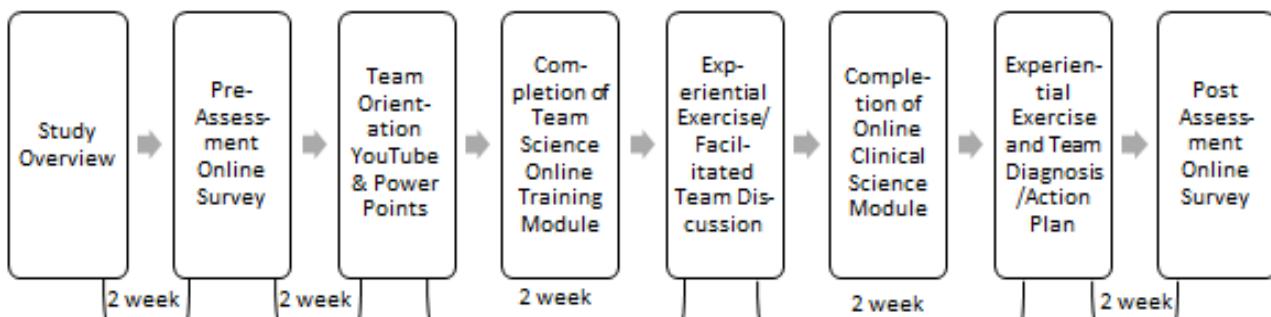


Figure 1: Overview of the Team Science Training Intervention Pilot Study

Part II: The panelists share their experiences of facilitating this training with new teams.

- Overview: We describe the various features of our respective translational teams.
- Focus: We discuss both the form (our technique) and the content (the various competencies included in the modules/pilot process).
- Impact & Area of Inquiry: We discuss how the teams reported initial improvements as a result of the training; as well as any unresolved questions resulting from the process of providing these teams with this training.
- Our Pilot –Objectives: We will share the various “Top Five” objectives each team defined (via the structured nominal group technique) defining their specific goals for improving their own collaborative competencies.

Part III: Panelists will discuss of some of the national trends supporting team science, beginning with an overview of ways in which NIH and CTSA national leadership have recently responded to the changing nature of teams. The group will give examples of current formal and informal dissemination of team science “best practices” evident throughout our various networks both locally and nationally, including but not exclusive to:

- An overview of the current goals of the Collaboration/Engagement Domain Task Force (CEDTF) Workgroup: re “Developing Measures for Assessing and Improving Collaborations”.
- The growing consensus that the CTSA should implement common metrics around collaboration and institutional support of team science.
- Various ways in which our own university and academic cultures can adapt to the changing nature of teams and the growing field of team science.
- Our own collaboration with the CTSA Team Science Affinity Workgroup.

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Thematic Session 2

Institutional Support and Recognition for Team Science

2:00-3:30 pm

Paper 1: Incenting & Rewarding Team Science in the Appointment & Promotion Process at Mayo Clinic

Authors: Timothy Beebe

Impactful science requires the bringing together of experts from diverse training and experiences to focus on a single research endeavor. However, there exist many barriers for individuals to engage in team science, including the fact that many appointment, promotion, and tenure committees only reward individual achievement by focusing on lead or senior authorship and principal investigator status on extramural grants. In order to incent research faculty to engage in team science and reward them for doing so, mechanisms to acknowledge the efforts of the individual within the context of a team must be woven into the faculty advancement process. This presentation will describe how the Mayo Clinic Research Personnel Subcommittee – Mayo's appointment and promotion committee for research staff – developed metrics for incenting and rewarding team science. How the new metrics were deployed and have been received since their introduction in 2015 will also be discussed.

Paper 2: Ensuring Institutional Recognition of Interdisciplinary Team-Based Research

Authors: Kathryn Plaisance & Robert Gorbet

The work of team science often involves collaboration in multi-disciplinary teams, with increasing levels of integration of research objectives and methodologies that differ across those disciplines. Faculty seeking to engage in and contribute to team-based research therefore often face many of the same challenges faced by interdisciplinary researchers, even if they may not themselves consider their work interdisciplinary. They may face implicit barriers from within their

discipline, from the academic institution, and less frequently from the other disciplines with which they collaborate. Examples of these barriers include variations in disciplinary norms for publication (journal vs. conference papers, order of authorship, importance of abstracts, etc.), a reward structure that privileges traditional dissemination over public communication of science, and a lack of training as to how to collaborate effectively with others. In this talk we will present the lessons we've learned and the tools we've created for addressing institutional barriers to the appropriate evaluation of interdisciplinary research, particularly as it pertains to pre-tenure faculty.

Our experience comes from the Department of Knowledge Integration (KI), which is housed in the Faculty of Environment at the University of Waterloo. The department includes two engineers, a philosopher of science, a sociologist, and a climate change researcher, and offers an interdisciplinary degree to undergraduate students. KI takes a novel approach to interdisciplinary faculty hiring in that appointments are held within a single interdisciplinary department, with each faculty member being cross appointed to one or more traditional departments that are most relevant to their area(s) of research. These cross appointments allow faculty "access" to the departments that align best with their disciplinary background, providing opportunities to teach graduate courses, supervise graduate students, and interact with their disciplinary peers, but without conferring any obligations to those departments. In the process of setting up this structure, we have had to create departmental guidelines and policies for evaluating our faculty members' research. This has posed some interesting challenges given that most of our faculty members have diverse sets of research programs, some of which are in line with the norms of the departments to which they're

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cross appointed while others cross disciplinary boundaries where the research norms can be quite different. We think this model will be of interest to many scholars working in the Science of Team Science. Even though many researchers engaged in team-based science may be housed in a unit aligned with their disciplinary home and collaborating with others from outside that unit, they may still face the barriers described above because of the interdisciplinary nature of their collaborative research. We believe the lessons learned from the KI context are valuable, and that the tools we've developed may provide a relevant template for appropriate evaluation and recognition of others' collaborative work.

In this talk, we will outline the benefits that the KI model has for interdisciplinary research, as well as the challenges it creates within a traditional system of merit assessment, reappointment, tenure, and promotion. We will describe our circumstances and the mechanisms we've put in place to ensure the protection of pre-tenure faculty engaging in interdisciplinary research. We will explain the benefits of our solution to those doing collaborative cross-disciplinary research from within more traditional academic units, as well as for those with formal cross- or joint-appointments to explicitly interdisciplinary units (another common structural model for interdisciplinarity within academia). We hope this will lead to an open comparative discussion among attendees, identifying the need for such mechanisms even in more traditional appointments. We hope through this discussion to begin to create a set of best practices for participants in team-based science, recognizing the barriers that exist at various levels and encouraging participation and success in these important endeavors.

Paper 3: Inspiring Teams in Computational Science

Authors: Sawsan Khuri, Stefan Wuchty, & Nicholas Tsinoremas

The starting point of computational science is data. Big or small, data needs handling, management,

storage and analysis so that it can be interpreted. These computational skills are increasingly in the hands of researchers other than those who created, and will eventually interpret, the data. The process is usually iterative, with interpretation feeding ideas for new experiments that generate new data, and so on. This makes team work and team science the norm in the computational sciences, with computationally skilled researchers working at every interface of the physical, life and social sciences, and increasingly in the humanities, communication and artistic communities. In the context of academic research, this means that research disciplines, who had previously not worked together before, are now coming together on projects that push disciplinary boundaries and encourage innovation.

Many institutions are providing centralized cores that house computational power. Over the last nine years, the Center for Computational Science (CCS) at the University of Miami (UM) has been providing service and training, and getting involved with research across all disciplines at UM. We built a large cyberinfrastructure, installed data management, data mining, software engineering, and visualization expertise, and organized our research programs into broad theme areas, such as Climate and Environmental Hazards, Drug Discovery, and Smart Cities. Our initiatives and collaborations over the years have allowed us to observe several key team science phenomena, and have given us new insights into today's evolving academic structures.

- First, we see examples of all stages of the team science collaboration continuum (per Bennett and Gadlin, 2012), with uni-disciplinary researchers, multi- and inter- disciplinary collaborations, and two teams who are approaching trans-disciplinarity, where computational skills have become intrinsic to the experimental approaches taken in these traditionally non-computational groups.
- Second, we note that the different cultures within academia dictate the way with which we engage

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- these communities, in terms of due regard to publication practices, experimental procedures, and the student body of each discipline.
- Finally, we experience the need for psychological safety, motivating leadership, and coordination, all of which are known components of team success.

Based on these observations, we propose several parameters with which we can predict the success of a computational science collaboration, regardless of the precise disciplines that make up the team. We hope our conclusions are useful in other cross-disciplinary ventures.

Paper 4: Is Everything Awesome When You're Part of a Team?

Authors: Kevin Kniffin & Andrew Hanks

Objective: Building upon prior studies that have focused on the differential impact of team-produced publications and patents, we will analyze individual-level outcome variables such as salary, job satisfaction, and hours worked to assess whether – and to what degree – the individuals who participate in teamwork in the STEM fields are rewarded by the respective employment sector

Methods: With data collected through the National Science Foundation's (NSF) Survey of Doctorate Recipients (SDR) as well as the Survey of Earned Doctorates (SED), we focus on responses to a set of teamwork-related questions that were uniquely posed in the 2006 SDR and examine (1) the relevance of background traits such as academic discipline and demographic variables as well as (2) the question of

whether or not teamwork is broadly rewarded across STEM labor markets. With the benefit of matched responses to the 2006, 2008, 2010, and 2013 waves of the SDR, we investigate the degree to which participation in teamwork leads to compounding effects – either positive or negative – over time.

Summary of Findings: While there exists important variation across disciplines, our initial findings indicate that approximately 40% of all scientists and engineers sampled in the 2006 SDR reported working as part of a team and on average their incomes were \$22,700 greater than those who were not part of a team. While teamwork has not been measured in the SDR since 2006, our analysis of matched-responses to subsequent waves of the SDR shows that average salary growth from 2006 to 2013 is greater, at just over 7%, for those who declared teamwork in 2006 when compared with the average salary growth rate of 3.3% for those who said they were not involved in teamwork. In addition to earning significantly higher salaries, we also find that people who were part of teams worked significantly more hours per week on average than the rest of the sample (47.1 vs. 42.7). In contrast with the significant patterns involving salary and hours-worked, we find no direct relationship between teamwork and job satisfaction among the 2006 SDR respondents.

How the Research Advances the SciTS field: Our findings focus attention on the only set of team-related questions that has, to date, been posed through the SDR regarding teamwork among STEM professionals and contributes to a deeper understanding of the relevant labor markets and labor market outcomes.

Thematic Session 3

Biotech Teams for Translational Research and Development

2:00-3:30 pm

Paper 1: Research Obstacles and Problem Solving in Scientific R&D Teams

Authors: David J. McBee

Scientific teams allow for the integration of individuals' expertise into a coherent effort, benefitting from depth and breadth of knowledge - a winning combination for

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creativity and novelty, two cornerstones of innovation. However, a lot can go wrong between a good idea and its ultimate reception! As a complement to research that focuses on team-based creativity and innovation, this paper focuses on how scientific teams deal with research obstacles – challenges that must be overcome in order to fulfill research aims. In doing so, I argue that team-based problem-solving is an important, but understudied, social process that is fundamental to scientific innovation. This paper seeks to inform academics, managers, funding agencies, and science policy experts by providing them with a greater understanding of the social processes underlying team-based problem-solving and how the weight of serious research obstacles can break them down.

To better understand how scientific teams engage in team-based problem-solving, I interview all core scientists, project leaders, and several research executives of "BioSimm", a small pharmaceutical company in the Greater Boston area. I draw primarily ideas from recent studies on interdisciplinary research and Organizational Learning to analyze these in-depth interviews. As expected, teams engage in a modified version of 'disciplinary sovereignty' where problem-characteristics are matched to the expertise of individual scientists within the project team, e.g. it is understood that the team's chemist will deal with research obstacles associated with chemistry. However, the fundamental nature of some research obstacles are difficult for anyone to understand and – by extension – fit to the expertise or disciplinary background of any scientist within the team. Project leaders and core scientists describe how they deal with such uncertainty. As expected, the scientists I spoke with described the problem-solving process primarily as a knowledge-seeking/ knowledge-integration (KSKI) process. Not only do scientists reach out to other scientists for advice, but they bring this advice back to their team and integrate what they learned into a common understanding of what the issue is. Contrary to my expectations, the bulk of KSKI activity occurs within their organization. Legal realities pose serious barriers to spontaneous interorganizational communication –

but there are exceptions. With a nod to Harry Collin's work on tacit knowledge, expertise, and experience; I find that scientists deal with atypical research obstacles by mapping research obstacles' scopes to the experiences – not necessarily the expertise – of more senior (executive) scientists.

Paper 2: Open Innovation and Collaborative Models for Translation into Practice through Multidisciplinary Team-Based Science at the Mayo Clinic

Authors: Thomas Chung, Andrew Bradley, & Jeff Anderson

With costs (> \$1B per new chemical entity (NCE)) and duration (10-15Y) of traditional R&D as practiced, disease advocacy groups, government and investment communities are looking for new innovative business models for drug discovery and development, in particular the participation the best of academia to catalyze new innovation and translational research. The Office of Translation to Practice (OTP) is a relatively new unit in the Mayo Clinic house within the Center for Clinical and Translational Sciences whose mission is "To facilitate and accelerate the translation of novel products into clinical practice by enabling bidirectional interactions between strategic academic and industry collaborators and Mayo Clinic researchers". We have created key resources and operationalized best practices to enhance team-based science amongst internal and external collaborators, toward the goal of translating innovative biomedical research onto a product development path, and into clinical practice. We have established new models of "open innovation" in academic drug discovery and development that leverages the multidisciplinary and multi-domain expertise of our strategic collaborators through virtual teams. In this talk we will describe our capabilities, operational models and current successes. Additionally, we will describe how these successes have informed our strategy for future collaborations.

Paper 3: Working at the Bioinformatics Crossroads - A Management Perspective on Interdisciplinarity

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Authors: Andrew Ritchenson

Today's biomedical research challenges are rarely met by a solution owner from a single discipline, or are the privileged domain of a lone subject matter expert. In few places is this more the case than in bioinformatics. Bioinformatics is located at a crossroads where biomedical research, data science and information technology combine to advance the understanding of disease prevention and cure.

Like any crossroads, there is complexity to be managed. This complexity increases with each new disciplinary intersection, offering an ever-expanding range of risk, opportunity, and reward. This crossroads challenges conventional management models, and causes us to evolve new collaborative approaches, and in particular those that are interdisciplinary. Better understanding the relationship of interdisciplinarity to management - both conceptually and practically - in supporting bioinformatics initiatives benefits all levels and phases of the biomedical research lifecycle.

Public sector biomedical research organizations, which annually account for more than 1/3 of U.S. biomedical R&D, are expected to be more productive with fewer resources, while demonstrating accelerating innovation and return on investment. This places a premium on management approaches that not only deliver reliable task execution, but that also efficiently facilitate technological and disciplinary juxtaposition, collaboration, development of novel approaches and solutions, and ensure that the precious resources and funds available to biomedical research efforts are spent to best effect.

Operational realities complicate and even hinder bioinformatics initiatives such as emergent and rapidly changing requirements and goals; iterative and discovery-based processes; vast and disparate stakeholder arrays; an absence of basic project management practices addressing the triple constraints of time, cost, and scope; SME over-focus resulting in getting less done with more (additive-effect), rather than more done with less (multiplying-effect); and

persistence in management and execution models that rely on rigid processes, and the assumption of known deliverables and milestones. A new approach is needed, and interdisciplinary management offers an important and timely alternative that is fully complementary and supportive of overarching and key objectives like open technology, data standards and sharing, interoperability, and team science.

Interdisciplinarity as a management approach encourages links between disciplines in a coordinated and coherent whole and is an important alternative to traditional, top-down, hierarchical approaches. However, interdisciplinarity within a team context cannot simply be willed into existence, or used to rename existing modalities – it has to be done, and it has to be practiced. Success is a result of active factors like training, maintenance, communication, and development, and there must be both leadership and buy-in for it to deliver successful and lasting value.

Our assessment at the bioinformatics crossroads reveals a complex and emergent field that is constantly changing, and rich with challenge and opportunity. Bioinformatics is by definition an interdisciplinary-discipline and arranging our efforts in this way is in keeping with the requirements of our environment. We find that managing complexity and delivering value and innovation in this space requires shifting away from less dynamic, specialty-driven, vertical structures, and that investing in interdisciplinarity pays out to all parties and across an extended timeline. Critically, interdisciplinarity is not a destination; it is an approach and the oxygen that fuels the team-based SciTS field.

Interdisciplinary management supports how our teams organize, communicate, contribute to research and collaborate to achieve scientific breakthroughs that would not be attainable by individual efforts and is an important target for ongoing, methodical, and experiential study, adaptation, and optimization.

Paper 4: An Ethnography of Team Science

Authors: Anna Jabloner & Sandra Lee

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This presentation describes the use of ethnographic methods to study the culture of team science through a case study of a year long interdisciplinary training program at Stanford University, aimed at innovating medical technologies. The fellowship program brings together teams of four with backgrounds in clinical medicine, bioengineering and business and ushers them through a process to collaboratively innovate concepts based on solutions for clinical needs. Through ethnographic methods such as long-term observations of team activities, repeat semi-structured and unstructured interviews, and ad-hoc participation in team social events and activities, we elucidate the

broader social processes that impact and play roles in team dynamics. For instance, we describe diverging disciplinary educational cultures and their respective customs and expectations, socio-economic and cultural pressures and challenges, career trajectories and biographical junctures and contexts, as well as interpersonal conflicts in their relation to fellows' socio-economic and disciplinary contexts and team dynamics. By triangulating data from observations, interviews, participant-observation, and the content analysis of program materials, we also identify institutional arrangements that enhance and impede team science within the university.

Thematic Session 1

Communication in Team Science

3:45-5:15 pm

Paper 1: Enabling Innovation Across Fields - Facilitating Dialogue and Collaboration with STEAM Researchers

Authors: Stephanie Vasko

The STEAM (science, technology, engineering, and mathematics (STEM)+ "art") movement is gaining significant traction.¹ While there has been confusion and argument about the best acronym to represent this concept, for purposes of inclusivity and breadth, I will operate from a definition that expands the ambiguous "A" in STEAM to include art, craft, and design (ACD) identities at personal and professional levels and I will note this as ACD/STEM.² Proponents of STEAM invoke innovation as a selling point; we are beginning to see STEAM events, collaborations, and research centers that focus on enhancing innovation in research and industry.³ John Maeda, former VP of the Rhode Island School of Design and noted STEAM proponent, offered the following thoughts on the matter: "So what does it mean to add Art to turn STEM to STEAM? The problem solving, fearlessness, and critical thinking and making skills that I see every day across campus at the Rhode Island School of Design are the same skills that will keep our country innovating."⁴ Recognizing the value of the skill sets that the arts can bring to STEM research

is the first step on the path to innovation.

The next step involves putting ACD and STEM researchers in dialogue to find similarities, through core concepts such as values and methodologies, which they can leverage for collaborative innovation strategies. In this talk, I argue that philosophically-based Toolbox Project⁵ could be used to enhance collaborations between STEM and ACD researchers by offering tailored modules, dialogue prompts, and co-creation activities to structure discussions which uncover similarities and starting points for collaborations. While there have been previous efforts aimed at dialogue between these communities,⁶ I posit that the Toolbox Project offers a more flexible and tailored approach to meeting practitioners where they are at, allowing them to interact as researchers and as people to form common ground, to express views and methods of practice, and to develop collaborative solutions to research questions.

I will look toward future directions and strategies for Toolbox approaches to aiding ACD/STEM collaborations. I will also identify potential future clients and present example dialogue prompts and workshop

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structures for ACD/STEM collaborative teams. Recent discussions of improvements to the Toolbox Project include attention to issues of intersectionality and feminist epistemology, as well as of prompts focused on identity development with respect to ACD and STEM.⁷ This will allow us to investigate if identity and presuppositions about disciplines influence values and ultimately disrupt innovation. Working with ACD/STEM collaborations will also allow the Toolbox Project to continue work on examining the differences the values of researchers as compared to their academic branch⁸ and to begin work comparing the differences between of values of participants as compared to how they self-identify.⁷ Finally, we aim to use ACD/STEM collaborations to build on Bell et al.'s 2011 finding that "functional background variety diversity had a small positive relationship with general team performance as well as with team creativity and innovation"⁹ through analyzing quantitative (Likert scale) and qualitative (dialogue transcripts and interviews) data.

Paper 2: Micro-Integration in Dialogue - How Communication Drives Interdisciplinary Integration

Authors: Stephen Crowley, Chad Gonnerman, Michael O'Rourke, & Brian Robinson

As interest in collaborative, interdisciplinary research responses to complex problems grows, so does interest in the phenomenon of integration. "Integration," Julie Klein tells us, "is widely regarded as the primary methodology of interdisciplinarity" [1], a fact that makes it a critical part of addressing grand challenges that confront human societies, such as those related to health and the environment [2]. Research on integration has also blossomed in the interdisciplinary life sciences, including neuroscience [3] and systems biology [4]. Integrative processes operate at multiple levels, from the global combination of domains (e.g., biology and chemistry), disciplines, and fields, to the more local combination of explanations, data, and methods [5]. But even at the most local levels, the mechanisms of interdisciplinary integration are not often described in detail. For instance, how is it that

science teams effectively integrate the methods they use to address their common problem?

In this presentation, we discuss integrative mechanisms in the context of interdisciplinary team science. We describe dialogue as one important integrative mechanism for integrating scientific inputs in a collaborative context. This is not a surprising answer; indeed, one might understand communication (taken in its etymological sense as involving sharing or making common) as essentially integrative in character, bringing people together in the service of the co-construction of meaning [6]. Although not surprising, the answer has not been developed in detail in the literature. We develop this answer in two ways: (a) we apply an analytical framework designed to supply a systematic way of thinking about integration to our examination of dialogue [7], and (b) we identify, discuss, and systematize a number of specific integrative modalities in actual dialogical exchanges among scientists.

We use transcript data from the Toolbox Project as our focus [8]. Toolbox transcripts record dialogue exchanges among collaborating scientists from a range of disciplines who are seeking to identify, share, and understand differences in their attitudes about science and scientific practice. We analyze the data contained in six coded Toolbox transcripts using our framework, which highlights the role of "integrative relations", or relations that correspond to the type of integration involved in a particular case. Focusing on integrative moments in the transcripts – what we call "micro-integrations", or exchanges that combine or bring something specific together – we identify the specific integrative relations involved. These include relations such as sequential integration, reconciliation, and subsumption. The identified integrative relations are illustrated, explained, and systematically organized into a taxonomy.

This research advances team science by supplying a better understanding of dialogue as an integrative mechanism. We focus on interdisciplinary science, but

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the integrative relations we identify are found in other contexts where teams must function in a coordinated way. In addition to the theory of the science of team science, a principled understanding of these relations also informs interventions (e.g., the Toolbox approach) designed to enhance the effectiveness of team science.

Paper 3: Facilitating Collective Decision-Making in Climate Resiliency Planning

Authors: Michael O'Rourke, Bryan Cwik, Chad Gonnerman, & Brian Robinson

We describe the development and implementation of a complex, participatory action research approach to climate resiliency planning at the region scale. We also present preliminary results from the implementation at the West Michigan Climate Resiliency Conference in Grand Rapids, MI, in October 2014 [1].

In April 2013, Grand Rapids, MI experienced a record flood, resulting in widespread damage. Combined with the prospect of additional severe weather events due to climate change, this flood convinced leaders in Grand Rapids and the surrounding region that climate change could negatively affect West Michigan's economic and social viability. To respond to this prospect, these leaders initiated a climate resiliency planning process involving many key stakeholder communities, including energy, food and farming, the built environment, and government.

First, though, the leaders needed to develop a common conceptual framework that could enable the region to produce a climate resiliency plan that is accessible, inclusive, resilient, and measurable. A common conceptual framework is a way of thinking about the problem (climate change) that helps filter information, focus attention, and structure decision-making that reflects consensus priorities and values. The group chose to pursue this framework in five stages: (a) share information about the problem widely; (b) gather perspectives on the problem from as many stakeholder groups as possible (inclusive), (c) bring people together to discuss the range of views in a way that is respectful

and builds camaraderie (accessible); (d) assess the quality of the dialogue and the resulting planning process (measurable); and (e) revisit the dialogue as priorities and circumstances change (resilient).

Our partner – the West Michigan Sustainable Business Forum – completed stage (a) by hosting a series of 10 informational pre-meetings. These were designed to convey customized information about the potential impacts of climate change to nine different industry sectors, plus municipal and community stakeholders. We assisted with stages (b), (c), and (d) by developing and implementing a complex, participatory action research approach to climate resiliency planning at the region scale.

1. We completed stage (b) by producing a values-informed mental model of a key informant from each sector. After constructing a touchstone "expert" mental model of the socioeconomic effects of climate change, we interviewed representatives of the various industry sectors and used their interviews to construct mental models of how they thought about vulnerabilities and ways of adapting to climate change [2]. These models paid special attention to how ethical and epistemic values and priorities informed thinking about climate change.

2. We used the models as an input to the Toolbox process, a dialogue method designed to enhance communication and collaboration involving people with different worldviews [3]. Toolbox dialogue is one way to address stage (c), since the dialogue is structured to enable participants to articulate and share their views on climate impacts in West Michigan. Using the mental models from stage (b), we developed a Toolbox dialogue instrument and conducted 12 parallel dialogue sessions at the West Michigan Climate Resiliency Conference.

3. Post-workshop questionnaires of participants revealed that most believed the workshop stimulated new thoughts about climate resiliency and provided a better conception of other community members' views on climate resiliency. In addition, analysis of pre- and

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post-workshop responses to the instrument showed noticeable reductions in the number of participants responding "I don't know" as a result of the dialogue.

Paper 4: Testing Methods for the Co-Production of Target Knowledge in Transdisciplinary Teams

Authors: Tobais Buser & Silvia Tobias

Scholars seeking to address sustainability challenges have developed novel research approaches that are based on transdisciplinary co-production of knowledge between researchers and other societal actors. While their understandings of transdisciplinarity vary, all approaches aim at transcending existing boundaries between scientific disciplines and between science and practice in order to accommodate the complexity of current sustainability challenges. Transdisciplinary research is considered to be a particularly useful form of knowledge production in situations where solutions to complex, uncertain, and contested issues need to be found. Moreover, there is increasing agreement that in these situations science should not only produce systems knowledge, but also target knowledge, i.e. knowledge about what more sustainable situations are.

Transcending existing boundaries between science and practice requires approaches and methods, which enable the connection of researchers and other societal actors' perspectives. In recent years, a growing number of methods has been developed and made available (for example the td-net's toolbox <http://transdisciplinarity.scnat.ch/toolbox>). These methods have successfully been applied in many

transdisciplinary projects; however, they have rarely been tested in systematic ways.

Against this background, this paper will present a study, which systematically tested different methods for the production of target knowledge. The methods have been applied in the Swiss research program "Room for People and Nature", which aimed to develop scenarios of future landscape development combining scientific visualizations and regional actors' visions. In this process, we applied and tested the methods in four workshops.

In three workshops, we used different scientific or artistic methods to support the visioning process with real-time visualisation; in the fourth workshop the participants developed their visions without any visualisation support. In the evaluation we focussed on three main points: (1) Does real-time visualisation provide a common basis for communication? (2) Does it support the actors in developing target knowledge regarding future landscape conditions and (3) does real-time visualisation stimulate the development of new ideas?

The comparative analysis of survey data revealed that real-time visualization generally supports the different actors in creating target knowledge. In particular, visualization provided a better common basis for communication, but it only marginally inspired the actors to develop new ideas. The main trade-off we found was that the actors assessed the influence of visualisation on the discussion as too strong. It focused the discussion heavily on visual aspects.

Thematic Session 2

Team Science Training and Education

3:45-5:15 pm

Paper 1: Learning Interventions for Collaborative Team Science - Preparing Health and Biomedical Workers for Success in Collaborative Teaming through Reflective Sensemaking

Authors: Gaetano Lotrecchiano, Yianna Yovides, Trudy

Mallinson, Holly Falk-Krzesinski, Laurie Lyons Ma, Colleen Roche, & Jesse Pines

Problem. Collaboration is the cooperative effort between two or more entities striving towards a common goal. Optimizing team collaboration is key

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for healthcare and biomedical knowledge producing teams (KPTs) that strive to engage in cross-disciplinary knowledge building through bringing together diverse perspectives, and leverage collective resources. Solving complex problems requires a variety of intra- and interpersonal skills to achieve common goals. Variations in motivations and threats impede individuals' ability to collaborate and may diminish the ability of teams to successfully achieve their knowledge-producing objectives. The purpose of this study is to develop products to assess motivations and threats to collaboration for health, medical, and research workforces.

Method. The learning interventions generated for this study are part of a larger project developing and validating the Motivation Assessment for Team Readiness, Integration, and Collaboration (MATRICx) tool which to date has yielded a model, scoping review, and preliminary findings based on data collected from nearly 125 health and biomedical participants spanning the knowledge-producing workforce on multiple levels and across the sector. We translate these findings and psychometric analyses to design and pilot a series of high-impact educational interventions targeting key audiences within the health and biomedical sector, namely a) emergency medicine residents, b) emergency medicine stakeholders that are part of the national Urgent Matters Project through the GWU Office of Clinical Practice Innovation (OCPI), and c) graduate students studying for degrees in translational research and occupational therapy enrolled in HSci 6285: Collaboration and Team Science in Practice and Research. The learning interventions are designed with a strong focus on self-reflection. Reflection triggers one to correct erroneous interpretations resulting over time in a changed perspective which could influence future decisions and actions. We emphasize transformation as a key outcome of the learning process for adults who are charged with collaborative tasks; that through the process of making-sense of and reflecting-on one's own perspective about subject matter under study, changes to meaning structures can occur which could involve refinement or elaboration of existing

meaning schemes and/or creation of new schemes and perspectives. This process of sense-making can be thought of as the continual exploration, integration, and judgment of an emerging perspective much like a drafting process. The learning sequence of reflective sense-making begins with exploration followed by identification, further processing and integration, and judgment; it is an iterative cycle so that it can trigger meaningful connections through reflection thus enabling individuals to adjust their mindsets especially as it relates to collaboration. Polling of participants, narrative text composed by participants, and MATRICx results will be textually analysed using the REFLECT rubric (Reflective Sensemaking Model), and calculated through Rasch analysis. Descriptions of interventions and results of impact on learners will be presented as findings.

SciTS Advancement. Recent recommendations from academic communities, national governing bodies, and accreditation agencies have prioritized the need for data-informed interventions that will prepare a new generation of collaborative health and biomedical scientists and practitioners. There is a growing need for targeted training in this area. Our response is specific to health and biomedical scientists and practitioners, who are required to work collaboratively to increase clinical efficiency and effectiveness, tackle complex health and research problems, and exercise key interpersonal skills that ensure more integration across disciplines. We bridge professional need with empirical MATRICx findings. Outputs include knowledge about the usability of the MATRICx itself, the learning interventions, our informed understanding of the applicability of findings to learning, and learning theory.

Paper 2: Teaching Teamwork to Undergraduate Students - A Case Study in Applied Collaborative Pedagogy

Authors: Kathryn Plaisance, Georgia Lamarre, Akanksha Madan, & Shane Morganstein

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Day 2: Tuesday, May 17

In this talk, we report on a collaborative project between the Associate Chair of Knowledge Integration (KI) and three undergraduate students completing their Bachelor of Knowledge Integration (BKI) degree at the University of Waterloo. KI is an interdisciplinary program that trains students to collaborate across disciplines. In addition to giving students an opportunity to work on a variety of teams, KI teaches students the theories and best practices regarding how to collaborate effectively, and provides students with opportunities to reflect upon their experiences and improve their collaborative skills as a result. In conversations with other students on campus, and through their experiences in courses outside KI, many KI students have noticed a lack of such explicit training in teamwork outside KI – and an expression of frustration about this on the part of other students at the university. While professors and employers frequently expect undergraduate students or recent grads to have and utilize teamwork skills, there is little formal instruction on how to engage in collaborative efforts. Despite there being extensive research in team science addressing this knowledge gap, it seems that little of this research is applied to the undergraduate classroom, resulting in a disconnect between theory and practice at the undergraduate level. Our objective for this project was to close the gap between theory and practice by putting team science into action for students at the University of Waterloo outside of KI.

In Canada, incoming university students are required to apply to a specific program, and are typically discouraged from taking too many courses outside their area of specialization, resulting in university education that is highly siloed at the undergraduate level. We wished to address this problem by making connections between programs on campus and teaching students how to work in collaborative (and often interdisciplinary) teams. The aim of our project was threefold: 1) survey students and faculty at UW to determine what gaps existed around team science education; 2) provide practical information and opportunities for students to develop teamwork skills; and 3) disseminate research and relevant knowledge

relating to collaboration to students. Notably, our project itself is the result of a collaborative effort between students and a faculty member at UW.

We designed and delivered an interactive workshop series called “UW Collaborates”, with workshops on group communication, group conflict, and leveraging diversity in teams. We offered these workshops to undergraduate students across different faculties to encourage skill development and promote an interdisciplinary culture on campus. We gathered empirical data through surveys before the workshop series to test our hypotheses regarding the attitudes and concerns of students towards collaborative practices in the classroom, as well as after the workshop to determine the impact of the workshops and interest in further learning opportunities. We also offered an abridged workshop for instructors regarding teaching collaborative skills and supporting teamwork in undergraduate courses. These workshops not only allowed us to directly address the knowledge gap, but also acted as a pilot project to determine the potential impact of an undergraduate, cross-faculty course focused on team science theory and skills.

Preliminary findings suggest that students do not feel prepared to engage in effective teamwork and instructors lack the tools to effectively teach or support the learning of collaborative skills. The data indicate that our workshop series had a positive impact on the students’ attitudes and competencies, and the high level of interest in the workshops themselves seems indicative of a campus-wide interest in collaborative skills training. In this talk, we will describe our project and its impact, suggesting some general ways that research in team science might be better disseminated as part of an undergraduate university education.

Paper 3: A Model for Team-Based Interdisciplinary Doctoral Education

Authors: Nilsa Bosque-Perez, Jo Ellen Force, Lisette Waits, Sanford Eigenbrode, JD Wulffhorst, Kate Cleary, Joseph Holbrook, Sara Galbraith, Amanda Bentley Brymer, Zion Klos, Paul Rhoades, Michael O'Rourke, Bryan Finegan, & Nicole Sibelet

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Interdisciplinarity is critical for addressing the complex problems society faces. There is an urgent need to educate early-career scientists in interdisciplinary team-based research. Effective interdisciplinary research teams comprise individuals with the disciplinary depth needed to understand the specialized components of complex systems, the interdisciplinary breadth required to communicate and integrate effectively across disciplinary boundaries, and the ability and commitment to work with stakeholders to address problem-based research questions. We present a model for educating doctoral students for careers involving interdisciplinary, team-based research to address problem-based questions. The educational model involves: 1) identification of integrated research questions combining team members' disciplines; 2)

course work to review the theoretical underpinnings of interdisciplinarity and develop integrated research proposals to address the questions; 3) meetings and workshops to enhance team cohesiveness; 4) engagement with stakeholders; and 5) interdisciplinary team research that yields joint dissertation chapters and publications. The educational model is theoretically-based and evaluated in light of the literature, faculty perspectives, and an assessment by students of educational successes and challenges they experienced. The model achieved a high level of integration among students. This model addresses the widely acknowledged need to impart interdisciplinary team research and problem-solving skills as part of graduate education.

Thematic Session 3

New Approaches to Stimulate Innovation

3:45-5:15 pm

Paper 1: Increasing the Performance of Interdisciplinary Research Teams

Authors: Hannah & Jennifer Cross

How do we best transfer knowledge in interdisciplinary research teams? How do we facilitate the creation of new knowledge in interdisciplinary research teams? Colorado State University (CSU) has developed a program called the Catalyst for Innovative Partnerships Program (CIP). As part of this program, CSU has invested money and resources to fund seven interdisciplinary research teams. Teams have focused their research on topics ranging from polymers to urban Eco-districts. We are currently one-year into a two-year longitudinal study to answer more specifically: how do network structures and membership impact innovation and scientific discovery? How do interdisciplinary scientific teams develop into successful collaborative groups? What is the ideal network structure of personal and professional relationships?

Current research on inter-disciplinary teams has

found that the structure of social connections (social network analysis) as well as personal relationships (like being friends or trusting others) has an impact on both communication (knowledge transfer) and the ability of teams to create innovative solutions (knowledge creation). Research has also found that the social ground rules and facilitation tools influence the social structure of the network. These factors influence the effectiveness of the network in transferring information and creating between members and creating innovative solutions. More specifically, Woolley et al (2010) proposed the C-Factor which is calculated based on three measures of collective intelligence. These three measures are: social sensitivity of group members, even turn-taking, and the proportion of females in the group.

Our research methods include regularly attending meetings for the different research groups and conducting Social Network Analysis (SNA). During meetings, we take field notes on team dynamics, and code the conversations for evidence of the C-Factor. In

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addition, SNA data has been collected at two different time intervals: before the research teams began and half-way through the research. It will be collected once more two months after the research concludes. Through SNA, we have tracked how the social networks of the teams change overtime. We compare network changes to different facilitation styles in the teams, and the C-factor.

Each team in our study has developed differently. Some teams create and transfer knowledge better than others. We will demonstrate in our presentation how social networks have changed since the start of the study based on facilitation in each team, the powerful influence of the C-Factor on SNA, and discuss what might be the ideal network structure for interdisciplinary teams.

Paper 2: An Epigenetic Model of Team-Driven Innovation

Authors: Morton Tavel & Devin Markovits

Conrad Waddington's "epigenetic" model of cellular development, now being used to understand complex diseases like diabetes and Alzheimer's, is presented herein as a model to describe the functioning of innovating teams. The model focuses on interacting networks as the basic mechanisms of innovation development and network entropy is viewed as a driving force. An innovation is defined here as the development and subsequent adoption of a new concept. The epigenetic model distinguishes small scale spatio-temporal activities by which a team develops a new concept, from larger scale "Darwinian-Mendelian" evolutionary processes by which the team's developed concept is then selected by its fitness for survival in a competitive space. Waddington noted that during an organism's development, its genome is buffered by regulatory networks so that small variations may accumulate, yet remain unexpressed. Waddington suggested that developing organisms travel down a tilted, incised surface he called an "epigenetic landscape" and are guided by increasingly deeper channels as their cells differentiate and stabilize.

We suggest that a team also falls into differentiating channels and that doing so may constrain innovation and prevent the team from finding novel approaches to problems. We associate these channels with low entropy and suggest that movement into these low entropy channels is promoted by the information (negative entropy) provided by specific networks of team members, including a network of team members linked by their technical contributions, social networks that foster collective intelligence, and cultural networks that link team members and their activities according to cultural predispositions. As their information content is utilized, these networks may be unable to sustain further innovation and a revitalization may be needed in the form of new sources of entropy. We suggest a possible use of game-play as a method for injecting entropy into a team.

Paper 3: Evidence-Based Organizational Change to Support Women's Careers in Research

Authors: Vaness McKean

The underrepresentation of women in senior academic roles in science and medicine remains a challenge (Sugimoto et al 2013). This presentation examines the means by which organizational change can be undertaken in research institutions to retain women and develop their careers in research. I argue that many of the characteristics of successful team science (including collaboration, strong networks and diverse teams) also foster women's careers in research, and that programs of support for women can remove barriers to collaboration and team work.

I take the case of an organizational change project in the Institute of Cancer Research, London (ICR) which aimed to address the loss of women from science and clinical academia. The ICR has a strong team science ethos, with a focus on translational research, which was recognized by the American Association for Cancer Research Team Science prize in 2012.

The ICR took an evidence-based approach to understanding women's experiences of academic scientific careers. We undertook a systematic analysis

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of four years' data on gender of staff in all research career paths, recruitment data (gender ratios of those applying, shortlisted and selected), promotions, committee membership, working patterns and maternity leave. The proportions of women in each career path (scientific, clinical academic and technical) were benchmarked against proportions in UK universities and against individual peer institutions. This was supplemented by further research to understand why women chose to leave research or move to technical career paths. This included interviews with team leaders on barriers and enablers to careers in research, focus groups for part-time research staff, and staff surveys. Initiatives were developed to address specific issues, and impact of these initiatives measured through three staff surveys (2011, 2014 and 2015) and data on the current destinations of former ICR postdoctoral researchers.

The initiatives identified as particularly successful all contribute to a culture in which diversity – in both people and their roles – is valued. Collaborations and networks are encouraged through three leadership development programs for women, mentoring, and women's networking groups also accessible to

clinicians from the partner hospital. Diversity in teams is supported by dedicated programmes of career development for each staff type and strong staff associations. Culture changes included enhancing workforce flexibility and minimizing the impact on careers of extended periods of leave (e.g. maternity). These led to more researchers being able to participate in meetings, seminars and the wider life of the Institute.

The impact of these measures have resulted in more women in senior academic roles, on committees, more comprehensive career development, and in higher staff survey scores from researchers. The impact of the project has also been recognized through a national accreditation scheme.

I assess the factors which contributed to the ICR's successes which can be applied by other research institutions. These include oversight from a diverse project team – diverse in disciplines, career paths and life-stages represented; and strong leadership from a senior management team already committed to team science. Resources, including dedicated project staff and funding, both signal the commitment of the institution and provide mechanisms for change.

Thematic Session 4

Publishing Team Science: Challenges and Opportunities

3:45-5:15 pm

Paper 1: The Dark Side of "Inclusivity" - Problematizing Authorship Practices in Interdisciplinary Teams

Authors: Isis Settles, Sheila Brassel, Kendra Cheruvellil, Kevin Elliot, Georgina Montgomery, & Patricia Soranno

Inclusivity, or the participation of individuals from underrepresented (e.g., women, racial minorities) or marginalized (e.g., early-career, international) groups, is an important and much needed goal in contemporary science. However, inclusivity in authorship may actually harm those we are trying to help when it devalues authorship and minimizes the

contribution of those who provide intellectual labor on scholarly publications. Indeed, at times a policy can be mistakenly held up as "inclusive" when really it fails to adequately consider the complex power dynamics in science teams and in fact results in negative impacts for team members.

We present results from 12 qualitative interviews conducted to study authorship, data sharing, and mentoring practices in interdisciplinary environmental science teams. Two members of six different NSF-funded interdisciplinary science teams, one project PI and one early-career team member (i.e., graduate

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student, post-doc, or assistant professor), took part in a recorded one-on-one interview that lasted from 1 - 1.5 hours. All six PIs were White men; of the early-career participants, there were 3 White women, 1 woman of color, 1 White man, and 1 man of color.

One of the major themes that emerged was a contrast between the responses of the early-career and senior scholars to questions about their team's authorship practices. The senior scholars uniformly described their authorship practices as being "inclusive," with some emphasizing the importance of erring on the side of including more, rather than fewer, authors on publications resulting from the team's research. Although most early-career scholars also mentioned "inclusive" authorship practices, there was some ambivalence expressed about the effects of these practices on their careers. Half of the early career participants noted their credit for authorship was diluted because so many authors were included on their papers, even though they did the majority of the work and many other authors played very minor roles. In these cases, inclusivity policies designed to assist marginalized groups in fact disadvantage them.

We provide excerpts from the interviews to reveal new perspectives on authorship and highlight the impact of gender, power, and status on authorship practices. Based on our findings, we advance the science of team science by providing suggestions for ethical authorship practices that truly empower marginalized groups.

Paper 2: Scientific Publishing and Team Science - How the Publishing Process Can Be Used to Foster Effective Scientific Collaboration

Authors: Emily Warner & Sarah Greene

The publication of scientific papers, because of its association with funder and administrator decisions to advance research careers, is the primary incentive today that structures the conduct of science. The traditional publishing armamentarium undermines scientific investigation and collaboration through several mechanisms: (1) the misallocation of credit to

individual, primary authors; (2) the disconnect between productive science and reviewers' judgment; and (3) disincentives to revise and update research findings, leading to non-reproducible results in the published literature. Though there is extensive dialogue about the promises of precision medicine, where shared genomic and clinical datasets and a systems approach to investigation are required to find precision solutions, current publishing processes, if unaltered, will continue to dampen achievements in this field. This talk will discuss these structural impediments to collaborative scientific research and describe how publishing can be reinvented to facilitate rather than impede progress. Insights will be drawn from existing literature on scientific collaboration as well as extensive interviews with scientists.

Paper 3: Bringing Team Science to Research Publishing and Science Communities

Authors: Eric Olson

Scientists face no shortage of challenges in the arena of scholarly communication. There are pressures to not only get your own work into research conversation, but also to provide visibility for your institution and keep up with the developments in your own field. This dilemma is only compounded by decentralization and the lack of discoverability of the large percentage of strong, potentially impactful scholarly content created and shared on the web. While some tools have addressed parts of this "wicked" problem, like the now defunct Google Reader, none have satisfactorily approached a solution to all of them, particularly in a research context. PressForward is a free, open-source digital tool that combines a response to these issues with researcher collaboration to create a robust platform for aggregating, discussing, curating, and publishing the best research content on the open web, all from a single dashboard.

Any content from the open web can be pulled into PressForward, from white papers and blog posts to Google Alerts and Twitter feeds. Then, individual researchers or teams of hundreds can utilize the

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integrated community curation system to discuss and select the best, most valuable content to share with collaborators and the public. Several science organizations are already utilizing these unique collaboration and community-focused features that PressForward provides, from the recently launched PLOS Collections and PLOS Blogs to the upcoming Marine Biological Laboratory and American Association for the Advancement of Science projects. With

PressForward, scientists won't have to juggle multiple tools in order to collaborate on the project and it is easy to introduce new contributors at multiple permission levels. Researchers or information officers can easily represent their field or institution, while their audiences can interact with one resource instead of dozens. From dozens or even hundreds of sources in the periphery, to one source in focus.

Wednesday, May 18, 2016

Thematic Session 1

Evidence-Based Strategies for Success

11:00-12:30 pm

Paper 1: Team Science Challenge Busters

Authors: Nancy L. Dianis & Tracy Wolbach

Westat is an employee-owned professional services company headquartered in Rockville, MD incorporated in 1963. The Clinical Trials Area delivers excellence in design, management, and analysis for domestic and international clinical trials for almost 30 years. Westat supports drug, biologic, and device development for both commercial and government clients through contracts and grants. A new internal Westat project team and Westat/Client project team whose members usually have no prior experience working together are constituted with the expectation both teams will immediately coalesce and operate seamlessly to accomplish project deliverables which usually have tight timeframes. The challenge can be daunting, but through the use of the Science of Team Science Tool Kit and Westat developed project templates the teams are successful.

Paper 2: Radical Transdisciplinarity - Using Group Model Building Principles to Develop a Transdisciplinary Team

Authors: Asheley Skinner, Andrew Perrin, Janna Howard, Cary Levine, Anna Bardone-Cone, Jane Brown,

Cynthia Bulik, Michael Steiner, & Eliana Perrin

More than simply creating a common communication opportunity, development of a true transdisciplinary team requires methods of creating knowledge beyond the sum of what individual members bring. We convened a team bringing expertise in visual culture, quantitative psychology, clinical psychology, cultural sociology, public health, and pediatrics to explore the complex relationships among children's movie viewing, cognitive processing, and obesity-related behaviors. Our team development process was funded by an NIH R24 grant and included several planned components. The process included team building as well as two planned products: a transdisciplinary conceptual model and a pilot study incorporating the entire team's input. Steps included: (1) an initial session designed to create a common baseline understanding of the problem; (2) a seminar series to provide in-depth introductions to each discipline's contributions to the area; (3) a retreat to allow for intense application of previous work to a study design; (4) implementation of a pilot study; and (5) revisiting the conceptual model.

The Introductory Session and Initial Model Development. The introductory session required a

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leader with some experience in Group Model Building (GMB) and system dynamics. Model building is useful in developing a transdisciplinary team because it brings together different points of view and explicitly works to ensure each aspect is included.

Seminar Series. The second part of the process was to build outward, with sessions from each discipline. Each seminar included a presentation of the general approach of the field and the particular insights it uses to conceptualize important concepts and aspects specific to obesity and culture in children's movies.

Components of the seminars included: 1) how the paradigm views obesity and culture, 2) prevailing theories, 3) possible methodological approaches; and, 4) gaps in understanding. We also included transdisciplinary seminars to demonstrate to team members how their fields were synergistic.

Retreat. The retreat was a day-long opportunity to revisit the development of the conceptual model, make revisions, and begin designing a pilot study. In the retreat the group applied the integration of the disciplines as a common structure for developing research questions and strategies for future work.

Model Confirmation. Typically, GMB would use in-person sessions to gather feedback on the model and reassess the structure. Our team, comprised of senior academics and scientists, each of whom had many competing demands, required a different approach. The GMB leader created a conceptual diagram displaying the many relationships identified throughout the team development process. Individually, each team member indicated the ten relationships they thought were most important to the overall goal for the team. Using responses from each person, the most important relationships were identified and a central conceptual model was created. We will use this model to direct our initial analysis of data from the pilot study, and will also revisit the model as our work continues.

Pilot Study. The pilot study was designed to 1) provide hands-on application of multiple research approaches;

2) inform the conceptual model; 3) assess key questions about children's viewing of movies; and 4) provide the needed preliminary data for a larger study of obesity and children's media use.

Discussion. Many scientific challenges would benefit from broad transdisciplinary input that include different paradigms, disciplinary languages, and methodological approaches. We have described the process of successfully developing a transdisciplinary team which came together to solve problems and overcome these challenges by: 1) introducing the whole team to the unique value added from each discipline; 2) realizing that it is only through the thorough integration of these disciplines and privileging of the interstices that unique work will ensue; and 3) using this thoroughly integrated team to develop a research strategy addressing the measurement of health-related culture in children's movies and how children view and interpret such culture.

Paper 3: Learning to Be a Science Team

Authors: Catherine Gabelica, Stephen Fiore, & Jacquelyn Chini

Scientific teamwork is an increasingly important area of inquiry in the context of complex collaboration (Börner et al., 2010). However, if the potential benefits of scientific teamwork are promising, so too are the challenges. Multi-disciplinary workers avoid some of the pitfalls of experts working in isolation, but are not always able to take advantage of the diversity of expertise and understanding in a team (Salas, Sims, & Burke, 2005). In fact, true teamwork does not occur automatically just because individuals are assigned to a team. Team members have the challenge of understanding the concepts and language of the other disciplines and therefore of learning about and with each other to constantly update their knowledge and coordinate their efforts to adapt or improve (Edmondson, Dillon, & Roloff, 2007). In other words, since problems are being addressed by diverse professionals with specialist knowledge and skills, these specialists have to learn to work effectively

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and efficiently. However, research and practice have shown that team learning processes do not occur naturally (Johnson & Johnson, 1992; Rummel & Spada, 2005; Sims, Salas, & Burke, 2005). The awareness that not all teams learn, and as a consequence may reach substandard group performance, raises the need to outline deliberate interventions to build learning in teams. Research so far is very scarce on the ways to develop and support high performing and fast-learning scientific teams in practice. In the present study, we designed and tested learning interventions combining the use of team-level feedback and guided reflexivity in intact undergraduate science teams and investigated the learning consequences of team reflection. We addressed questions such as do these teams learn and continue to learn after they have been given guidance on how to learn and does it impact how they efficiently and effectively work together subsequently?

Twenty-eight intact undergraduate teams following the course "Physics for Engineers and Scientists" at an American university participated in the field study. The physics course was the second part of a sequence required for all students majoring in engineering, computer science, biological science, and the physical science and using a relatively new way to teach physics which combines classroom work (in teams) with coordinated laboratory exercises and which removes most lecture. Every week, teams had to solve one complex physics problem and submit a team solution. These problems related to complex laws and theories that needed to be properly interconnected to other ideas to generate the correct solution. Following a week during which teams worked together without any form of intervention (week 0/baseline), teams were subjected to team-level feedback (week 1), while from week 2, they also received guided reflexivity (i.e., instructions asking students to reflect on what they did, what they could have done differently and how to improve problem-solving and collaboration for next week). Data collection by means of surveys (measuring team learning and knowledge coordination) and performance rating took place at five points in time (T0 to T4). We tested if team reflexivity after it had been

induced predicted subsequent learning outcomes and processes (at Times 3 and 4). More specifically, we examined the relations between prior team reflexivity (after guidance has been presented) and subsequent team performance, team knowledge coordination, and team learning behaviours. We found delayed effects on team coordination, immediate and longer-term effects on performance but only after the first time reflexivity has been stimulated, and even stronger effects over time on team learning processes.

Paper 4: Interdisciplinary and Collaborative Development of Scientific Research Proposals - Negotiation of Disciplinary Differences through Boundary Objects

Authors: Laura Paganucci & Louise Wetherbee Phelps

The purpose of this study is to examine the complex process that is required for the development of interdisciplinary and collaborative research proposals in the sciences. Funding agencies are increasingly requesting interdisciplinary solutions to scientific issues, prompting a rise in the number of collaborative teams that cross disciplinary borders. This scenario complicates the collaborative process by requiring the integration of disciplinary differences to produce a cohesive proposal and research design. Funding agencies also face challenges in determining how to effectively solicit these research solutions and review subsequent proposals. When combined, these challenges can result in an inefficient funding system that requires significant effort from all people involved and minimal reward as reflected by low funding rates. Additional research is therefore necessary to better understand the complexities of this process in order to potentially improve components of the system.

This study addresses this need through a novel methodology by using a framework based on Star and Griesemer's concept of boundary objects. Boundary objects are items that have a robust structure, function, and informational capacity that is accepted and recognized across different scientific disciplines; and,

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in turn, these objects can be adapted according to disciplinary need. These qualities allow boundary objects to act as modes for negotiation between disciplines, and are therefore a nexus of collaborative activity. Analysis of the qualities of boundary objects offers insight into the interdisciplinary and collaborative process as it occurs. This study used this framework to examine a team of 13 scientists representing 10 disciplines, and their development of a federal research proposal. Multiple methods were used including an interview protocol, demographic analysis, meeting observations, E-mail and Word Track-Changes protocols and textual analyses. These methods were uniquely integrated to support four separate analyses that included the identification of the research proposal boundary object, the description of the disciplines involved in this proposal, examination of the informational requirements of the proposal, and the analysis of the negotiations that occurred through the proposal.

The findings from this study offered significant insight into interdisciplinary collaborations in the sciences. First, the concept of boundary objects was

demonstrated as an effective method to analyze this process. The analyses resulted in the identification of five distinct characteristics that differed between scientific disciplines. These differences required negotiation between team members in order to create a cohesive proposal. The analyses also demonstrated how this negotiation process occurred and the varied levels of consensus that were necessary for productivity. Additionally, this study identified specific issues with the federal solicitation and review processes as they relate to interdisciplinarity. These findings impact team science in multiple ways. This study offers a structured method to identify distinct differences between disciplines. This identification is beneficial because increased disciplinary awareness can assist in developing optimal team composition and can improve the collaborative process by prompting increased communication, negotiation and resolution. Enhanced disciplinary awareness can also assist funders in predicting necessary team composition in order to solicit appropriate scientific solutions. These established expectations for interdisciplinarity as it relates to specific solicitations may also help normalize the proposal review process.

Thematic Session 2

Panel: Creating the Next Gen Team Science Workforce - Lessons Learned from Tennessee

Authors: Suzie Allard, Janet Nelson, Danielle Pollock, Kristina Dorsett, Amy Forrester, Robert Partee, & Thomas Waldrupe

This is a panel proposal. This panel is unique because it is designed to spend approximately half the session engaging the audience in a knowledge building exercise around the three perspectives represented by the panelists. This exercise will be led by the panelists.

Crossing disciplinary boundaries within teams presents challenging information and communication puzzles that can be facilitated by a team member with expertise in organizational communication, data management and communication. This panel presents three interrelated perspectives on building and sustaining team science members who can help support the creation of new knowledge across disciplinary boundaries.

Perspective One: Capacity Building. Universities are working to facilitate team science collaborations, but this can include the need for changes in research culture and practices. Dr. Janet Nelson, Associate Vice Chancellor for

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Research Development in the University of Tennessee's Office of Research and Engagement will discuss the challenges and solutions to encouraging and supporting a team science environment across campus and across institutions.

Perspective Two: Curriculum Building. Teams are often dealing with data intensive issues which can be facilitated with information expertise and solid communication skills. Dr. Suzie Allard, Associate Dean for Research (College of Communication and Information) will share lessons learned from developing curriculum for and graduating the first cohort of students in the University of Tennessee's School of Information Sciences program to develop team science oriented information professionals. There will be an overview of the courses and experience learning that is the foundation of the program.

Perspective Three: Catching Fire. Workforce development can be a challenge given the uncertainty surrounding the meaning of a professional having "team science skills." Four masters students and their doctoral student mentor from the first cohort of the Team Science information professionals program will share their experience learning about team science and learning how their skills can help them "fit" into teams in the professional world. Their experiences include operating as a team to develop a tool for the Office of Research and Engagement and being embedded with teams at sites including Oak Ridge National Laboratory, Y12 National Security Complex, the UT Medical Center and the university library. Students have a variety of disciplinary backgrounds including microbiology, marine biology, chemistry and philosophy. (student bios at <http://scholar.cci.utk.edu/team--science/people>)

Approximately half the session will be an interactive exercise with the audience breaking into groups for each perspective where the group will address a core question. Potential core questions are: (Perspective 1: Capacity Building) How should institutions approach changing the culture of researcher practices to support team science? (Perspective 2: Curriculum Building) What do we as a community of team science researchers/educators identify as the core of team science education? (Perspective 3: Catching Fire) What does the future look like to new professionals engaging with team science? Top line comments from each discussion will be reported back to the full session and we will end with discussing a way forward for effective workforce development.

Thematic Session 3

Network Analysis and Data Visualization

11:00-12:30 pm

Paper 1: Scholar Plot - A Compact and Scalable Visualization Method for Academic Careers

Authors: Kyeongan Kwon, Dinesh Majeti, Brian Uzzi, & Ioannis Pavlidis

In this paper, we present Scholar Plot (SP), a compact visualization of academic merit. SP is a scale space framework, enabling the user to gain insight about individual academic entities and their relative

contribution to aggregate academic entities. SP's base level covers academics, its second level departments, and its third level colleges. At each level, SP packs in a figure multi-faceted information about the entity's publication, citation, and funding profiles. SP draws data from open sources, including Google Scholar, the Journal Impact Factor List, and Open Data. Initial feedback through a focus group and a survey study,

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having high potential in serving as a complementary assessment tool in merit reviews and an insightful aid in search of an advisor or department. Next steps in this line of research include: a) SP's endowment with a wiki function for faster population of its department and college levels; and b) a longitudinal study to understand SP's usage patterns in practice, feeding back to the design cycle.

Base Level Visualization: The base level of Scholar Plot (SP) visualizes individual academic records. The first issue we had to address as part of the design process for this level was to determine what to visualize. To answer this question, we looked at the merit criteria considered by promotion, tenure, and search committees; these are: a) publication quality and quantity, and b) research funding. Furthermore, publication quality is defined by two factors: citation counts and prestige of the journals where the publications appeared. Accordingly, we decided to structure individual scholar plots as two-panel arrangements - the top panel visualizing the individual's publication record, while the bottom panel visualizing the individual's research funding record. This arrangement brings to the fore any causal relationship that may exist between funding and publishing, as publication production is often powered by research dollars. The common timeline in the horizontal axes of the two panel graphs facilitates such an association.

Group Level Visualization: Scholars do not pursue research in vacuum. They live and work within academic departments and academic departments cluster in colleges. The next two levels of Scholar Plot (SP) are group levels, visualizing scholarship in departments (aka Department Plot) and colleges (aka College Plot). In these aggregate plots it is important to show how much each constituent entity's record contributes to the aggregate score for the specific merit indicator. For this reason, Department and College Plots make heavy use of pie charts.

Conclusion: The basic idea behind SP is to facilitate instant insights regarding different strengths of

academic records, supporting the work of evaluation committees and the curious academic in search of an advisor or department. One of SP's strengths is that it draws data from open sources that are inclusive. This creates, however, a technical problem because Google Scholar - a key open source used by SP - does not offer an application- programming interface. For the base level of SP we solved this problem with sophisticated data scraping assisted by a simple one-time wiki function: if the individual sought by the user is not recognized by SP, then SP asks the user to copy and paste the targeted individual's Google Scholar URL; SP remembers it thereafter, automatically recovering the scholar's data every time a user requests it by name. For the department and college levels, a wiki function is in the works.

Paper 2: What Brings Us Together - Institutions and Linking Behavior in Early Stage Academic Communities

Authors: Katharine Anderson, Eleanor Sayre, & Matthew Crespi

There is considerable long-term interest in understanding the dynamics of collaboration networks: how these networks form and evolve over time. Most of the work done on the dynamics of social networks focuses on well-established communities. Work examining emerging social networks is rarer, simply because data is difficult to obtain in real time. In this paper, we use thirty years of data from an emerging scientific community to look at that crucial early stage in the development of a social network. We use this data to explore the effects of three factors on the structure of the collaboration network: growth, changes in social norms, and the introduction of institutions such as field-specific conferences and journals.

Over the past thirty years, the field of Physics Education Research (PER) has grown dramatically, from a handful of researchers, to hundreds of authors publishing nearly 150 articles a year. With this explosive growth, the structure of the collaborative community has naturally changed as well. Initially, islands of individual

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researchers labored in relative isolation, and the co-authorship network is disconnected. Thirty years later, rather than a cluster of individuals, we find a true collaborative community, bound together by a robust collaboration network. However, this change did not take place gradually—the network remained a loose assortment of isolated individuals until the mid-2000s, when those smaller parts suddenly knit themselves together into a single whole.

During the same time period, we also observe the emergence of the “superstars” of the field. Initially, there was little to distinguish researchers from each other: the degree distribution was not skewed the way we have come to expect in other collaboration networks. But over time, a small group of researchers start accumulating links more quickly than their peers, making the network look increasingly like more established social networks. In this new, larger community, a small number of individuals are identifiable as giants of the field.

This prompts a final question: what is the source of the changes we see in this emerging community? In the rest of this paper, we consider the role of community growth, behavioral shifts, and institutional change. We are able to observe the introduction of two different institutions: the first field-specific conference, and the first field-specific journals. We also identify two relevant behavioral shifts: a discrete increase in co authorship coincident with the first conference, and a shift among established authors away from collaborating with outsiders, towards collaborating with each other. The interaction of these factors gives us insight into the formation of collaboration networks more broadly.

Paper 3: Integration of Peripheral Regions in Collaborative Science - A Bibliometric Analysis of Scientific Activity and Co-Authorship at American County Level

Authors: Gregoire Cote & David Campbell

Bibliometrics can be used to measure trends in scientific collaboration by using the information on

co-authorships available in academic publications. The increase in scientific collaboration has been extensively studied at various levels (between institutions, between sectors, between countries, etc.), and it is an observable trend that new communication technologies facilitate the collaboration of researchers who are not physically working in the same place.

It is well known that scientific activity at present is highly concentrated in large urban areas and is infrequent in peripheral regions, but little is known about trends in this concentration of scientific output, whether the situation is evolving. On one hand populations tend to migrate toward large agglomerations, which would intensify the concentration of their scientific output. However, on the other hand, new technologies facilitate the participation of researchers from regional organizations in scientific teams, which could in turn support more scientific activity in regional areas.

This presentation will examine trends in the concentration of populations and of scientific output at US county level. Preliminary findings show that although the US population is increasingly concentrated in some counties, the distribution of scientific output remains fairly stable. The hypothesis is that new means of communication support the collaboration of peripheral regions with urban centers and therefore counterbalance, to a certain extent, the effect of population migration.

This study uses geocoding to link each scientific publication with one or more US counties. Changes in the GINI coefficient are used to measure trends in the concentration of populations and of scientific publications at the county level over the last 15 years. Social Network Analysis (SNA) is then used to analyze scientific collaboration (using co-authorship data) between counties over the same period. For instance, the collaboration affinity of each county towards urban centers (a measure comparing the number of observed co-publications between a given county and all urban centers to the number expected based on a random

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network) are computed on an annual basis; the results will be displayed using an animated geographic map showing the evolution in the affinity of each region towards urban centers. The hypothesis is that the affinity towards urban centers increases in peripheral regions; in other words, the periphery becomes more integrated in the network. To further validate the findings of this analysis, we compute the eigenvector centrality of all counties in the network on an annual basis, to test the hypothesis that the average centrality of the peripheral county is increasing over time. The analysis also investigates changes in the centralization of the network. Trends towards more integration should lead to decreases in overall network centralization.

Paper 4: Linking Scientometrics of Multidisciplinarity with Analyses of Interdisciplinarity in Order to Detect the Challenges that Face Multi-Expertise Teams

Authors: Kristin Lund, Heisawn Jeong, Grauwin Sebastian, & Pablo Jensen

There are many fields of research in academia that are recognized as being multidisciplinary, and therefore

use diverse frameworks and approaches. However, interdisciplinary teams also function within such fields and their work can be captured by the extent to which different types of integration (e.g. theoretical, methodological, etc.) occurs across disciplines (e.g. Wagner et al. 2011). Establishing disciplinary composition can be done quantitatively, but evaluating interdisciplinary collaborations that give rise to new concepts or a coherent new scientific field requires qualitative analyses of individual papers (Jensen & Lutkouskaya, 2013; Balacheff & Lund, 2012; Lund, Suthers, Rosé, & Baker, 2013). After illustrating how scientometric methods allow us to longitudinally establish disciplinary content of multidisciplinary research fields, we use a case study of research in education — reflecting that disciplinary content — to illustrate some of the challenges that face multi-expertise teams. Although experts in a multidisciplinary field may think they know where to analyze for interdisciplinarity, tracking changes in disciplinary components of fields over time and in databases other than Scopus may help to focus on where to analyze for challenges of multi-expertise teams.

Thematic Session 4

International Perspectives and Considerations

11:00-12:30 pm

Paper 1: Toward Understanding of Low-Overhead, Action Oriented Team Science

Authors: Iftekhar Ahmed, Marshall Poole, Elizabeth Simpson, & Natalie Lambert

International Virtual Research Organizations (IVRO) for multidisciplinary collaborative research that are built upon cyberinfrastructure provide a complex system of organizing, planning, and decision making for scientific research. IVRO initiatives combine people, complex data systems, scientific instruments, and other technologies to support scientific activities, communication and coordination among partner organizations. Decision making related to

organizational structures and processes provide challenges for the managers of IVROs as this decision making process has a direct relation to decision success (Dean & Sharfman, 1996). Because of the complexity of IVROs, it seems obvious that strategic decisions should be taken according to structured approaches such as value chain analysis or SWOT analysis (deWit & Meyer, 2004) and that research collaborations should be carefully planned and follow structured workflows and processes.

This case study discusses the Joint Lab for Extreme Scale Computing (JLESC), an IVRO organization that has generated complex projects, spans multiple

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institutions, cultures, scientific and engineering specialties, and technological infrastructures. JLESC represents a case of dynamic collaboration and scientific network among investigators, projects, and supporting organizations that has generated a significant number of valuable products and team science projects without a high level of structure or specified processes. Instead it uses an exceptionally low-overheard, highly improvised process emphasizing DOING rather than administrative structures and planning/management. The organizers of JLESC have applied the principles of computer engineering and systems development to organizing its activities and processes: rather than planning ahead they sketch out flexible frameworks that encourage participants to "go build things." The case focuses on how JLESC uses general research areas, co-location of personnel, and system development processes to organize scientific projects.

JLESC represents an improvised approach of organizational planning and decision making that reflects a high number of 'emergent strategies' similar to Mintzberg's (1978) idea. As Heath and Staudenmayer (2000) argue, "organizations often fail to organize effectively because individuals have lay theories about organizing that lead to coordination neglect" (p. 155). JLESC has proven adept at coordinating activities among six supercomputing centers, and carries some lessons for Team Science.

Paper 2: Developing Multinational Collaborations to Translate Knowledge - Lessons Learned from a North American Partnership

Authors: Rebecca Lee, Erica Soltero, Lucie Levesque

International collaboration with neighboring nations is extremely important for translating knowledge that improves the strength and health of the American public. This paper presents the process, outcomes and lessons learned from a decade of multinational collaboration that has developed through a participatory process involving a multidisciplinary

team of researchers from Canada, the United States and México. The partnership has aimed to increase scientific capacity and infrastructure in México with the express objective of discovering, enhancing and implementing strategies across multiple settings to increase physical activity among Hispanics or Latinos throughout North America. The process has involved multiple meetings, strategic networking, sustaining national and local funding from all three countries, and developing relevant products including policy development and implementation, individual and organizational intervention research, intercultural exchange and professional training, peer reviewed publications and knowledge dissemination through scientific, community and policy channels. We present lessons learned such as learning from each other, emerging in the culture, implementing a participatory process, determining mutually beneficial outcomes and enhancing fundability. These efforts have resulted in collaborative publications and grants among American, Canadian and Mexican scientists that directly benefit the health of Mexicans, and directly and indirectly contribute to the health of all Americans by way of enhanced scientific understanding and collaboration.

Paper 3: The Effect of Public Research Funding in China's Context

Authors: Dongbo Shi

China's National Science Foundation for Distinguished Young Scholars (Jie Qing Program) has gained significant results in creating a flexible and competitive environment to facilitate the development of outstanding young scientists. This research analyzes and evaluates the effects of Jie Qing Program to the growth of S&T talents in the past 20 years. The project constructs an exhaustive demographic database for Jie Qing Program sponsored scientists, and a database of all Jie Qing projects. And it also employs data mining methods to extract the scientific publications and citations database of Chinese scientists from Scopus database. Further, this research, employing the latest Coarsened Exact Matching method to build the control

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group, analyzes the causality between the Jie Qing Program and the growth of high-level S&T talents by a count regression model. The results show that, Jie Qing Program effectively enhanced the research productivity, the creativity and the scientific impacts of young scientists. Furthermore, this effect is larger among the scientists who were funded under 40 years old. And the result varies largely with disciplines. Combined with case studies and interviews, this research categorizes the mechanism of Jie Qing Program into four groups:

supporting scientists at their early career, enhancing the freedom of research, motivating scientists to take risk and attracting scientific talents. Base on the above discussion, this research dissects the institutional issues for Jie Qing Program and the general talent funding system, such as the phenomenon of "45 years old", the homogeneous management of heterogeneous disciplines, the over-low proportion of female scientists and the inflexible budget management for explorative research.

Thematic Session 1

Panel: A Feminist Approach to Facilitating Interdisciplinary Collaboration

2:00-3:30 pm

Authors: Michael O'Rourke, Kathryn Plaisance, Stephanie Vasko, & Stephen Crowley

Overall Theme

Complex, real-world problems are increasingly taken to motivate interdisciplinary, "team science" approaches, a fact that explains in part the increase in interdisciplinary research efforts. Because of the importance of complex problems such as climate change, food and water security, and poverty, it is incumbent on us to respond as efficiently and effectively as we can. This has motivated an interest in facilitating and enhancing approaches to interdisciplinary research and team science more generally. An important entry in this literature is the recent monograph published by the National Academies that focuses on enhancing the effectiveness of team science. Written by a committee of leaders in team science theory and practice, this volume reports on the state of the art in team science, focusing on what can be done to enhance team science at all levels of practice (e.g., individual, team, institutional).

Among the topics discussed in the volume is the beneficial impact of diversity on team science – different points of view, skill sets, and backgrounds can enrich the number of perspectives and ideas that condition research responses to complex problems. Diversity, though, can also complicate team process. Diversity along various lines – disciplinary background, career stage, gender, ethnicity – can create power differentials that undermine trust and psychological safety. Efforts to enhance the effectiveness of team science should acknowledge these factors and, to the extent possible, accommodate them. In accommodating them, these efforts must be mindful of ethical and epistemic dimensions of collaboration, since decisions about how to treat one another and how to think and make knowledge together will exemplify and potentially reinforce inequitable differences among collaborators.

Two important theoretical perspectives on issues related to equality and justice across lines of difference are feminist theory and, more generally, intersectionality. Feminist theory emphasizes the lived reality of women and girls over abstract verities that purport to apply to everyone; when it comes to practices of knowledge making, it highlights the contextual, embodied, relational, and value-laden nature of knowing and understanding. Intersectionality emphasizes the fact that a single individual may belong to several disadvantaged groups and experience injustice that differs from injustice experienced by those who belong only to one of the groups. Neither of these literatures is well represented in or in the surrounding conversations about team science and interdisciplinary research, yet both embody important insights and lessons for those who seek to respond to complex problems as members of interdisciplinary teams.

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This panel is devoted to bringing feminist epistemological and intersectionality theories to bear on interdisciplinary team science. We summarize and apply these approaches through a case study involving a specific intervention designed to enhance the effectiveness of team science. The intervention on which we focus is the Toolbox approach, a dialogue method that employs philosophical concepts and methods to enhance communicative and collaborative capacity in interdisciplinary teams. This approach, developed by the Toolbox Project, will serve as a case study in evaluating how feminist theory and a broader concern with intersectionality can influence adjustments and improvements to interventions designed to enhance team science.

Presentation 1: "Introducing the Case of the Toolbox Project" – Stephen Crowley & Michael O'Rourke

The Toolbox Project is a research effort that aims to understand and facilitate communication within collaborative, inter/transdisciplinary research teams. Team-based research that aims to integrate multiple disciplinary perspectives must confront the reality of different languages, methods, and priorities. Philosophy can help here, providing concepts that frame common forms of research engagement and methods that support abstraction away from disciplinary difference toward collaborative common ground. Drawing on epistemology and the philosophy of science, we have developed a workshop approach that centers on dialogue among collaborators about their re- search worldviews. This dialogue is structured by a survey instrument—the Toolbox—that comprises prompts which map key dimensions of research worldviews, including the epistemic dimension, associated with how we are that we can investigate the world, and the metaphysical dimension, associated with how the world is that it can be investigated by us.

In a Toolbox workshop, collaborators from different disciplines talk about the prompts in the Toolbox, exploring and comparing their different approaches to research in dialogue with the aim of enhancing the effectiveness of their communication with one another. The key idea underlying the approach is that collaborators are more likely to avoid miscommunication if they understand one another better as researchers. The operative sense of communication in the Toolbox Project is a rich one that includes but extends beyond transactions of research-related information. As we understand it, communication can be understood both as informational, involving message-based information transactions, and relational, involving actions that result in mutual identification and association.

Certain relational aspects that are potentially inimical to robust and equitable communication are evident in Toolbox workshops. While the Toolbox dialogue is framed philosophically, the details of the conversation are generally grounded in aspects of their research activity, including their common project. Further, the workshops are only lightly facilitated by Toolbox Project personnel, which encourages collaborators to interact in the dialogues as they would outside the workshop setting. As a result, the workshop dialogues often exhibit conversational patterns that reflect differences in commitment to the project and imbalances in power among the collaborators outside the workshop.

In the opening talk of this panel, we introduce the Toolbox approach in three stages. First, we describe the history and philosophy behind the approach. In recounting its history, we describe its origins, its development with support from the US National Science Foundation, and its deployment in over 170 workshops to date around the world. Our discussion of the philosophy underpinning the approach will reveal a dependence on traditional analytical epistemology and philosophy of science. Second, we articulate the principal objective of the approach in terms of communication understood as the co-construction of meaning. This will involve characterizing communication transactionally and relationally, and also describing the relationship between mutual understanding and communicative capacity. Third, we detail departures between the Toolbox approach in its original form and feminist themes. While feminist approaches to epistemology and philosophy of science were discussed during the original development of Toolbox dialogue method, the decisions that led to the creation of the Toolbox instrument were not made with feminist priorities in mind.

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Presentation 2: "Taking a Feminist Approach to the Toolbox Project" – Kathryn Plaisance

As discussed in the previous talk, the Toolbox Project has been quite successful using philosophical insights to facilitate cross-disciplinary collaboration. Its main contribution has been in helping researchers recognize and articulate their various disciplinary worldviews, thus enabling cross-disciplinary teams to anticipate problems and reconcile their disciplinary differences before engaging in collaborative work. In other words, its focus has been on the epistemic barriers to collaboration that arise from disciplinary differences. However, as I've argued elsewhere, the Toolbox Project has largely overlooked the role that interpersonal factors and group dynamics play in collaboration. In this talk, I turn to feminist and social epistemology to demonstrate why we need to pay attention to psychological and social factors in collaborative knowledge production. In particular, I will talk about some key concepts and theories that can serve as useful frameworks for enhancing the Toolbox Project (and other efforts to facilitate effective teamwork). Furthermore, I'll show how different kinds of diversity can intersect in significant ways in interdisciplinary collaboration, often in ways that exacerbate well-known problems of ensuring that those in more marginalized positions (such as women and racial minorities) are empowered to contribute fully to collaborative efforts.

Since at least the late 1970s, feminist epistemologists, as well as feminist science studies scholars, have emphasized the need to pay attention to the role that personal characteristics and experiences play in generating and transmitting knowledge. This idea that knowledge is situated is now a fundamental tenet of feminist and social epistemologists. It has since spawned a number of epistemological theories regarding how we ought to understand the production of knowledge. Of most relevance to the Science of Team Science community is probably Helen Longino's theory of critical contextual empiricism. Drawing on the concept of situated knowledge, Longino argues that it is through individual's background assumptions that values and biases can affect scientific theorizing. Furthermore, she demonstrates how these background assumptions often go unnoticed, allowing for moral, social, and political values to affect scientific research in unknown ways. One of the reasons they go unnoticed is that members of scientific communities often share certain background assumptions, and it's often not until individuals with different assumptions (typically arising from different characteristics and experiences) point out these assumptions that they are recognized. Thus, she argues, if we increase the diversity of those communities, we will increase the chance of identifying potentially problematic assumptions. However, it is only when those who bring diverse perspectives to the table are heard that their perspectives can enhance knowledge production. Yet, contemporary psychological research (e.g., on implicit bias and stereotype threat) illustrates that those diverse perspectives are not always given their proper weight.

In particular, research in social psychology demonstrates the significant role that power dynamics play in teams, often silencing those in marginalized positions (e.g., women and racial minorities). This is a particularly salient issue in interdisciplinary work, as fields in the sciences and engineering tend to be more male-dominated than fields in the humanities and social sciences, and the former tend to be more highly respected (e.g., by university administrators) than the latter. Thus, there is a good chance of some researchers being in a doubly marginalized role where a team may be comprised mostly of male scientists and engineers and female social scientists, which increases the likelihood of the female researchers not being given the same amount of credibility as the men. By taking into account these various factors, and drawing on lessons from feminist epistemology as well as recent research in social psychology, I demonstrate how the Toolbox Project could be substantially improved.

Furthermore, the insights discussed here are applicable to research on collaboration and team science more generally, and thus should be of interest to a broad audience.

Presentation 3: "Adapting the Toolbox Project for Feminist Epistemological and Intersectional Issues" – Stephanie E. Vasko

From the experiences of Toolbox Project members to critiques of Toolbox methodologies by colleagues across disciplines, it is clear that the Toolbox Project must adapt to and address questions of power dynamics. Recent

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studies have also pushed us to examine the roles of structure and power dynamics in academic settings for women, including (but not limited to) situations where collaborations can be damaging and where program structures do not offer safety. In addition, research in feminist and social epistemology, discussed in the previous presentation, suggests a need for attention to the role of power dynamics in knowledge production.

As noted above, however, these feminist insights into power dynamics and the relational dimensions of communication did not exert a significant influence on the early development of the Toolbox Project. Early workshops were conducted without much regard for the differences among groups, focusing instead on the degree to which the initial Toolbox instrument could enable those groups to identify important similarities and differences. Over the years, the workshop protocol was modified to include initial contact designed to inform the workshop experience for the participating group; however, these modifications were not systematic and did not reflect attention to any particular literature. For the most part, issues associated with power dynamics and other sources of inequality within a dialogue group remained unidentified and unmanaged.

We are in the initial stages of addressing these issues, and they have had a shaping influence on our interactions with new clients. We are now structuring workshop experiences with feminist and intersectional concerns in mind, resulting in adjustments to the Toolbox workshop protocol in three phases:

1. First, client groups now go through a more robust and systematic on-boarding process consisting of face-to-face or virtual discussions with group leaders and a pre-workshop questionnaire completed by the leadership. These interactions with representatives of the client group help us identify group needs, values, and desired outcomes. Recognizing that group power dynamics may not be noticed by project leadership, we supplement the information we collect from the leadership with an anonymous survey designed to collect opinions from all participants.
2. Second, the nature of the workshop experience itself has been modified. Using a new online data collection process and R-based data processing strategies, we provide participants with a snapshot of the initial distribution of group values, opinions, or responses to prompts immediately prior to the dialogue portion of the workshop. We hope that this will aid participants in structuring a dialogue that allows them to identify native capacities and create a context in which they teach themselves.
3. Third, adjustments have been made to workshop follow-up in light of the adjustments in the first two phases. The changes made to our pre-workshop information gathering efforts reflect a new, organic, team-centered approach that meets the team where they are instead of asking the team to meet us where we are. Because we are now in a position to evaluate the communication dynamic of a group in a way that reflects their specific situation, we are pursuing a more prescriptive, follow-up approach in the form of observations presented in reports to clients.

In this presentation we will describe the changes we have made to our Toolbox workshop protocol, explaining motivation for them in relation to feminist and intersectional theory. In addition, we'll discuss changes to data collection strategies and how these will provide future basis for explorations of intersectional identities using multivariate categorical quantitative data. From a mixed methods perspective, we will highlight considerations about the correct stage for our mixing qualitative and quantitative data to highlight feminist epistemological concerns and intersectionality in interdisciplinary research [3-5]. Finally, we will discuss possible future adjustments to the protocol, including movement from lightly-facilitated dialogue sessions to quasi-facilitated dialogue sessions, and the possibility of developing specific prompts that make power the focus of dialogue. At the end of the presentation, we'll open up the discussion to the SciTS audience to discuss additional ways we might use insights from feminist theory to improve the Toolbox Project, as well as team science more generally.

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Thematic Session 2

Biotech and Healthcare Teams

2:00-3:30 pm

Paper 1: Novel Collaborative Approaches for Accelerating Pediatric Device Development

Authors: Gwenyth Fischer, Jodi Fenlon Rebuffoni, Karen Kaehler, Tucker Lebien, & Sandra Wells

Historically, medical device development for the pediatric population is estimated to lag the adult market by a decade. Amendments have been made to the Food, Drug, and Cosmetic Act to encourage the development of devices for use in pediatric patients. However, availability of devices developed and approved for pediatric use remains low compared to those approved for adult use. For example, of the 38 FDA Premarket Notification Device approvals in 2013, only 8 were labeled for use in a pediatric population or subpopulation. Further, many medical devices approved for pediatric use are scaled-down versions of adult devices that vary in clinical functionality because they have not been designed specifically for the pediatric patient or end user.

The real world impact of this innovation gap results in pediatric care providers often improvising or making due with inadequate products. Minnesota is a leader in medical device innovation and is home to many well-known industry leaders including Medtronic, St. Jude Medical, Boston Scientific, and 3M. However, factors such as smaller market size and high development costs remain barriers to the development of devices that address pediatric health needs.

The University of Minnesota's Clinical and Translational Science Institute (CTSI) aims to improve health and well-being by accelerating discoveries into practice. Programs developed by the CTSI's Office of Discovery and Translation (ODAT) provide funding and cross-disciplinary team support to University faculty. From 2012-2014, ODAT received 224 applications

from faculty requesting funding and team support to advance therapeutics, devices, software, and treatment approaches. Yet, only 5 (2%) of the 224 projects addressed specific child health needs. This low representation of pediatric-specific technology is also reflected in the numbers of invention disclosures, intellectual property filings, and licensing agreements through the University of Minnesota's Office for Technology Commercialization (OTC). A data review for the period of 2010-2015 revealed that less than 1 percent of the 1857 total invention disclosures to OTC were for pediatric-specific medical technologies.

In 2014, ODAT partnered with the Minnesota Pediatric Device Innovation Consortium (PDIC) to pilot a funding program intended to incentivize faculty to pursue projects focused on identifying and creating innovative solutions to pediatric health needs. This program engages an advisory panel of academic and industry experts and community-based parent advisors with knowledge in clinical needs assessment, market analysis, business planning, patenting, regulatory, engineering, and prototyping. In the first two years following the program launch, ODAT received an additional 18 pediatric-specific medical device project applications. Although this funding mechanism has been successful in identifying more novel pediatric-specific projects, the number of total applicants remains relatively low in comparison to other ODAT programs not focused on the pediatric population.

To augment the existing funding program and further accelerate pediatric device development, ODAT and the PDIC evaluated the continuum of innovation at the University of Minnesota from idea to patient access. The outcome of our evaluation is the implementation of new programs coalesced around creative, cross-disciplinary, team-based solutions. We

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have expanded our collaboration to include the voices of patients, family members, healthcare providers and other community partners. We have formalized partnerships with other health care systems, pediatric consortia, CTSA programs, and the medical device industry. This includes unconventional approaches to intellectual property led by OTC and a novel pediatric device incubator/accelerator, which leverages device development assets both within and outside of the academic research setting to provide hands-on, expert development services for projects that are lacking key resources for advancement. Through these innovative team-based approaches, we expect to accelerate the development of novel technologies that will directly impact child health.

Paper 2: Functional Characterizations of Novel Somatic Mutations to Define New Therapeutic Strategies - A Translational Team Science Approach

Authors: Jan B. Egan, David L. Marks, Anne M. Vrabel, Ashley N. Sigafoos, Ezequiel J. Tolosa, Stephanie L. Safran, Elisa Enriquez Hesles, Luciana L. Almada, Tara L. Hogenson, Paola A. Romecin Durin, Eriko Iguchi, Gavin R. Oliver, Naresh Prodduturi, Eric D. Wieben, Tammy M. McAllister, Konstantinos N. Lazaridis, Karl J. Clark, Eric W. Klee, & Martin E. Fernandez-Zapico

Exome sequencing has increased the ability to generate clinically relevant results from genomics-based personalized medicine tests. However, a large number of identified variants in potentially druggable targets are not characterized, thus limiting the ability for action. The aim of this study was to investigate the functional and biological value of variants of unknown significance (VUS) in therapeutically targetable genes identified in clinical oncology genomics tests. VUS mutant sequences and their wild-type counterparts were incorporated into mammalian expression plasmids and expressed as epitope-tagged proteins in cancer cell lines using conventional transfection protocols. Functional assessment of each mutant included comparison with the wildtype (WT) form. Expression levels and downstream pathway

activation was assessed with western blotting and immunocytochemical staining to determine subcellular localization of WT and mutant proteins. Potentially aberrant mutations in druggable genes were evaluated in BCL2, BTK, MTOR, FBXW7, FGFR2, FGFR4, PDGFRB and RARA. All mutant proteins were expressed at significant levels and delivered to the same cellular compartments as their WT counterpart. Initial results demonstrate that some BCL2 and BTK mutants showed reduced expression. WT and mutant BCL2 localized to the mitochondria while BTK localized to cytosol and membrane. An FGFR4 and RARA mutant each showed increased expression but did not exhibit changes in localization compared to their WT controls. MTOR, FGFR2 and PDGFRB mutants and WT proteins were expressed at similar levels and localized to their expected cellular compartments. Downstream target activation by mutants yielded interesting findings; some that have required ongoing analysis of downstream pathway activation to completely understand. While FBXW7 mutants altered AurKA and Cyclin E expression levels differently, both FBXW7 mutants reduced phosphorylation of AKT when compared to WT controls. Studies of FGFR2 mutants demonstrated that mutant FGFR2 signaling and expression are dependent on the cell context. Analysis of the downstream pathway activation by these mutations is ongoing. These findings are of great clinical significance as they demonstrate the feasibility of rapid identification of activation or inactivation of significant pathways due to somatic mutation. Differences in expression levels seen for mutants such as BCL2, FGFR2, FGFR4, and RARA may be significant and suggest further focused studies to verify results and characterize the mechanisms of altered expression. This research further advances the Science of Team Science field by demonstrating collaborative translational team science, thus advancing not only the scientific body of knowledge regarding gene functions, but also providing new insights into patient care decision making. Clinicians are then enabled to make informed treatment decisions based on a thorough understanding of a tumor's molecular behavior.

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Paper 3: Collaboration and Proactive Teamwork Used to Reduce Falls

Authors: Katherine Jones, Victoria Kennel, Anne Skinner, Dawn Venema, Joseph Allen, John Crowe, & Roni Reiter-Palmon

Inpatient falls remain a common, costly, and serious adverse event. A 2011 baseline assessment revealed that the risk of falls was significantly greater in Nebraska's 64 Critical Access Hospitals (CAHs) than in its 18 non-CAHs due to an absence of a structure for accountability and coordination of organizational level fall risk reduction processes in the CAHs. With funding from the Agency for Healthcare Research and Quality, we collaborated with interprofessional fall risk reduction coordinating teams in 16 CAHs to develop and implement a customized action plan to address needs identified in the baseline assessment. From Aug. 2012 – July 2014, we embedded these coordinating teams in a multiteam system (MTS) structure. An MTS is made up of two or more component teams that interact to achieve an overarching organizational goal such as fall risk reduction. Coordination consists of three basic processes: (1) standardization (e.g. policies/procedures and audit), (2) planning, and (3) adjustment in real time (e.g. conducting post-fall huddles). When effective, these coordination processes ensure accountability by establishing clarity around roles and responsibilities, predictability by anticipating the actions and needs of others, and a shared mental model of how individual tasks coordinate with component team actions to achieve organizational goals. We assessed the context of fall risk reduction in each hospital using multiple assessments of culture, readiness to change, and teamwork – analyzed by the MTS component with a focus in coordination – and then supported coordinating teams by conducting site visits, webinars, conference calls and creating an internet-accessible toolkit. We evaluated the effectiveness of the coordinating team intervention using a repeated measures ANOVA design. Coordinating team effectiveness scores were derived from coordinating team assessment of

effectiveness in conducting 16 coordinating activities using a Likert Scale (0 = not done/not effective to 4 = very effective). Our findings indicate that the more effective the coordinating team, the lower were the total and injurious fall rates (see Table 1). Effective coordinating teams included engaged members from quality improvement, nursing, rehabilitation therapies, and pharmacy. They standardized the structure and process of fall risk reduction at the organizational level by selecting a fall risk assessment tool, educating staff to choose appropriate interventions linked to risk factors, conducting audits to ensure accountability, and communicating with staff regarding actions taken as a result of reported falls.

Paper 4: Improving Cancer Care Coordination through Team Science

Authors: Nancy Cooke, Sen Ayan, Nathan McNeese, Nandita Khera, Sara Wordingham, Noel Arring, Sharon Nyquist, Amy Gentry, & Brian Tomlinson

Critically ill cancer patients typically have multiple organ system dysfunction requiring support from several different specialists. Each specialty itself can involve multiple clinicians. In addition, each specialty understands the patient's issues through the lens of that specialty and often communicates with the patient or the patient's family individually. In many cases the advice, prognosis, or care plan communicated by one specialty conflicts with that of another and as a result the family receives mixed messages, often leading to the patient receiving aggressive care when not warranted, increasing medical expenses, and poor quality of life. Our research team is applying research on team effectiveness and recommendations made in the National Academies of Science, Engineering and Medicine Report, Enhancing the Effectiveness of Team Science to improve care coordination for critically ill cancer patients.

These groups of medical specialists and other allied health care staff can be viewed as science teams who apply science to caring for individual patients. However, there are some interesting distinctions between these

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groups and academic science teams. Like science teams, the medical specialists can face challenges of high diversity of membership, need for deep knowledge integration, goal misalignment, permeable boundaries, and high task interdependence (National Research Council, 2015). However, unlike academic science teams who may work on a single problem for years at a time, medical specialists work on multiple problems (embodied in a patient) and need to address each one in a timely manner. There are other science teams for which speed is of the essence (NASA mission control, emergency response teams). These teams seem to be a cross between academic science teams and action-oriented teams. Further, the group of medical specialists may not self-identify as a team and may never come together to collaborate either face-to-face or remotely.

The National Academies report recommends interventions in composing the team, developing the team, and developing team leadership. However, specialist teams are already composed and there may be little time for development. Instead, collaboration needs to be fostered. Although multidisciplinary

team conferences may be the most direct way of bringing specialists together, they are not likely to be implemented frequently due to time constraints. We are therefore considering other approaches to facilitate collaboration among specialists who are a cross between traditional science teams and action teams. Cooke, Gorman, Myers, & Duran (2013) propose that interventions for action-oriented teams need to focus on communication, coordination and interaction. Therefore some other potential interventions to improve care coordination among specialists include establishing a team role (e.g., nurse) for facilitating communication and coordination, developing a workflow that includes team communication, setting collaborative and clear goals, developing an interactive team white-board for real time collaborative decision making and the supporting collaboration through the next generation of Electronic Medical Records. We intend to implement these and test them in the context of delivery of care to critically ill cancer patients. This work will help extend the science of team science to medical specialists who operate on faster timescales than traditional science teams.

Thematic Session 3

Collaboration and NIH Supported Center Initiatives

2:00-3:30 pm

Paper 1: Developing a Methods and Measurement Health Disparity Cross-Disciplinary Team

Authors: Nancy Breen & Deborah Duran

Objective: The etiology of health disparities is complex. Health disparities are shaped by multiple domains of health determinants. Domains of health determinants range from genetic and biological risk factors to the social and physical environments. The complex etiology of health disparities requires cross-disciplinary collaborations, complex analysis methods, and consistent measures. The impetus for addressing methods and measurement science in health

disparities is two-fold. First, despite the wide range of indicators and methods used in health disparities research, complex modeling methods are not widely used. Different disciplinary perspectives may explain the inconsistencies in how different studies perceive the causes of health disparities. Second, the complex etiology of health disparities and the likelihood of more complex methods for analyzing health disparities make it critical for the field to come to agreement on standards and harmonized measures. Given the cross-disciplinary nature of the field and the range of methods required to understand disparities, a team science approach is needed. A team science approach

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will enable use of complex multifactorial methods to determine the causes and reductions in health disparities and help the field come to agreement.

Description of research methods: NIMHD convened a Trans-NIH Working Group on Methods and Measurement Science for Health Disparities Research to build a foundation that will lead to a scientific discipline. This includes the methods and measures needed to know when disparities exist and when each has been eliminated. Disciplines of working group members are philosophy, economics, demography, chemistry, biology, statistics, medicine and dentistry.

The working group reported some preliminary results in the draft foundational paper. A wide range of statistical approaches are used to measure health disparities and associated health determinants. Currently used statistical methods are not adequate to fully understand the multifactorial and multilevel causes of health disparities. These methods are important and will continue to be used. However, these statistical methods are limited when relations among health determinants are complex and cross-disciplinary. Complex systems approaches that specify conditional interrelationships between multiple factors and agents can be used to explore and evaluate the impact of both direct and indirect effects in health disparities research. However, complex systems approaches are not widely used in the field, and this is a limiting factor in adequately characterizing real world relationships. Exploring use of complex systems analyses is recommended to overcome this limit and to better understand the dynamic interactive causes of health disparities. Further discussion of how to move this forward at the SciTS conference will be beneficial.

Statement of how the research advances the SciTS field: Initial findings from the year long process that addressed the system science approach for health disparities will be presented. Discussion questions will be posed to foster interactions that can promote optimum use of team science in assessing health disparities. Activities to date indicate that a team

science approach with a cross-disciplinary set of researchers is not only an effective tool but a necessary one to build support across NIH and in the field of health disparities for moving health disparities to the next scientific step of being able to assess the complex contributing causes of health disparities. We anticipate that the SciTS conference will provide discussion and guidance that will help us lead the process even more effectively. Successful use of SciTS methods to create harmonized strategies for determining and assessing health disparities will provide a high-profile and important case for the importance of SciTS.

Paper 2: CHEAR Planning for a Team Science Evaluation - NIEHS Children's Health Exposure Analysis Resource Program

Authors: Kristianna Pettibone & Jennifer Collins

Objective: In 2015 the National Institute of Environmental Health Sciences funded the Children's Health Exposure Analysis Resource program (CHEAR), a large infrastructure designed to provide the tools for researchers to assess the full array of environmental exposures which may affect children's health (<https://chearpogram.org/>). CHEAR resources will be used by children's health researchers conducting epidemiological or clinical studies that currently have very limited consideration of environment, or those who have collected exposure data but seek more extensive analyses.

The CHEAR program is intended to:

- Expand the number of studies that include environmental exposure analysis in their studies,
- Implement the exposome concept in children's health studies,
- Create a public resource of children's exposures across the country, and
- Develop data and metadata standards for the environmental health sciences community.

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With six independent laboratories, a coordinating center, and a data center, the CHEAR program requires groups of researchers to work together to develop the tools, conduct analyses, and promote the resources to other researchers. Team science approaches are essential for its success. This poster will describe team science approaches used to facilitate the program goals, as well as team science focused evaluation goals and questions planned for the program. The authors seek feedback on the appropriateness of the evaluation questions and metrics, and ideas for additional metrics. Our evaluation goals and questions will be informed by similar evaluations of the Transdisciplinary Research on Energetics and Cancer (TREC).

Summary of Findings: As part of the program start-up activities (award terms, kick-off meeting, initial steering group discussions) specific governance structures have been established with the aim of facilitating team science outcomes. These activities will be presented with an eye towards establishing metrics for team science.

Statement of How the Research Advances the SciTS Field: By presenting our team science evaluation plans to the community of team science researchers, we hope to strengthen the evaluation and provide a solid evidence of what federal funders can do to support and facilitate team science projects, as well as a description of the success and challenges of the CHEAR program. Ultimately, we intend for this work to contribute to the field of SciTS and the work conducted with the TREC and similar NCI funded initiatives.

Paper 3: Transdisciplinary Outcomes in Two NIH-Funded Center Grant Initiatives - A Qualitative Study of the Transdisciplinary Research on Energetics and Cancer and the Centers for Population Health and Health Disparities

Authors: Sarah Hohl, Health Noble, Meagan Brown, & Beti Thompson

Objective, problem under investigation, hypothesis or research goal: In this study, we explored

and compared challenges, successes, and progress towards transdisciplinary outcomes of two National Institute of Health (NIH)-funded center grant initiatives: Transdisciplinary Research on Energetics and Cancer (TREC) and the Centers for Population Health and Health Disparities (CPHHD).

Description of research methods: Between May 2015 and January 2016, We conducted one-on-one semi-structured interviews with 53 investigators, trainees, and staff from the TREC and CPHHD programs and funding program staff from the NIH. Interview questions were designed to explore 1) transdisciplinary outcomes within TREC and CPHHD and 2) investigator-perceived impacts of transdisciplinary collaboration on investigators, research centers, and the scientific community. Interviews were transcribed verbatim, checked for accuracy, and uploaded into Atlas.ti for coding and analysis. The team applied a constant comparison content analysis approach, in which emergent themes are identified and compared within and across all qualitative data sources.

Summary of findings: Investigators from both TREC and CPHHD described nine broad outcomes unique to transdisciplinary research: transdisciplinary authorship, new transdisciplinary grants, disciplinarily-integrated research methods and statistical designs, consortium building, new multi-level intervention models, policy changes, awareness and dissemination, translation, and training. The infrastructural support of a central Coordination Center and ongoing funds for one-year pilot projects in TREC facilitated both cross-center consortium building as well as cross-center intellectual exchange and partnership. The requirement of CPHHD grantees to implement a community intervention provided a means for investigators to extend their academic consortium building by engaging communities. Investigators of all levels across TREC and CPHHD described new discoveries and career advancement that they in part attributed to their participation in a multi-site, transdisciplinary initiative.

Statement of how the research advances the SciTS

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field: In this study, we built on previous research that has explored the processes and facilitators of transdisciplinary team science by identifying outcomes of this type of work. As such, our results elucidate the value of investing in transdisciplinary center grant initiatives to foster innovation that can solve more complex public health problems. In turn, our findings could help garner the appropriate academic institutional and departmental support for transdisciplinary research conduct, in effect, more efficiently and effectively generating public health impact.

Paper 4: Modeling the Dynamics of Collaboration in the Scientific Workforce - The Case of Clinical and Translational Science Awards Pilot Grant Program

Authors: Alina Lungeanu, Denis Agniel, Kun Lei, Noshir Contractor, & Griffin Weber

Over the last 50 years collaboration and teamwork have increased in scope and volume in virtually all scientific fields (Wuchty et al., *Science*. 2007;316(5827):1036-9). Recent research has shown that the results achieved through team collaborations have also increased in quality: teams yield publications with higher intellectual impact than researchers working alone. However, consistently assembling such teams is a daunting task, for intellectual as well as logistic and technical reasons. For one, scientists need to have clear common ground or hold knowledge mutually understood by all parties. Second, scientists also need to know how to coordinate their collaborative tasks. However, effective interaction and coordination is hard to achieve: Scientists need to have compatible approaches to science and writing styles, they need to give the same level of priority to their joint work, and they even need to have "the right chemistry" (Hara, Solomon, Kim, & Sonnenwald, 2003). Given these challenges, there is sizable risk of assembling teams in a suboptimal manner, with a resulting negative impact on the scientific enterprise (Contractor, 2013). Therefore, understanding how scientific teams assemble and how can they be "optimized for the

knowledge and skills required for the science to be conducted" (Börner et al., 2010), represents an important but overlooked research endeavor.

Our study seeks to advance our understanding of the assembly of teams where individuals have discretion in their formation and the team requires diverse and specialized expertise to successfully accomplish its goals. We bring together social network theories and research on groups and teams to first examine the mechanism leading to collaboration in scientific teams. Next, we determine which among the assembly mechanisms also affect team success.

We tested our research questions using archival and bibliographic data about scientists submitting research proposals to a Clinical and Translational Science Awards Program at a research university in 2009. There were 458 grant proposals submitted. A total of 1,469 researchers out of 37,266 possible applicants were identified as PIs/Co-PIs, of whom 1,220 did not have awarded proposals, 56 had both awarded and un-awarded proposals and 193 had only awarded proposals. Demographics, education and employment information, and school and department affiliation were extracted from the university internal database. Additionally, we used publication data from Scopus to construct the bibliometric information (including publications, co-authorship and citation relations) for the entire population of possible applicants.

We first use Autologistic Actor Attribute Model to predict the factors influencing researchers to apply for a grant and then we use Exponential Random Graph Models to assess factors influencing the assembly and success of grant proposal teams. Preliminary results show that researchers are more likely to submit proposals with their co-authors and with those they share a high number of cited papers. However, researchers are more likely to submit successful proposals with their co-authors and with those they share a lower number of cited papers. Results also show that female researchers are more likely than men to collaborate on awarded proposals

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Thematic Session 4

Lessons Learned from Multi-Disciplinary Organizations & Fields: From Design to Ecology

Paper 1: Interdisciplinary Collaborative Design Process in an Educational Setting - The Interdisciplinary Design Studio

Authors: Arsev Aydinoglu & Pinar Kaygan

Background. Middle East Technical University Design Factory (METU DF) is an interdisciplinary research and education center whose primary objective is providing space and equipment infrastructure required for collaborative design projects. METU DF's first collaborative design activity was called Interdisciplinary Design Studio (IDS) in which interdisciplinary student teams address a design problem with guidance from academic and industry mentors for four to eight weeks. Faculty consists of 20 people from nine departments (engineering to industrial design to business). Student teams are diverse as well (from 18 different departments).

Objective. The objective of this qualitative study is to understand the dynamics of interdisciplinary collaborative design process better and evaluate the potential of the Interdisciplinary Design Studio as an educational tool.

Methods. The data for this study was generated through (i) semi-structured interviews with students (50) and faculty (24); (ii) natural observation (two graduate students spent four weeks with the teams); (iii) online surveys (open-ended questions); and (iv) a focus-group study with industry partners. After the analysis of each dataset, the findings were integrated to narrate the experiences of students and faculty in regards to interdisciplinary collaborative design process.

Findings. (1) The students benefited from peer-learning as much as they benefited from the curriculum in

regards to collaborative research. (2) The perspectives, values, and workflows were quite different among the faculty and they confused the students, hampered their learning. (3) Space (or lack thereof) was critical to facilitate collaboration not only among the students but also the faculty. (4) Soft skills (communication, conflict management, etc.) were as important as domain-based skills and knowledge (coding, using 3D printer, static calculation, etc.). (5) Although, the students performed fine in the teams, their roles in the teams and how it changed over time require more discussion.

SciTS Relevance. Collaborative science has become important; however, educational settings that promote collaborative work are rare –especially among engineers, designers and social scientists. This study addresses that gap. Due to the innovative nature of the IDS, the findings are applicable to collaborative research as well. Moreover, the inclusion of industry through mentoring brings new perspectives to the science of team science literature.

Paper 2: The Prevalence and Interdisciplinarity of Collaborations in Multidisciplinary Institutions - A Case Study of iSchools

Authors: Zhiya Zuo, Xi Wang, Kang Zhao, & David Eichmann

During the past decades, the importance of interdisciplinary research has been widely recognized and science has become more interdisciplinary. While there are many ways to promote interdisciplinarity in research institutions, one way is to create a multidisciplinary institution with researchers from various domains. The goal of this study is to examine the connection between multidisciplinarity of an institution and the prevalence and interdisciplinarity

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of collaborations within the institution. Specifically, we utilized text mining and social network analysis techniques to address two research questions: First, does a multidisciplinary environment breed more collaborations? Second, do interdisciplinary collaborations emerge in a multidisciplinary environment? Answers to these questions can help research institutions and funding agencies more effectively promote interdisciplinary research.

We used 27 Information Schools (iSchools) in the U.S. as a case study, because they are multidisciplinary institutions with faculty members from various disciplines. Our dataset includes 23,758 papers authored by 675 faculty members, and their educational background. The multidisciplinarity of an iSchool was measured with two metrics: educational multidisciplinarity is based on the Shannon Entropy of an iSchools' faculty members' educational background distributions; research multidisciplinarity, which is the diversity of faculty members' research interests, is measured by topic distributions from their publications.

After building an internal collaboration network for each iSchool among its faculty members, we found that having a higher level of multidisciplinarity is not associated with a more collaborative institution, as the correlation between multidisciplinarity and the connectedness of collaboration networks is not significant. We also conducted assortativity analysis for collaboration networks using collaborating faculty members' research interests derived from topic distributions of their publications. We found some surprising results: (1) higher prevalence of internal collaborations does not mean higher levels of interdisciplinarity of collaborations. (2) a more multidisciplinary environment cannot guarantee collaborations that are more interdisciplinary. An OLS regression with various control variables further confirmed our finding – educational multidisciplinarity is a non-significant predictor of the interdisciplinarity of collaborations, while research multidisciplinarity has significant negative effect.

Using social network analysis and text mining techniques, this research found that a multidisciplinary environment alone does not necessarily lead to a more collaborative environment, or more interdisciplinary collaborations. More coordination, management, and incentives may be needed to fully exploit the benefits of institutional multidisciplinarity in stimulating collaborations and interdisciplinarity.

Paper 3: Focus on Them - Applications and Experiences Using Business-Based Assessments to Promote Collaboration, Teamwork, and Leadership

Authors: David Gosselin & Ron Bonnstetter

Higher education is being confronted with a paradigm shift that is forcing it to collectively reexamine their ability to develop graduates who have relevant professional competencies. Collaboration, team work, and leadership are competencies that are sought after by employers. We may leadership more difficult than it needs to be. A critical first step is recognizing leading is not about you, it is about whom you lead. The creation of effective collaboration is critical to developing the interdisciplinary linkages that are necessary to confront the many environmental challenges posed by human activities. We need to prepare students to meet future intellectual and workforce demands that require collaborative leadership. To address the challenge of focusing on whom you lead and the development of collaboration skills, the Environmental Studies (ES) program at the University of Nebraska-Lincoln (UNL) in partnership with TTI Success Insights® used a backward curriculum design, multiple modalities of experiential learning, and a reflective action research approach to develop collaboration and teamwork skills in undergraduate students. Through the use of an instrument, the TriMetrix®, the UNL-ES program is taking a page from the business world to help students understand themselves and adapt more effectively to others in the professional world. The analysis of these data have informed us about how to improve their use in debriefing the class. We have identified certain mixtures of behavioral styles and motivational

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drivers that may be problematic to group work. Many students have experienced team projects, but have not explicitly had to learn about the factors that go into effective collaboration or they have never been

explicitly explained to them. This is particularly the case with regard to processes of developing a shared-vision for a project. Education had the opportunity to add the missing link: the science of self.

Thematic Session 1

Panel: Communicating a Value Proposition for Integrating Social Scientists and Natural Scientists/Engineers - A Sales Pitch through Integration Case Studies 3:45-5:15 pm

Authors: Sharon Ku & Christine Hendren

Objective and problems under investigation

The importance of social science in comprehending and facilitating scientific collaboration has been well recognized in team science research and practice. Classic social science agendas such as leadership, organizational studies, and infrastructural building deeply resonate with team science design, management, human resources and implementation. Funding agencies also encourage integration between natural science and social science as an active component of emerging science and technology development, as evidenced by efforts such as ELSI (Ethical, Legal and Societal Implications) for human genome research or nanotechnology. However, while such interdisciplinary collaboration is applauded by science and policy communities, the actual working relationship between natural and social scientists remains confusing and controversial due to the lack of integration, disciplinary hierarchies, power dynamics, along with different expectations on goals. We assert that the quality of interactions between these communities overall currently remains shallow and transactional in nature, often limited to what will satisfy top down requirements from funding agencies. The true value proposition to natural scientists and engineers for harnessing social science wisdom to improve science outcomes has not adequately been made, nor has the allotment of their time and resources to connecting with and learning from social sciences been adequately incentivized. This value proposition must be made if meaningful cross-pollination between social and natural sciences is to be realized.

In this panel, we plan to reflect on the current "demands and supplies" of socio-technical integration, by inviting social scientists/humanists who are developing methods/case studies of implementing social and ethical dimensions in team science to share their methods, research findings as well as reflections on collaboration barriers and difficulties in the process of integration. We juxtapose these different approaches for a comparative understanding of their niches and limitations in terms of scales and goals of integration; furthermore, we will also explore potentials for developing a "toolkit" which could systematically address the cognitive, social and political barriers in team science planning and practice.

Our intended audience extends beyond social scientists to include team science practitioners such as researchers, project managers, team leaders and research development professionals who navigate team dynamics, collaboration barriers or societal outreach in their job duties. This panel will have been successful if it makes a persuasive case that team science practitioners are potential "clients" for the social science methods. Through eliciting their feedback, we will examine whether current methods address their concerns or demands, and what individuals and organizations can do to support sustainable socio-technical integration.

We seek a two-way dialogue between social scientists and team science practitioners to discuss current problems, solutions and opportunities of future collaborations, through exploring the following questions:

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- Why would scientists benefit from spending their time/resources to enlist the expertise of social scientists?
- How to conceptualize the relationship between natural and social scientists in team science? Are social scientists/humanists perceived as “partners”, “guests”, or “intruders” of natural scientists/engineers?
- What are the common interests, goals and potential conflicts of socio-technical integration? Can social science be utilized to deliver more than just instrumental functions defined by scientists, but also critical reflections on the goal, practice and outcome of team science?
- What are the social science methodologies available for collaborating with natural scientists and engineers? What are their strengths and limitations? What are the benefits and risks?
- How can mutually beneficial collaborations at the interface between natural and social sciences be designed, communicated and incentivized? What are the required infrastructures?

Description of research methods and showcases

In the proposed panel discussion, three distinct methodologies in conceptualizing and implementing “socio-technical integration” will be showcased, with specific focus on the degree of integration, the collaboration model, and collective research outcomes. Each presentation will be commented upon by a team science practitioner to facilitate mutual understanding and communication between “supply” and “demand”.

1. Socio-technical Integration Research (STIR; Erik Fisher, Arizona State University)

Methodological Niche: STIR is a globally tested and proven approach for enabling scientists and engineers to anticipate and respond to societal dimensions of their technical work. Originally developed to assess researchers’ capacity to take social and ethical values into account during routine research activities, STIR has been recognized by research funding organizations around the world. It has become an established mechanism for “responsible innovation,” seeking to modulate research and innovation trajectories in desirable directions, after research and development priorities have been set, but before societal consequences can be known.

Degree of Integration: STIR facilitates high-impact reflection on routine research decisions as they are made and unfold in real-time. It does this through ongoing, structured interactions between an “embedded humanist” and collaborating scientists/engineers for a period of 12 weeks. Interdisciplinary collaborators use a variety of feedback and engagement tools to map decision styles, elucidate stakeholder values and expand options.

Collaboration Mode: The STIR “decision protocol” facilitates real-time, collaborative description of research opportunities, considerations, alternatives and outcomes. During this time, collaborative description evolves into collaborative inquiry, which can identify new, alternative, socially robust courses of action.

Expected Outcomes: Through over three-dozen studies performed in scientific and engineering laboratories across North America, Europe and Asia, the STIR process enhances reflexive learning, value deliberation, and practical adjustments. In the process, it boosts creativity, productivity and stakeholder value integration.

2. Toolbox Approach (Michael O'Rourke, Michigan State University)

Methodological Niche: The Toolbox approach is a method that involves producing philosophically structured dialogue among collaborators designed to reveal differences in research perspective and increase communicative capacity. Methodologically, it combines philosophical analysis with dialogical integration. By structuring the dialogue philosophically, the Toolbox approach foregrounds fundamental aspects of one’s research worldview (e.g., preferred methods, attitude toward application, importance of hypotheses) and makes them available for collective consideration. By featuring dialogue, the approach encourages collaborators to collectively identify and examine similarities and differences among their worldviews.

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Degree of Integration: Toolbox dialogue is structured by a survey instrument – the “Toolbox” – constituted by prompts that are abstract, in that they focus on aspects of research that are not tied to any specific context (e.g., “The world under investigation must be explained in terms of the emergent properties arising from the interactions of its individual components”, “Value-neutral scientific research is possible”). In responding to these prompts, participants are asked to adopt their primary disciplinary perspective, and so the responses can be understood as articulating commitments that frame one’s research approach. Together, the prompts provide a model of one’s disciplinary perspective, which is then articulated and shared in dialogue by each of the participants. The dialogue, then, supports collaborators in identifying native values and native capacities. Integration takes place in this dialogue along two dimensions: (1) articulation of beliefs and values can enable participants to integrate a new, reflexive appreciation for their own tacit commitments with the rest of their conscious self-knowledge, and (2) dialogue about similarities and differences in research worldviews can coordinate them, guiding the trade-offs required for collaborative decision making.

Collaboration Mode: As delivered by the Toolbox Project, the Toolbox approach is interventionist, centering on a relatively brief dialogue workshop lightly facilitated by outsiders. The facilitators interact in advance with project leadership, gathering information used to design an instrument that reflects beliefs, values, and priorities that are central to the collaborators. When delivered by outsiders, critical distance on the process of the collaboration is ensured, and this informs a post hoc evaluation of the dialogue which can serve as a window on the team’s communication dynamic. A key determinant of the causal efficacy of the dialogue is interest on the part of the participants to take up and use the insights it generates.

Expected Outcomes: Proximally, the Toolbox approach is designed to enhance self- and mutual understanding among collaborators. More distally, the approach aims to enhance communicative and collaborative capacity within a project. Achievement of these outcomes in a particular case is dependent on a number of contextual factors, including buy-in on the part of participants and the location of the intervention in the life-cycle of the project.

3. Multi-sited Ethnography (MsE, Sharon Ku, Drexel University)

Methodological Niche: MsE is an anthropological method to study large-scale scientific collaboration which involves multiple stakeholders a field full of diverse interests, technical indeterminacy, proprietary commercial activities, unsettled political order and diplomatic sensitivity from different knowledge institutions. MsE connects social science to a range of epistemic spaces from laboratories, factories, courts, policy rooms to international forums where the social science research agenda such as power, hegemonies, values, ontology or geopolitics can be directly linked and respond to science and policy issues.

Degree of Integration: MsE investigators move around and follow horizontally with multiple stakeholders instead of staying in place to identify the critical boundary work for the creation and harmonization of multi-sited interests, as well as uncovering the relational exchanges and subtle interconnectedness of people, things and spaces over multiple locations. The sociological analyses of the interplay of knowledge, people, organization and power inform practical concerns in team building, enabling MsE to act as a powerful entry tool for incremental socio-technical integration, using ethnographer’s multi-sited navigation and sensitivity to step-by-step build the critical moments of collaborations and spectrum of integration.

Collaboration Mode: MsE envisions a contemporary affinity between natural and social scientists as “epistemic partners” who will inevitably provoke each other to think their own research in new ways. It mobilizes ethnographic design, multi-sited networks and data to engage communications and mutually beneficial collaborations with science and policy practitioners, who are viewed as “para-ethnographers” having “a preexisting ethnographic consciousness or curiosity” epistemologically equivalent to the anthropologist’s. Actors’ para-ethnographic insight can contribute to critical social science investigation in knowledge, power and organization, while social science analyses enables the scientists to re-evaluate their job, identity and career paths in a fresh and

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reflexive angle.

Expected Outcomes: MsE helps dissolve the traditional hierarchy within the science-social science collaboration, enabling symmetric socio-technical integration for timely reflections, assessment and awareness of the bigger socio-political context where team science is formulated and functions. Using nanotechnology as a case, the MsE will demonstrate how it works with multiple stakeholders from university, government, industry and non-profit organizations to define collectively shared goals and intellectual products.

Implication for SciTS

Through methodological comparisons and interactive dialogues among social science researchers and team science practitioners, this panel offers an integrative scope to advance coordination and communication at different stages of team building, inter/transdisciplinary team approaches for various stakeholders, and methodological innovation for designing and implementing team science in a complex socio-technical space.

Thematic Session 2

Conceptual Models and Theory

3:45-5:15 pm

Paper 1: A Thermodynamics of Interdependence - Science, Scientists, and Scientific Teams

Authors: William Lawless

Introduction: As multitasking skills wax and wane between interdependent and independent, each team's focus on tasks interferes with its bistable interpretations of how to improve performance; i.e., $\sigma_A(\text{skills})\sigma_B(\text{interpretations}) \geq 1/2$ (Eqn.1), where $\sigma_A(\text{skills})$ is the standard deviation of variable A over time, $\sigma_B(\text{interpretations})$ is the standard deviation of its Fourier transform, the two forming a Fourier pair of tradeoffs between skill practices and social interpretations (see Fig. 1): as uncertainty in a team's skills decrease (e.g., improved multitasking), uncertainty in interpretations increase (i.e., poorer team awareness), motivating the need for a team manager and team practice.

Equation (1) captures social disagreement (e.g., political, judicial, scientific). For social dynamics, if all individuals are committed to different sides, conflict ensues. We claim that neutrals interdependent with both sides, like quantum entanglement, allow neutrals to process both sides of an issue. Neutrals not only moderate conflict, they can decide elections, the

competition for them generating limit cycles (Lawless et al., 2016).

Thermodynamics, Entropy Production and Multitasking. With Shannon's information theory, overlooking the interdependence of multitasking, three human or robotic scientist slaves generate zero entropy; i.e., $\log 3/3 = 0$; and three independent scientists give an entropy of $3 * 1/3 \log 1/3 = 1.584$ (Lawless et al., 2016). In contrast, with graph theory, we postulate that a team of independent scientists interdependently multitasking perfectly is like the well-fitted different roles played by the independent members of a great baseball team.

When a set of tasks performed by the least number of scientists forms a team (graph) that multitasks perfectly (e.g., a small team of a theorist, modeler and experimenter), a group is converted into a team structure that produces least entropy (LEP). But like entanglement at the quantum level, interdependence reduces degrees of freedom (dof), just as it does for a crystal. Setting Boltzman's constant k to 1 gives: $= \log(\text{dof})$ (Eqn. 2). As a collection of individual scientists is forged into a single unit, thereby reducing its dof, zero entropy is produced.

We revise equation (1) to give the standard deviation

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of LEP times the standard deviation of maximum entropy production (MEP). We find in the limit: $\lim_{\alpha \rightarrow 0} \# = \infty$ (Eqn. 3); i.e., as the entropy produced by a team's structure goes to zero, the entropy produced by its science equals MEP, our first novel finding. Thus, a scientific team composed of perfectly interdependent members can maximize its search for solutions to its target problem (Cummings, 2015).

Reversing the limit: $\lim_{\alpha \rightarrow \infty} \# = 0$ (Eqn. 4). Unexpectedly, our second novel finding is that as teamwork becomes dysfunctional, problem-solving ceases; e.g., enforced cooperation, authoritarianism, or split-ups. Eqn. 4 accounts for Department of Energy's scientific consensus to use ordinary cardboard boxes to dispose

of radwastes until the whistle was blown on DOE in 1983 (Lawless et al., 2016; see Fig. 2); for the environmental problems in China; and for the inability of young scientists in gang-controlled areas to flourish in school.

Paper 2: Knowledge Negotiation across Disciplines with Model Based Reasoning

Authors: Deana Pennington

In interdisciplinary socio-environmental research teams, deep knowledge from different perspectives must be integrated into shared mental models of the problem to be solved, which initially is ill-structured, or a wicked problem. The process of deep knowledge integration has been identified as a core challenge for team research in general, and in socio-environmental team in particular. These teams often come together to collaborate having very little training in common beyond introductory undergraduate science classes, yet they must learn enough about each others' perspectives to find interesting, potentially productive research intersections. Failure to generate a shared mental model can lead to goal misalignment, conflict, and inability to produce truly interdisciplinary outcomes.

There is little understanding of how to facilitate knowledge integration when the problem is ill-structured and the perspectives are both deep and highly heterogeneous. Group activities that have been developed for situations that call for integrating knowledge across diverse perspectives assume that participants primarily differ in the context from which they view the problem. Brainstorming activities, for example, call for generating and building on each other's ideas without critique. In contrast, in socio-environmental research teams it is often not possible to build on each other's ideas because no one understands the ideas put forth by the other disciplines. Team members simply do not have the background, training, and vocabulary to understand each other's research.

For progress to occur, team members must understand each other's disciplines well enough to find points of intersection. It is fundamentally a learning problem, but one that is mediated by group processes and depends on transformational learning. This presentation will introduce new conceptual models that have been developed and are soon to be tested by the National Science Foundation-funded Employing Model Based Reasoning in Socio-Environmental Synthesis (EMBeRS) project (grant DGE-1545404). The project was conceived and designed through a working group at the National Socio-Environmental Synthesis Center (SESYNC), also funded by the National Science Foundation (grant DBI-1052875).

Paper 3: Collective Intentionality and Science of Team Science

Authors: Deborah Tollefson

Over the past few decades, a number of philosophers have begun to investigate joint agency and its underlying intentional structure. John Searle (1990, 1995), Michael Bratman (1993, 1999, 2004, 2006), Margaret Gilbert (1989, 1994, 1996, 2003), and Raimo Tuomela (1992, 1993, 1995, 2007), among others, have offered accounts of shared agency that appeal to higher-level states (such as goals, commitments,

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and intentions) that are “shared” in some way. This theoretical work is the foundation of the rapidly growing field of collective intentionality. In addition to questions regarding the nature of shared agency, those working in this field explore a number of related issues including group rationality, group objectivity, and collective and shared responsibility. In this paper I consider how this literature might help to inform the science of team science (SciTi). In particular, I consider the ways in which “we-intentions” and “we-mode” beliefs might help us to theorize the mechanisms that contribute to effective team science and I consider how theories of shared responsibility might help us to understand responsibility in the context of team science.

Paper 4: Joining Forces - Some Issues in Collective Intentionality for Interdisciplinary Teams

Authors: Graham Hubbs, Ian Werkheiser, & Michael O'Rourke

In this presentation, we ask a number of theoretical questions about the collective activity of interdisciplinary research teams. Specifically, we are interested in the collective intentionality of these teams, where this is understood as the ability of a group of agents to function together in joint pursuit of a particular goal (e.g., thinking through a problem, making a decision, performing an action). This ability is typically analyzed in terms of psychological attitudes, e.g., belief, acceptance, and intention. Roughly, a group exhibits collective intentionality when they function in “we”-mode, rather than as a group of individuals functioning in “I”-mode.

So understood, collective intentionality is an important part of successful interdisciplinary research collaborations. To be successful, these groups must integrate their perspectives, both socially and epistemically, in the course of designing, performing, concluding, and disseminating their research. This integration is typically effected in the decision-making processes that underwrite these stages in the life cycle

of an interdisciplinary project. Integrative decisions are marked by the need to combine the beliefs and values of collaborators, and this requires jointly evaluating the research options and thinking collectively about trade-offs that can further project goals.

Against this background, we describe and discuss several questions about interdisciplinary research teams that concern their ability to function jointly in pursuit of project goals:

1. How extensive must mutual understanding be to enable collectively intentional activity? Both Michael Bratman's and Margaret Gilbert's accounts rely heavily (though in different ways and for different reasons) on the idea that members of a shared or collective project understand both the project's goals and the actions that other members of the collective are going to perform to achieve those goals at a high level. In many interdisciplinary collaborations, however, members of the communities of practice have radically different understanding of what the words used to describe the project's goals mean, what would count as achieving the goals, and similar deep ambiguities. We examine the collective intentions of an interdisciplinary community of practice in light of Bratman's and Gilbert's accounts.
2. How do environmental factors constrain collective thinking in interdisciplinary groups? Lucy Suchman's work on situated cognition suggests that particular arrangements of social, cultural, and physical contexts can shape the way individuals think. What does this suggest for collective thinking in interdisciplinary groups? At the level of the community, it could entail the ability of structured contexts to overcome disciplinary differences of members in order to forge a community of practice that is thinking collectively; alternatively, at the level of the individual engaging in the joint actions with other members, it could entail that interdisciplinary work either accentuates or de-accentuates a member's socio-cultural context of being, e.g., a biologist.
3. To what extent is collective intentionality required

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for project integration? As we have noted, integration is a mark of a successful interdisciplinary research project; when the project is collaborative, it is difficult to distinguish the social dimensions of integration from the epistemic dimensions. Using the theories

examined above, we will address the question of whether collective intentionality is a condition – necessary or sufficient – on integration in collaborative, interdisciplinary research projects.

Thematic Session 3

Team Training in the Trenches

3:45-5:15 pm

Paper 1: Taking Interdisciplinary Team Science to the Next Level - Team Training for Clinical and Translational PhD Scientists

Authors: Wayne McCormack

The UF Clinical & Translational Science (CTS) PhD program is based on the premises that interdisciplinary and interprofessional training in team science will enhance the effectiveness of research teams, and that researchers must be prepared for academic and nonacademic translational research-related career pathways. Supported in part by a CTSA TL1 training grant, we have expanded an innovative CTS curriculum, including didactic coursework, mentored research, and career and professional development, for the effective learning of CTS core competencies. Much of the core curriculum utilizes team-based learning as a primary teaching method, and we have developed a team-based model for research training in which PhD candidates from multiple disciplines perform collaborative doctoral research with a mentoring mosaic model of basic and clinical scientists. The impact of this team training model for PhD scientists is being evaluated using competency-based assessment and a range of innovative assessment metrics based on a conceptual model of training progression and career success.

The CTS program offers a PhD co-major and certificate program for students in nearly 40 partner PhD programs based in all six Health Science Center colleges (Dentistry, Medicine, Public Health & Health Professions,

Nursing, Pharmacy, and Veterinary Medicine) and five other colleges offering health-related PhD programs (Agriculture & Life Sciences, Engineering, Health & Human Performance, Journalism, and Liberal Arts & Sciences). The CTS core curriculum was designed to strengthen research skills through experiential group work that requires team collaboration, discussion, analysis, and presentations. Some core courses include: "Translational Research & Therapeutics: Bench, Bedside, Community, & Policy", in which student teams identify an unmet medical need and develop protocols for the T0-T4 stages of translational research; "Team Science", in which students work in teams to learn about the science of team science and practice skills related to team assembly, management, maintenance, and evaluation; and "Responsible Conduct of Biomedical Research", in which interdisciplinary student teams practice ethical decision-making via team-based learning.

The common theme of transformational learning brought about by collaboration and team science in the core curriculum is being extended to doctoral research training by implementing "TL1 Teams" comprised of two or more PhD and/or dual-degree students from different degree programs in at least two colleges, each of which identifies basic and clinical science dual mentors, has an original dissertation research project related to human health or disease with at least one CTS-specific research aim, and added elements of collaborative research and team mentoring. The formation of TL1 Teams will be driven in part by using

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an alteration approach that uses social network analysis to analyze networks of faculty mentors to identify optimal team-building where collaborators are picked from the network structure, rather than waiting for them to emerge on their own. Possible collaborators identified in this way will be screened for their potential as TL1 mentors and eligibility of graduate students for TL1 funding. It should be emphasized that TL1 trainees will not be working on "team dissertations", but will be expected to meet established minimum expectations and anticipated achievable research outcomes. TL1 Teams have a common research interest, such as a particular human disease being investigated at different levels (molecular, cellular, organismal, population), with different experimental approaches, and/or at different parts of the T0-T4 continuum. Trainees prepare a team plan that identifies ways in which the research projects of individual team members will inform each other, provide alternative experimental approaches or data analysis methods, assist with data collection or analysis, etc.

We are using the science of team science to transform doctoral training for translational scientists, and welcome opportunities to expand the collaborative training model across institutions.

Paper 2: Enhancing Integrative Capacity and Team Science Effectiveness - The Role of Team Training

Authors: Theresa Lant & Maritza Salazar

Although interdisciplinary scientific collaboration has many success stories, evidence suggests that in many cases these teams do not achieve the goal of successfully integrating knowledge to solve a joint problem. The goal of knowledge integration among diverse scientists is often elusive due to the make-up of the teams, lack of understanding about best practices for managing collaborations, and team leaders who are scientific experts but have not been trained to lead diverse teams of professionals. The consequence can be a costly investment in scientific endeavors that do not reap the expected benefits.

Prior research suggests that interdisciplinary teams must develop an integrative capacity, a capability that is sustained through an interactive system linking social, psychological, and cognitive processes and emergent states in the team that can provide them with the resources needed to succeed. This National Science Foundation supported research investigates how the development of a team's integrative capacity and subsequent knowledge outcomes are impacted by two types of interventions: (1) strategic team mapping – learn to better assemble your team to foster collaboration and (2) communication principles – to support cross-boundary knowledge sharing, integration and creation. We argue that exposure to these interventions (developed based on our prior study of sixty interdisciplinary research teams in one medical center) can nurture team members' trans-disciplinary orientation, the enduring values, beliefs, skills, and behaviors that support collaboration with teammates who have diverse disciplinary backgrounds, which, in turn, fosters the development of integrative capacity.

To test the effectiveness of these science team training interventions, we conducted a large-scale highly controlled quasi-experiment in the field involving 50 interdisciplinary science teams from across 7 top medical research schools. The study uses a 3x1 design, in which teams are randomly assigned to one of three conditions: strategic team mapping training alone, communication principles training alone, or both trainings. We tracked the impact of training on the level of integrative capacity and subsequent ability to generate integrated knowledge and innovation. Pre and post data collection were conducted in order to follow the development of the team's integrative capacity at various points during their collaborative process. Preliminary findings suggest that team training had the intended positive effect as indicated by enhanced social integrative behaviors compared to pre-training $F(1,47)=4.66$, $p<.05$. Receiving both types of training compared to only one was also found to be positively related to team effectiveness ($F(1,38)=5.43$, $p<.05$).

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Paper 3: Simulations for Team Science Training

Authors: Gia Demichele, Maritza Salazar, Theresa Lant, & Mackenzie Shults

Hidden profile tasks have been used in team studies for many years (e.g., Stasser & Titus, 1985; Lu, Yuan, & McLeod, 2012). Results from a meta analysis reveal that groups working with a hidden profile task are more likely to focus on shared information than on uniquely held information, making it less likely that teams working with a hidden profile task will find the correct solution, compared with teams in which every member was given access to all information pertaining to the problem (Lu, Yuan, & McLeod, 2012). This finding approximates the daily experience of an interdisciplinary research team wherein each member has a) a different background, b) a different level of expertise, and/or c) a different understanding of the problem at hand, which results in interdisciplinary teams being less effective than their combined levels of expertise would suggest. Because of these similarities between interdisciplinary teams' experiences and the experiences of teams working on a hidden profile task, we felt that this method was the optimal method for use in conjunction with interdisciplinary team communication training.

In order to demonstrate to interdisciplinary teams the importance of clear communication focused on uniquely held information, we created a hidden profiles task about a MRSA (Methicillin-resistant *Staphylococcus aureus*) outbreak at a hospital. The majority of teams participating in our interdisciplinary team training program were medical research teams, so we felt that a problem around a common hospital infection would be the most relatable and understandable to all team members (rather than a task focused on selecting the best candidate, which is a common format for hidden profiles tasks). The hidden profile task was broken into four separate profiles: 1) information related to human resources (e.g., who was working when), 2) information about the operations of the hospital (e.g., a standard operating procedure for laundry washed in house), 3)

information about patients (e.g., patient histories), and 4) information about MRSA (e.g., how it is transmitted). Each profile contained key pieces of information for solving the problem of how a MRSA outbreak happened at a hospital, as well as filler or distractor information. For example, in the operations profile a participant would discover that the water heater was not functional the first night after a MRSA infected patient arrived at the hospital—when this same individual reads that the standard operating procedure for laundry involves washing in hot water with bleach, the team member often comes to the conclusion that the lack of hot water has caused the spread of MRSA. However, the individual who has read the information about MRSA profile would be able to counter this false positive with the information that states that bleach alone is enough to kill the MRSA virus. This activity, in conjunction with a training focused on improving communication on interdisciplinary teams, serves as an educational tool that demonstrates how different types of communication (or lack thereof) impact interdisciplinary team performance.

In this presentation we will provide examples of how this activity can be used for the purposes of training and development with interdisciplinary teams. These examples are based on our work with interdisciplinary student and medical teams as part of the BRIDGES (Building Resources for Integrating Disciplines for Group Effectiveness in Science) National Science Foundation grant.

Paper 4: A Team Science Approach to Leadership Development

Authors: Amy Moore

The Institute of Cancer Research (ICR) in partnership with the Royal Marsden Hospital is a world leading comprehensive cancer centre, and the largest in Europe. The 'bench to bedside' model for translational research is facilitated by multidisciplinary teams, bringing diverse skill-sets together to drive discovery and accelerate patient benefit. In 2012 the ICR's Cancer

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Therapeutics and Drug Development Units were recognised by the American Association of Cancer Research Team Science Award, becoming the only non-US recipient of the award to date

The ICR recognises that research career mobility seeds expertise across the global cancer research community and that the traditional boundaries of working within one organisation may limit capacity to collaborate. Over 90% of ICR postdoctoral researchers (postdocs) will move to a new organisation after a maximum of 7 years here and research into career destinations of postdocs demonstrates the global reach of our alumni, with 30% of a sample of 232 alumni represented in over 20 non-UK countries.

Postdoc alumni data highlighted that most postdocs who achieve an academic team leader role do so in organisations they are new to. The value of effective leadership training for team science has been previously highlighted, so there is a strong rationale for preparing scientists for leadership before they transition into such roles. The ICR took a "team science" approach to support outstanding postdocs to prepare for academic leadership by developing and evaluating a cross-organisational programme, namely "Pathway to Independence; Developing future scientific leaders". Organised by ICR and world-leading peer research institutes (e.g. the Wellcome Trust Sanger Institute) in partnership with a major UK government

research funder (the Biotechnology and Biological Sciences Research Council; BBSRC), the programme was launched in 2013 and so far has seen 48 delegates participate from twelve different UK research institutes.

The programme (building on US-developed resources) supports the challenges of transitioning to a team leader role and explores key skills required to deliver science in a multidisciplinary environment e.g. influencing, negotiation, and collaboration skills. Workshops provide multiple perspectives from within and outside academia, including current research leaders, funders, industry professionals and journal editors. Feedback indicated that 100% of delegates valued the cross-organisational nature of the programme and variety of speakers: "...really important to have the different perspectives arising from different organisations." and "it was particularly useful to have discussions about research leadership with people from industry and in publishing; after all, they are also key collaborators". Over 90% cited feeling increased confidence in their ability to lead a team and in managing key relationships required for effective team science. Three year career-tracking revealed that 50% of the pilot cohort successfully achieved research leader roles, the majority in new organisations, compared to the UK sector average of less than 10%. This model demonstrates the value of a collaborative approach to leadership development in scientific research.

Thematic Session 4

Shared Resources and Collaboration: Events, Data, and Documents

3:45-5:15 pm

Paper 1: Communities and Common Pool Resources in Science - An Event-Based Social Capital Perspective

Authors: Federica Fusi, Eric Welch, & Selim Louafi

As science becomes increasingly computational and data-intensive, social capital - the goodwill available to individuals and groups - gains importance in scientific communities for accessing, sharing and using resources

including data, knowledge, or IT assets. Research has shown that communities – organizations, teams, groups – with greater social capital are more likely to share and collaborate, but we know little about how social capital is developed as a community attribute, particularly in an increasingly global research context. While scientists rely on their personal networks to access and share resources, they are often reluctant to

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As science becomes increasingly computational and data-intensive, social capital - the goodwill available to individuals and groups - gains importance in scientific communities for accessing, sharing and using resources including data, knowledge, or IT assets. Research has shown that communities – organizations, teams, groups – with greater social capital are more likely to share and collaborate, but we know little about how social capital is developed as a community attribute, particularly in an increasingly global research context. While scientists rely on their personal networks to access and share resources, they are often reluctant to engage in resource sharing within global communities. Thus, understanding about how communities develop social capital is important as research teams become larger and more international.

This paper aims at investigating how social capital is constructed and developed within large-scale scientific communities that aim to promote resource sharing across national borders, sectors and disciplines. We hypothesize that community-based social capital is built through a continuous interplay between micro and macro level behaviors and decisions. Evolutionary stages of community development – setting-up the initial team, defining the resource, designing rules and boundaries – determine the patterns of social capital growth. Building cohesive and cooperative communities might be challenging, and mapping those patterns will enhance our understanding on how social capital can be created and sustained into large-scale scientific communities. Moreover, it will enhance our understanding on how macro-level actions and decisions influence micro-level patterns and social outcomes and vice versa. Social capital literature is still missing critical understanding of how social capital components are combined at those different scales.

Our study draws from the analysis of six initiatives that are building communities for resources sharing across

different scientific fields. We selected our cases using a purposeful sampling strategy in order to maximize the unique contribution of each case. We particularly considered heterogeneity in resources, actors and project maturity stage. We operationalized social capital as both a combination of sources - networks, resources, trust, reciprocity and shared beliefs – and outcomes - collaboration, cooperation, access to resources. Interviews and documents collected for each case have been used to develop a narrative for each initiative and identify sources and outcomes of social capital at different stages of the case. Preliminary results show that the creation and long-term sustainability of community-based social capital is a non-linear process, which is marked by events that create new opportunities for interaction between the macro and the micro level. Moreover, patterns of social capital are highly dependent on the types of resources that are shared. Implications for the building of large-scale, distributed scientific communities are discussed.

Paper 2: Tracing the Evolution of Collaborative Virtual Research Environments - A Critical Events-Based Perspective

Authors: Ashley Trudeau, Iftekhar Ahmed, & Marshall Scott Poole

A significant number of scientific projects pursuing large scale, complex investigations involve dispersed research teams which conduct a large part of their work virtually (Cooke & Hilton, 2015). Virtual Research Environments (VREs), cyberinfrastructure that facilitates coordinated activities amongst dispersed scientists, thus provide a rich context to study team science. Due to the constantly evolving nature of technologies, it is important to understand how teams of scientists, system developers, and managers respond to critical incidents.

Critical events are organizational situations that trigger strategic decision making to adjust structure or redirect processes in order to maintain balance or improve an already functioning system (Gaddis, 2002; Gersick,

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1991; Mintzberg, Raisinghani, & Theoret, 1976; Poole, 2004). Critical events are disruptions that demand the attention of organizational decision makers. Critical events range in severity (Mintzberg et al., 1976), impact on organizational activities (Gersick, 1991), may be anticipated or unanticipated, and are not temporally bound. Critical events may be a sudden crisis requiring immediate action or a slow recognition of a problem (Mintzberg et al., 1976). Decisions made because of critical events involve a change in structure, policy, or practice.

Paper 3: A Neglected Site of Interdisciplinary Exchange - Large-Scale Datasets in the Social Sciences

Authors: Erin Leahey, Attila Varga, & Jerry Jacobs

Interdisciplinary Research (IDR) is the subject of a great deal of interest on the part of science policymakers, university administrators, and academic researchers. Federal agencies like the National Science Foundation and the National Institutes of Health are promoting it by supporting cross-cutting funding opportunities and interdisciplinary research centers. Universities are funding cross-department and cross-college research endeavors and even reorganizing to facilitate IDR by developing cross-disciplinary schools and/or research centers (Sá 2008). Indeed, many studies of IDR to date focus on interstitial places like university research centers (Biancani, McFarland, and Dahlander 2014; Boardman and Corley 2008).

A premise that guides the current study is that interdisciplinary research may well be fostered at other levels, and practiced in other places. It may even be fostered unintentionally, or practiced without top-down orchestration, prodding, or support. Jacobs (2013) makes clear that disciplines themselves are porous, and serve as a site of much interdisciplinary scholarship. We suspect that large, survey-based datasets that are available to the scholarly community may also serve to foster ‘bottom-up’ interdisciplinary scholarship among social scientists. Panel studies are particularly likely to foster collaboration across fields.

The expense of fielding such studies necessitates multiple sources of funding and thus leads to the inclusion of a wide suite of topics and questions, making the resulting dataset of interest to a broad swath of scholars. The inclusion of many topics and questions allows and perhaps prompts scholars to engage in nuanced, sophisticated analyses that are attentive to (or at least control for) variables that scholars from other disciplines have found to be critical. In short, the richness, depth and breadth of panel data make nuanced, complex, and integrative investigations possible.

The role of “big science” in stimulating the growth of large projects and collaborative teamwork in the natural science has been a prominent theme in science studies dating back to the work of Price (1963). This study seeks to ascertain whether the advent of large-scale panel datasets in the social sciences represents a similar development, albeit on a smaller scale.

To investigate this claim, we are embarking on a project to examine the research output of various large panel datasets, including Panel Study of Income Dynamics (PSID), National Longitudinal Study of Youth (NLSY), and National Longitudinal Study of Adolescent Health (AddHealth). Here, we present preliminary results from one of these large social science datasets: AddHealth.

Add Health is an ideal case to investigate. As stated on its website (<http://www.cpc.unc.edu/projects/addhealth/about>), this “most comprehensive longitudinal survey of adolescents ever undertaken” received funding from not only from National Institute of Child Health and Human Development (NICHD), but also 23 other federal agencies and foundations. Co-funding is a clear indicator of broad, cross-disciplinary interest. The website also states that AddHealth provides “opportunities to increase knowledge in the social and behavioral sciences and many theoretical traditions.” This is because in addition to standard self-reported attitudinal and behavioral items, AddHealth also collects ego-centric social network data as well as blood and urine samples to obtain bio-markers. The

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administrators “encourage researchers and students of public health, human development, biomedical sciences and related fields to explore the possibilities in this rich dataset.”

Data & Methods

From the Carolina Population Center, with which Principal Investigators of the AddHealth project are affiliated, we obtained an updated ENDNOTE library containing bibliographic information for all papers and presentations (as of October 2015) that utilize AddHealth data ($n=4806$). In our analysis we principally focus on the 1686 journal articles that are indexed in Thomson Reuters’ Web of Science (WoS), omitting comments, replies, book reviews, book chapters, conference presentations, and articles published in journals not represented in WoS. For these 1686 articles we downloaded the full WoS record, including article title, publication year, author names,

institutional affiliations, abstract, journal name, and subject categories (SCs). There are approximately 250 SCs that roughly correspond to disciplines or large sub-disciplines; examples include sociology, demography, management, and social psychology. Between 1 and 6 SCs are used to classify each journal, and by extension, each constituent article. We rely on these SCs to define the knowledge space ‘covered’ by AddHealth based scholarship.

We also collected information about the works cited by these 1686 focal articles, including the number of references cited and the SCs associated with those referenced articles. Such data allowed us to calculate what Alan Porter (2007:127) calls Integration: a sophisticated measure that incorporates not only the variety of disciplines (i.e., SCs) referenced, but also the evenness of their distribution as well as the (dis)similarity of the disciplines. This captures the breadth of research referenced in a paper. We refer to this informative measure more modestly as a measure of interdisciplinary research, because it does not really capture the extent to which diverse ideas are fully

integrated in the paper in question. Porter’s measure is a particular parameterization of the Stirling Index:

$$1 - \frac{\sum_{i,j} s_{ij} p_i p_j}{\sum_i p_i^2}$$

where s_{ij} is the similarity between SCs i and j , p_i is the proportion of referenced papers in subject category i , and p_j is the proportion of referenced papers in subject category j (Rafols and Meyer 2010: 267-8). Intuitively, a paper’s IDR score increases as it references more, relatively unrelated SCs (Porter, Cohen, Roessner, and Perreault 2007). The IDR score ranges from 0 to 1, with scores closer to 1 indicating greater interdisciplinarity.

Information obtained from the bibliographies of these 1686 focal articles also allowed us to ascertain whether and to what extent each article is citing other AddHealth articles. For each focal article, we calculated the percent of journal articles in its bibliography that also utilize AddHealth data.

Results

The mean IDR score across all 1686 articles is quite high: 0.78 (recall the theoretical range is 0 to 1), and the median is 0.8. This suggests that on average, AddHealth articles draw upon on a large, and dissimilar group of disciplines. When we compare AddHealth research to samples of articles that other scholars have analyzed, its level of interdisciplinarity is even more apparent. In their study of over 25,000 articles from a broad range of disciplines including engineering, life sciences, and physics, Leahey, Beckman, and Stanko (2016) found the mean IDR score to be 0.62. In their study of 6 fields (Math, Biotechnology, Electrical Engineering, Medicine, Neuroscience, and Physics), Porter and Rafols (2009) found IDR scores as low as 0.211 (in Math) and as high as 0.66 (in Biotech and Medicine). Clearly, the set of articles we analyze, all of which utilize AddHealth, are on average more interdisciplinary than other articles.

As another indication of the interdisciplinary scope of AddHealth research, we find that these articles were published in many different outlets (a total of 386

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journals are represented among the 1686 articles) across a wide range of subject areas, including criminology, psychology, sociology, and many smaller fields. In total, over half (160/250) of the WoS SCs are represented, including biotechnology, computer science, dentistry, engineering, gastroenterology, history, international relations, microbiology, oncology, rehabilitation and urology.

We also see evidence that over time, AddHealth scholarship is becoming more interdisciplinary. The bivariate correlation of IDR score with publication year is 0.18. The positive correlation between publication year and IDR score remains even when we control for the number of articles referenced, which one author (Varga) has shown to be related to IDR. Articles published in the first three years after AddHealth's release (1997-1999) have a mean IDR score of 0.72; this increases to 0.80 in the last three years (2013-15). This 11% increase over the 18 year period (1997-2005) corresponds with other longitudinal analyses of interdisciplinarity, and likely exceeds it. Porter and Rafols (2009) studied a longer time period (1975-2005), and found upward shifts in the range of 2.7%-6.5% for all fields except Physics (15% increase) and Mathematics (38% increase). Leahey, Beckman, and Stanko (2016) found a 17% increase in mean IDR scores between 1979 and 2005. These comparisons suggest that AddHealth scholarship has, in a short period of time (18 years: 1997-2015) witnessed increases in interdisciplinarity that meet or exceed that found in other bodies of scholarship.

Collaborative research is also common among AddHealth papers. Overall, 85% of AddHealth articles are co-authored by two or more scholars. This percentage is greater than for sociology articles more generally (Hunter and Leahey 2008; Moody 2004), suggesting a culture of collaborative practice among AddHealth users. We know that roughly 75% of the collaborative articles are authored by scholars from different institutions. Collaboration intensity is stable in the period: the average number of authors of a paper did not change. However as the collaboration network

grew, it became more specialized. Another measure of clustering in two-mode networks, 4-ring closure, shows a similar trend, increasing over time. These preliminary results suggest that collaborations among scholars using AddHealth have become more specialized over time.

In the coming months, we will attach university prestige rankings (from Leiden or Shanghai) to assess whether collaboration is increasingly taking place within (but not across) prestige levels, as Jones et al. (2008) found. We will also disambiguate authors' names and collect individual-level data on gender, professional age, and primary department so we can analyze trends in team composition. While we plan to build on these analyses before the SciTS conference, the results thus far clearly indicate the promise of studying panel datasets as a site of collaboration and cross-field research.

Paper 4: Virtual Chaos, Face-to-Face Confusion - Academics and Document Stewardship in Virtual Collaborations

Authors: Sarika Sharma, Matt Willis, Steve Sawyer, & Carsten Osterlund

We present findings drawn from an ongoing study focusing on the shared work practices, uses of documents, and reliance on digital infrastructures of virtual scientific collaborations. Our findings suggest that organically driven collaborative teams of academics are constantly grappling with document chaos when situating their work online. The struggles of these academics are not an inherent reflection of disorganization or competence. Rather, what comes clear is that people bring their personalities and mental models to a collaboration that intermingle and collide. We surmise the different ways people interact may have to do with how they think and feel about certain collaborative technologies and how they interact through collaborative technologies.

We present findings drawn from an analysis of data gathered at two focus groups where we discussed

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distributed collaborative scientific practice. We were interested to learn about how participants organize their own work in distributed teamwork environment. Across the two focus groups, 11 scholars from intellectual communities of sociology, architecture, science and technology studies, anthropology, informatics, and communications, met with three members of the research team. Research team members were there to help manage the structure of the discussion and to take notes. From the initial analysis of the focus groups, we hope to provide insight to existing practices of attendees and spark conversation about successful collaboration, specifically in the area of interdisciplinary distributed collaborations.

The first focus group was approximately one hour in duration and the second focus group was an hour and half. To frame the conversation participants were given three vignettes. The first vignette describes the confluence of documents in the teamwork and how teams share, store, and reuse documents. The second vignette describes a scenario about a team using several ICT's, moving from one ICT to another and trying to make sense of the organization. The third vignette was aimed at describing data sharing norms in teamwork. These vignettes were developed from the data of 23 semi-structured interviews that had been conducted in the previous year (See CITE withheld for review). The vignettes were read to participants. A series of semi-structured questions, that built from these vignettes, were used as probes to further elicit data from participants.

Three findings emerge from the analysis. First, we learned that collaborators want to better understand how they are represented in their use of certain technologies. For example, one respondent maintains four email inboxes to ensure her identity as a professor and teacher, mother, and online surfer remain distinct from each other. Second, respondents bring their personal opinions on what collaborative technologies they have a preference to use. For example, "I refuse to use Google Drive" is the technological equivalent of "I

am a vegan I refuse to". Third, participants have different mental models and organizational schema when it comes to organizing their documents online. For example, we observed that depending on the platform in use (for example: Dropbox, Google Drive, local file manager) collaborators will bring different schema to those platforms and therefore collaborative groups have to build consensus around use.

We see this as a root cause of groups grappling with document chaos and experiencing problems with collaborating through documents. That members within a group impose different organizational schema and practices onto the collaboration if there is not an explicit practice.

This research is relevant to the Science of Team Science audience in that it helps us to understand why there exists no perfect technology or platform to facilitate successful scientific collaboration. Our findings make clear that distributed collaborative work is sustained through a variety of configurations of software, platforms, tools, and technologies. And, we find that people's practices are tied to their mental models of organizing documents, more than to the specific characteristics of any standardized and shared technological platform.

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Thematic Poster Group #1

Practical Resources, Tools, and Training

Poster 1 - UC Team Science Retreats: Promoting and Furthering Research, Excellence and Diversity in Team Science

Authors: Susan Carter, Barbara Walker, John Crockett, & Susan Carlson

Team Science (TS)-based research has become increasingly central in scientific discovery. Diversity on teams is known to have positive effects on creativity, innovation, and productivity. Having a strong network of collaborators, mentors, and co-authors is critical to a successful academic career. However, women and under-represented minority (URM) scientists are less likely to participate in TS collaborations and their participation in these networks develops later in their careers.

1. Relevance. Apart from its contribution to scientific breakthroughs and grand challenge problems TS has beneficial impacts on individual research careers. Giving women and URM scientists tools to engage in TS efforts earlier in their careers has numerous individual and institutional benefits.

2. Aims & Objectives. Institutional leadership can support TS efforts and increase the participation of women and URM in leadership roles in science teams through specific early-stage interventions including faculty training approaches, Leadership and Team Formation Retreats, and asset-based concepts.

3. Methods. These methods are based on components of a pilot program "the UC Team Science Retreat" funded by an Elsevier New Scholars award and the University of California Office of the President. The first Retreat took place at UC Santa Barbara in July 2014; a second was held in Pacific Grove, California in October 2015. These retreats included early to mid-career faculty in the University of California (UC) system. The target audience was women (especially URM) researchers across STEM disciplines, including the social sciences. While the retreats focused on issues facing women and URM scholars, we invited participation from multiple

team members, including males; this addition created a climate of inclusion. It also gave all participants insights and training related to unconscious bias and the ways that men, women, and URMs navigate academic careers differently. The activities will be expanded to the California State University System and additional UC participants via the recently NSF funded Center for Research, Excellence and Diversity in Team Science.

4. Results. Institutions can combine components that support early-career scientists through a TS leadership program within existing multi-disciplinary research centers, including a component that values functional diversity. These tools can support diverse scientific teams to successfully compete for big opportunities. Application and evaluation data from this program suggest that women and URM faculty perceive and experience different barriers to entering science teams than their White male counterparts. Among the participants, confidence about TS competencies increased after the TS Retreat by an average of 29%.

5. Conclusions. The activities increase research and science capacity and impact, promoting the recruitment and retention of diverse faculty and a stronger and more diverse STEM workforce.

Poster 2 - Learning Theory, Operative Model, and Challenges in Developing a Framework for Collaborative, Translational and Implementable Doctoral Research

Authors: Gaetano R. Lotrecchiano, Paige McDonald, Kenneth Harwood, & Mary Corcoran

Doctoral dissertation research in many disciplines utilizes a process of focused and specialized research to establish individual expertise through technical knowledge discovery. This type of research purpose, though arguably still dominant in many academic disciplines, is becoming challenged as more fields are confronted with recognizing the important roles of 1) relevance and impact of research on social impact and

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implementation (Splitter & Seidl, 2011; Nikolai & Seidl, 2010) and 2) the benefits of cross-disciplinary integration and techniques in the generation of new knowledge as requisite preparation of graduates (Fuhrmann et al., 2011; Nash, 2008; Mitrany and Stokol, 2005). By constructing a multi-paradigm model for doctoral research that applies principles of collaboration science, cross-disciplinary knowledge economies, and a translational approach to health science research, we propose that doctoral dissertation research, though challenging, can be a pedagogical and impact-driven experience with high social impact as part of its research goals. Doctoral student preparations for professional and/or scholarly careers, while once seemingly separate trajectories, are now more than ever synergistic social and knowledge networks where scholarly discoveries and professional problem-solving are intimately tied goals (Borrego & Newslander, 2010; Stokols, 2013). The translational capacity of research to bring mechanistic basic knowledge to impact social need is an emerging tradition grounded in the priorities of expediency and efficiency of knowledge application and the benefits of accessing cross-disciplinary teamwork to inform 'wicked' social problems (Woolf, 2008; Hirsch-Hadorn et al., 2008; Stokols, 2006). Our proposed model provides a framework that encourages multilevel knowledge generation and translation (Pohl, and Hirsch Hadorn, 2007), product and impact driven research and teaming priorities (Trochim, 2011; Kosaraju et al., 2014) to work beyond the boundaries of any one discipline's social and scientific priorities (Nash, 2008) cognizant of the environmental factors that impact findings (Stokols et al. 2008). We propose that this type of approach, though seldom utilized in single-researcher doctoral dissertation preparation, will be useful in the prioritization and development of highly relevant and impact-focused research outputs that are the result of changing attitudes and behaviors of doctoral students and the purpose of their work (Lotrecchiano, 2014).

Poster 3 - Questae: A Game-Like Training Tool to Build Transdisciplinary Teams
Authors: Hala Azzam

Objective: In a world facing increasingly complex problems such as environmental degradation and overpopulation, non-communicable diseases and epidemics of violence, there is an urgent need to train a new generation of professionals from disparate disciplines to work together and bring innovative solutions. At the heart of any teamwork is building relationships and trust. This necessitates time and a process which can facilitate connections among participants with different mindsets. To date, existing training approaches in academia have paid little attention to the relationship building aspect, whereas team building activities in the business world have not adequately focused on transdisciplinary team training. **Hypothesis:** There is a need to develop a systematic and highly interactive tool that facilitates transprofessional team building, is easy to adopt and can be adapted to needs. This tool would accompany traditional training in academia and will facilitate project-based group work. **Specific aims:** 1) Conduct research to develop a prototype of such a tool; 2) Conduct focus groups and expert interviews to evaluate the prototype and refine the tool; 3) Implement and evaluate the tool in academic settings willing to collaborate.

Description of research methods: Research was conducted by participating in a roundtable meeting that convened academicians from various universities and Coempower to discuss building developing interprofessional skills in global health (University of Maryland, Baltimore, October 2013). Further research was carried out into PubMed, SciTS resources and the grey literature to assess existing interactive training tools that would help train a new generation of transprofessionals.

Summary of findings: While academic centers have begun experimenting with different cross-disciplinary training modalities, most utilize the traditional seminar and lecture methods, teaching about transdisciplinary concepts or exposing students to different fields by bringing teachers from various disciplines to lecture. Some use simulations for targeted interventions, others end their training with an interdisciplinary

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group project and journaling, but without much by way of preparing the students for their group activity. These findings indicate a need for a tool that is highly experiential, interactive and removed from the traditional didactic model of training. This tool would borrow from the field of psychology, neuroscience and team science among others. It would need to facilitate self-awareness, help participants understand the mindsets of others and embrace differences using visuals to uncover mental constructs including complex thoughts, emotions and attitudes that are often unconscious or subconscious. While game-like interventions that seek to build teams using different perspectives exist, none adopt a comprehensive and progressive approach towards building cross-disciplinary teams. We report here the development of Questae- latin for mindset -- a game-like training tool to build transdisciplinary teams. Questae is highly interactive and takes the participants on a systematic journey of discovery and team work. It progressively builds activities resulting in a transdisciplinary project activity based on real challenges. The tool uses among other things visual cards, words, challenges and exercises focusing on interprofessional communication and professional mindsets, culture, values, team composition, team roles and team work activities to help participants understand their mindsets and that of others.

Statement of how the research advances the SciTS field: To our knowledge this tool is unique in its focus and comprehensive approach to professional mindsets and cross-disciplinary training. It will help advance the SciTS field by providing team members with highly interactive and systematic approaches to build cohesive transdisciplinary teams.

Poster 4 - Case Studies in Team Science: Observations and Lessons Learned

Authors: Karen Demby, Mary White, Richard Davis, Rachel Lerner, Thomas Egan, & David Peden

Objective: To promote collaborative research funding

at UNC, a Team Science Resource, a group of faculty and staff, was formed within our CTSA to assemble multidisciplinary teams to apply for external grant support. Lessons learned can help others who assemble teams.

Methods: Over two years, 21 teams were formed. Team members were selected by the Team Science Resource which screened and selected funding opportunities that specifically called for a multi-disciplinary approach and had sufficient funding to support multiple PIs. Resource members nominated faculty investigators from at least three disciplines to serve on teams. 18 teams were formed in this manner; the remaining 3 teams were developed following a single workshop to develop proposals in response to research gaps related to diabetes and obesity. Our measure of success was submission of proposals for funding.

Summary of Findings/Results: 8 of 21 teams submitted a proposal and one team is planning to submit (43 %). For the teams that submitted at least one proposal, 2 were funded and another two have the possibility of being funded. Successful teams were those where a leader self-identified early in the process. Ten other groups did not submit proposals for various reasons, which included: lack of leadership (no one stepped forward); indecision on an approach or project; funding opportunity deadline was inconvenient; lack of common logistics and time to meet; and waning enthusiasm due to extended timelines.

Advancement for SciTS Field/Lessons Learned: The process of selecting investigators and assimilating teams to find an approach to funding opportunities was labor intensive. Coordinating meetings was time consuming, so interest in the project waned or other activities took priority over team work. We have moved to assembling teams in a retreat setting, providing sufficient time to develop a tangible product (such as draft of Specific Aims, or white paper) which we surmise aids team cohesion. Feedback from teams led to various adjustments over time; most notably developing a team memorandum of agreement (MOA) and more structure around team facilitation and

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formation was helpful and should be a priority. For the 3 teams that formed to respond to research gaps, the members were allowed to self-select into groups. This left them without clear directives in terms of which role each would assume. Two groups lacked leadership; one lacked content experts and the other lacked methodological experts. The final group was comprised of competent principal investigators. None of these teams submitted proposals. This informed us that balanced composition of teams is critical for success. In our latest endeavor, we endeavored that each team had some potential principal investigators and balanced content and methodological expertise.

Poster 5 - Team Science Workbook for NIH Program Staff
Authors: Kristi Pettibone

NIEHS is increasingly using consortium mechanisms to fund team science. We funded more U mechanisms from 2006 to 2016 than in the previous 35 years total. Recent experience with U grants has shown that these can be very useful ways to move science forward, but managing these grants is more complex than managing a standard R01 type portfolio. We developed a Team Science Workbook that provides staff with an overview of key topics that facilitate team science success. As part of the workbook, we provide a list of questions for program staff to reflect on and answer in planning their team science initiatives related to each of the areas listed below:

- Using a U Mechanism
- Understanding the Benefits of a Consortium
- Structure & Goals
- Roles and Responsibilities
- Governance Rules and Decision Making
- Preparing for Conflict Resolution
- Meetings & Communication
- Building a Team

Sources of information for the workbook include:

- Feedback from program with experience managing team science initiatives

- Interviews with grantees who participated in team science initiatives
- NIH Field Guide for Team Science
- Other team science and group dynamics literature
- NIEHS Leadership Development Program

Staff can use the workbook as a way to document and assess past/current projects or to plan for future projects. Upon completing the discussion questions, staff will have created a concrete plan for effectively managing a team science project.

The poster will highlight each of these sections and will provide examples of the reflection questions staff can consider in launching a team science initiative. We will also include resources for evaluating team science initiatives, such as NIEHS' Partnerships for Environmental Public Health Evaluation Metrics Manual.

Poster 6 - Multi-CTSA Team Science Training Intervention Pilot Study

Authors: Damayanthi Ranwala, Gwen Baillarger, Allen R. Brasier, Juan J. Cordero, Karen B. Demby, Diazgranados Diazgranados, Cathleen T. Kane, David B. Peden, Angela F. Pfammatter, Bonnie Spring, Beth B. Tigges, William M. Trochim, Lori Wiseman, Kevin C. Wooten, & Fruma Yehiely

Preliminary data for an educational team pilot study conducted among seven CTSA institutions (CCTR, Cornell CTSC, ITS, NC TraCS, NUCATS, SCTR, UNM CTSC) will be presented. The overall objectives of the study were to determine the value and effectiveness of a team science educational program for existing translational science teams, and how team science training can be improved in both content and educational process for future team science training interventions. Figure 1 illustrates the overall educational intervention design, which includes two online modules (TeamScience.net) involving team science for team scientists, two face-to-face sessions involving experiential exercises focusing upon collaboration and communication, as well as team

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diagnosis, needs assessment, and action planning.

Evaluative measures are being collected involves pre and post knowledge checks assessing effectiveness of online modules developed by Northwestern University, collaboration practices (Hall, et al., 2008), psychological safety (Edmonson, 1999), collective orientation (Driskell, Salas, & Hughes, 2010), and team member effectiveness (Loughry, Ohland, & Moore, 2007). The results of these pre and post measures will be presented. Qualitative data in terms of subject feedback for improvement in the design and delivery of team science training, as well as observations from seven site coordinators who are responsible for the intervention will be depicted as lessons learned. The data collected from this training intervention will be helpful in developing team science training needs for the translational science teams which is in line with one of the strategic goals of the NIH/NCATS.

Poater 7 - Community Engagement Software Works To Enhance Team Function

Authors: Karen McCord, Laura Dress, David Proctor, & Josefina Engel

The majority of research today is conducted in research laboratories that consist of more than two individuals. In fact, most published research papers are written by two or more authors from multiple organizations. Wuchty et al. (2007) studied 22 million research articles and found that the number of authors per team has increased from 1.9 to 3.5 authors over the past 45 years. These collaborative efforts make it possible for individuals with different expertise, ideas, and resources to come together in the name of discovery and innovation. At the same time, the shift towards team science has created new challenges around coordination and communication. This work builds on prior research conducted by Judith Olsen and Paul Mattessich on work processes in collaborative research by investigating what feature sets and corollary interventions are critical for virtual teams to be successful through a user study. The goal of this

research is to fully define a human-centered design for collaboration software.

Breezio, a software company that provides solutions to enhance collaboration among teams, is launching a user study to determine the qualitative enhancement of team functioning. A quantitative and qualitative web-based survey is distributed to research laboratories at the University of Maryland to assess the work processes of science teams. Users are working in a variety of research fields from biology and chemistry to teaching and sociology. Survey questions are aimed at identifying current collaboration tools used in these settings to evaluate what capabilities researchers are missing from current software tools. The survey is also designed to capture work processes, policies, and collaborative practices used by researchers. Results are used to inform Breezio's computer scientists as they continue to improve upon the system design.

Limitations exist with current software for virtual distributed teams. While social chatting features, file sharing, and email exist across a number of free services, none of these offerings provide the opportunity to grow a sustainable knowledge network and accumulate bodies of work in one place. This research is advancing the science of team science by understanding the needs of collaborative research laboratories and virtual teams and translating them into technical requirements. Through this study, Breezio can continue to build upon its human-centered design for a new type of collaboration software. Since the user study is surveying laboratories in a range of research fields, the software solution will be advantageous to a large number of teams. In addition to developing additional features, integration with a variety of current software tools, virtual and distributed science teams will be able to innovate and collaborate more efficiently and safely, and as a result serve the global research community as a whole.

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Poster 8 - Articles about Interdisciplinarity and Where to Find Them

Authors: Dilyn Corner, Thomas Padilla, & Michael O'Rourke

Interdisciplinary and transdisciplinary research typically combines the perspectives of multiple disciplinary cultures, and as such yields output that has no obvious disciplinary home. A common problem for those who conduct interdisciplinary and transdisciplinary research is determining the best journals to disseminate their results. This problem is even more vexing for those who wish to publish research about interdisciplinarity or transdisciplinarity. Many academic journals serve as the publication outlet for specific disciplines. There are multidisciplinary journals, such as Science and Nature; however, they count as multidisciplinary not because they concentrate on publishing articles about multidisciplinarity but rather because they publish disciplinary articles that derive from a variety of different disciplines. The lack of a circumscribed set of obvious publication venues has resulted in the scattering of the literature about interdisciplinarity and transdisciplinarity to the four winds. The resulting "fragmentation" in this literature presents significant difficulty for those attempting to stay current with the literature and contribute to it.

In this poster, we provide preliminary answers to two questions: (A) how should we think of the category, articles about interdisciplinarity, and (B) where are articles about interdisciplinary and transdisciplinary research being published. We report the results of a conceptual and bibliometric investigation of recent publication patterns involving research about interdisciplinarity and transdisciplinarity. We have

provided answers to these questions in turn as follows:

A. First, we collected publications from a variety of fields and journals that are paradigmatic examples of contributions to the literature about interdisciplinarity and transdisciplinarity. We conducted a philosophical analysis of the content of these papers to determine the characteristic features of this type of publication. We supplemented our philosophical analysis with bibliometric techniques to provide additional specification of our set of paradigmatic articles. We applied corpus analysis software to our paradigmatic papers to generate keyword lists and determine the collocation of various terms. The philosophical work helps us filter the keyword lists, highlighting those terms (e.g., 'interdisciplinarity', 'integration', 'complexity') that articulate central dimensions of this literature.

B. Second, the philosophical and bibliometric analyses of research about interdisciplinarity and transdisciplinarity will guide us in developing search strings to be used in searching article databases such as Web of Science and PubMed, yielding insight into the nature and range of publication venues for this literature. Once we identify search strings that yield a high hit rate of papers about interdisciplinarity and transdisciplinarity, we will collect a large set of article records from Web of Science and PubMed -- 1,000 from each published since 2011. After winnowing the sets to eliminate articles that are not about interdisciplinarity or transdisciplinarity, we will collect and analyze publication patterns based primarily on the journals in which the articles appear. The main finding we will report concerns the range and nature of journals that publish research about interdisciplinarity and transdisciplinarity.

Thematic Poster Group #2

Virtual Collaboration, Technology, & Citizen Science/Crowdsourcing

Poster 9 - CitSciBio.org- The Biomedical Citizen Science Hub

Authors: Katrina Theisz, Jennifer Couch, & Elizabeth Gillanders

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In an effort to help connect the widely dispersed practitioners and resources of biomedical citizen science, NIH have teamed up with HUBzero to build the Biomedical Citizen Science Hub, CitSciBio.org. The Hub (CitSciBio) is designed to be a collaborative virtual environment, and to be complementary to the existing citizen science and crowdsourcing websites and project databases. The field of biomedical citizen science is ever expanding and changing, and resources can be difficult to find as they tend to be scattered across different areas of the internet (scholarly publications, lay publications, recorded presentations, project portals, social media, etc.). Our intent is to create an online collaboration space for this growing field, and to enable the gathering of references, methods, and communities to be discovered and engaged by interested stakeholders. Users are able to work on projects (anything from collaborating on a blog series or a scholarly publication, to starting a biomedical citizen science or crowdsourcing project), store data and databases related to those projects, upload different types of resources, such as fact sheets, presentations, and collections of links to their favorite sources of information. HUBzero infrastructure also allows for much more functionality which can be unlocked or developed as needed.

CitSciBio is designed to enable the community to:

- Promote the evaluation of citizen science methods and assess which kinds of scientific questions are best-addressed using citizen science approaches.
- Share knowledge, common practices, and successful citizen science methodologies to the biomedical citizen science research community and other stakeholders.
- Build expertise and resources to support the rapidly growing field of citizen science.
- Advocate for and support open and citizen-inclusive (empowered) data sharing and the development of tools and platforms necessary to do this effectively.

- Foster communication and interaction among the geographically dispersed biomedical citizen science practitioners.
- Assess the infrastructure and computational demands associated with direct engagement of patients and the public in data collection, data donation, and data analysis.
- Investigate and maintain informational resources on the ethical, legal, and social implications of research that uses citizen science methods.

Impact on SciTS field:

Citizen science and crowdsourcing are emerging fields as methods of research. As more biomedical researchers accept and adapt these methods (and as more citizen scientists partner with researchers), resources and infrastructure to support these endeavors become increasingly important. Over time, much can be learned from those using CitSciBio to collaborate, learn, and engage each other in regards to team formation, dynamics, and interdisciplinarity within the coordination and communication of distributed/virtual teams. In the short term, the hub can help contribute knowledge, resources, and a collaborative platform for researchers and citizen scientists to find resources, methods, and team members.

Poster 10 - The Team Science Toolkit: Practical Tools for Success in Team Science

Authors: Amanda Vogel, Kara Hall, David Garner, & Elliot Grant

Are you an investigator who works in teams or leads teams? Are you an academic administrator or organizational leader who would like to create an organizational climate that fosters success in team science? Are you a funder who would like to better support or facilitate team science? Do you need measures or instruments for SciTS research, or to use in quality improvement oriented evaluation? The Team Science Toolkit has practical resources to help you achieve your goals.

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The Team Science Toolkit (www.teamsciencetoolkit.cancer.gov) is an online one-stop-shop for resources to help you engage in, lead, facilitate, support, evaluate or study team science. It contains a user-generated knowledge base of resources and information that leverages the collective knowledge and resources of all members of the SciTS community. Anyone can upload or download Toolkit resources, creating a continuously evolving knowledge store that represents the current "state of the science" in the SciTS field.

The Toolkit was created by the National Cancer Institute, and debuted at the Annual International SciTS Conference in the spring of 2011. New content and functionality are continually being added. The Toolkit currently includes over 2300 resources.

The Toolkit offers three main types of resources: (1) practical tools to help engage in, facilitate, or support team science; (2) measures to study or evaluate team science; and (3) a bibliography that integrates resources from the wide range of disciplines generating scholarship relevant to success in team science. The Toolkit also includes a popular expert blog featuring knowledgeable perspectives relevant to maximizing the success of team science, and a vibrant linked listserv (SciTSlist).

This poster highlights practical tools for team science that are available on the Toolkit, to help with formation, team functioning, team training, quality improvement oriented evaluation, and recognition and rewards for team science. The Toolkit's practical tools have been generated by investigators, administrators, funding agencies, and SciTS scholars.

The poster also highlights the very popular blog feature on the Toolkit. Recent blog posts have addressed such wide-ranging issues as: data sharing and reuse, training undergraduates in team science, crowdsourcing to support harmonization of measures to enable meta-analysis and integrative data analysis, and interdisciplinary collaboration. Authors are hand-selected experts who are using team science in the field, teaching team science, or studying team science.

Overall, the Toolkit aims to integrate and unify the diverse and growing knowledge about effective practices for team science, and to make this knowledge broadly available to the wide range of stakeholders interested in team science. By doing so, the Toolkit can reduce unnecessary replication of practical tools for team science as well as SciTS research, stimulate new directions for team science practice and research, and ultimately help to maximize the quality of the science produced by teams.

Poster 11 - EarthCube and the Science of Team Science
Authors: Joshua Young

EarthCube, an initiative of the National Science Foundation, is an evolving, dynamic virtual community of more than 2,500 contributors, including earth, ocean, polar, planetary, atmospheric, geospace, computer and social scientists, educators, and data and information professionals. As an inherently transdisciplinary community-led initiative started in 2011, EarthCube has valuable real-world lessons and questions for the Science of Team Science conference regarding communications and coordination, governance, and the application of conceptual models for transdisciplinary science of team science projects.

Poster 12 - Cybersecurity R&D as a Homeland Team Science & Technology Challenge
Authors: Scott Tousley

Cybersecurity is a still-growing field getting ever more connected with other R&D domains; the new version of the Federal Cybersecurity R&D Strategic Plan illustrates its very large scale; and yet this remains a relatively new field still defining its nature and practice. It is an area still evolving across academic communities. The last few years in particular, all areas of the homeland security and business communities have started wrestling with cybersecurity risk, management and investment, as a continuous challenge over the long term. This leads us to our research question: What can the SciTS Framework tell us about Cybersecurity as a Homeland

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Team Challenge of applied, cross-domain research and development?

The purpose of this study is to use SciTS thinking to help homeland-focused Cybersecurity R&D managers better develop and execute their work in this changing area. This effort will involve:

- A) Literature review of both Cybersecurity R&D planning and SciTS reference materials;
- B) Design of a flexible survey instrument (primarily qualitative);
- C) Survey of ~500 Cybersecurity R&D practitioners;
- D) Analysis of results, Conclusions and a White Paper
- E) Outcome discussions with the Federal Cybersecurity R&D community

The primary focus of this study will be at the individual/team level; we already see many cybersecurity R&D efforts where a team proposed for the work involves individuals from several different academic domains, or a combination of academic and business team members, etc. A secondary focus will be on the institutional/organizational level, as many academic and business R&D organizations are looking at how to drive organizational change to better address this

large and shifting field. Other team elements we expect to address include the linkage of R&D and Operations staff in Operations Research efforts; the teaming of Information Technology and Computer Science expertise with Physical domain expertise; and the need to develop teams that can bring together complex cyber-based systems safety and security. We also expect to leverage Dr. Gina Ligon's work, "Strategic Planning for Collaborative Problem Solving: A Study of Public-Private Partnerships," and her concept of Problem Complexity and Collaborative Distance dimensions. Through CSD, we have access to 2000+ Cybersecurity R&D practitioners across the academic, business and international communities, so we expect to generate a substantial number of survey responses at the core of this planned work. We can also leverage informal assistance from Dr. Stephen Fiore, Dr. Reeshad Dalal (GMU) and Dr. Jared Freeman (Aptima) in conducting this work. We expect that this work will not only help the Cybersecurity R&D community, but will also contribute to the SciTS field, in areas such as Coordination and Communication, Institutional Policies, Multi-level and multi-team systems, Leadership, Organization/Management Factors, Research Networking, Learning and Knowledge Networks, Team Assembly/Composition/Dynamics, Technology Transition, and Public Private Partnership.

Thematic Poster Group #3

Collaborative Engagement

Poster 13 - Building Trust in a Distributed Federal Team: Outperforming the Classical Team Norms

Authors: Aras Eftekhari

A federally funded contract offers a unique teaming dynamic that creates public-private partnerships, governed by strict rules and policies, yet demanding a high level of collaboration and efficient use of public monies. More specifically, and for this case of a private company providing support of federal system that is in

the process of upgrading, is the cancer Data Standards Registry and Repository (caDSR) at the National Cancer Institute. caDSR falls under the Center for Biomedical Informatics and Information Technology (CBIIT). Most, if not all, teams within CBIIT are a case for interoperability research in themselves, as IT professionals, data scientists, and biomedical researchers collaborate to provide services and systems to the cancer research community.

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How can a team made up of technical experts and professionals from such diverse career backgrounds ensure that terms and needs from both sides of a federal contract are met (federal side vs contracting side)? Additionally, what if such an IT system is based in the DC Metro area for example, yet project and technical managers are distributed across the country and in different time zones? As if the challenge for efficient collaboration wasn't difficult enough, how can a freshly new contractor build trust of their fellow teammates in this environment?

caDSR has been in use for over 10 years, with some team members assigned to this project since project kick-off. If a new project contractor were to join, building trust of that project team would be vital to team success. However, a federal environment is already somewhat guarded to contractors and even more guarded in a case where years of energy and effort have been spent in development. The project team is distributed across the country and different communication methods and mediums are utilized to effectively manage the project. This virtual team meets twice weekly via web teleconferences, follows a project plan that is updated on a weekly basis, manages project documentation using cloud based systems, and shares updates and milestones via public facing wiki pages.

The planning process for eventual system upgrade is ongoing with system requirements constantly evolving to better serve users, while keeping track of all other similar efforts in the research. Keeping track of these efforts, along with researching emerging trends and cutting-edge technologies that can be utilized also ensures project success, stronger collaboration, and system extensibility.

After approximately one and half years of caDSR project experience with a distributed/virtual team, I believe that, compared to other classic teaming schemes where teams are concentrated in one physical place, that this distributed and virtual team performs more efficiently and effectively. This poster intends to present this case (along with a few other examples), setup further experimentation to prove this case, and make

the appropriate contributions to expand Team Science research.

Poster 14 - Project Aquilá: A community engaged transdisciplinary process to study culture in transnational communities in Massachusetts

Authors: Linda Sprague Martinez, Rosalyn Negron, Cristina Araujo Brinkerhoff, & Eduardo Siqueira

Objective: Transnationalism, Networks and Culture: Implications for Health and Health Behavior (Aqui Lá) – a data driven team science planning grant supported by the NIH Office of Behavioral and Social Sciences Research (OBSSR) and the National Institute of Minority Health and Health Disparities of the National Institutes of Health – is working within a multilevel framework to conceptualize the impact of culture and transnationalism on health. Aqui Lá, meaning Here and There, is the story of many Brazilian and Dominican transnational immigrants who are living emotionally, socially, and in some cases physically between two nations. Immigrant status has been found to present protective factors with respect to birthing outcomes [1-3] and disease mortality [4]; however these protective benefits fade dramatically over time and across generational status [5]. Although we do not fully understand the mechanisms by which immigrant health worsens over time, research has implicated culture, more specifically the process of acculturation, as an important determinant of declining health among immigrants [6-8]. Because culture operates at different levels, a more complex and contextualized understanding of the cultural factors influencing the health and wellbeing of immigrants is needed. Methods: We collaboratively explored the notion that health behaviors and attitudes are influenced by both transnational and local ecologies by employing several data collection methods. During ten cultural conversations ($n= 90$ participants), steeped in critical pedagogy, participants explored attributes of the cultures they belong to, and engaged in lively discussions about shared experiences of cultural

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adaptation, transnational practices, and health concerns. Egocentric social network interviews ($n=58$) allowed us to visualize and explore socially grounded practices which included transnational movement and activities, individual and group-level performance of cultural beliefs and behaviors, and interpersonal influences on health beliefs and behaviors. Finally, using Photovoice ($n=9$) we explored elements of participants' living and social environments that influence cultural practices. Based on themes that emerged from the preliminary data, a diverse group of six scholars and practitioners was identified and recruited to take part in the charrette planning dialogues with the core planning team. Charrette sessions were structured so that the core planning team presented themes, and participants provided feedback, in the context of their own research. We conducted a total of five charrette sessions, each informing the next. Sessions were taped and transcribed, and a thematic analysis was completed between sessions, with data used to inform the next session. We identified key themes across discussions. Thus, the process was iterative and helped to reinforce concepts that arose during data collection and helped narrow the scope for the following phase of the project. Summary: We found that the most salient health concerns expressed by both Dominican and Brazilian immigrants were related to mental health, particularly stress and distress. Another important conclusion from the planning process was that our project's social network approach was a particularly promising way to collect data that illuminated cultural processes at multiple levels, namely the individual and interpersonal relationship level. Therefore, as a starting point for the design of the pilot study, we systematically assessed the distribution of cultural knowledge within social networks to determine relationships between networked culture and health outcomes, Networked Cultural Consonance. Innovation: An important innovation of our work is that we brought together elements of successful intervention and applied research modalities, such as community-based participatory research and popular education (Freire 1973) and were able to integrate them in the context of

basic research frameworks.

Poster 15 - Negotiating Boundaries: Effective Leadership of Interdisciplinary Environmental & Sustainability Programs

Authors: David Gosselin, Deana Pennington, & Shirley Vincent

A special issue of the Journal of Environmental Studies and Sciences explores challenges and opportunities confronting higher education related to leadership and teamwork. The creation of linkages between students, faculty, administration and community stakeholders is necessary to address the many "wicked problems" facing society. One common thread among the 23 papers featured in issue that higher education is being challenged to collectively reexamine and change the paradigms under which they operate. Each of the articles express explicitly or implicitly that change happens through relationships and negotiating boundaries between individuals, groups, and organizations. This issue explores the challenges of leadership and program development at different scales from student and faculty learning to institutional initiatives that span across an entire campus. The leadership, relationship development, and boundary crossing experiences presented in the papers in this issue address four primary themes – Interdisciplinary Team Building Strategies, Curriculum and Community Connections, Institution-Level Leadership and Perspectives, and Interdisciplinary Leadership and Scholarship Support. Each of the individual papers address a pressing need in interdisciplinary and transdisciplinary work for development of effective, situation-relevant methods for negotiating disciplinary and professional boundaries.

Poster 16 - Using a Pilot Grant Program & Teamwork Training to Improve the Knowledge and Skills of Science Teams

Authors: Patrick Barlow, Joseph Zabner, Georgeanna Robinson, Beth Knudson, Gary Rosenthal, & Greg Stewart

Abstracts

Program Goal: The Institute for Clinical & Translational Science (ICTS) at the University of Iowa instituted a Pilot Grant Program with a primary goal of facilitating the development of science teams. Researchers at the University of Iowa were encouraged to form new transdisciplinary science teams and submit an initial one-page Letter of Intent (LOI). Eighty-one teams submitted LOIs, which were evaluated with 25 teams being invited to submit full proposals. As part of the proposal process, team members agreed to attend a 2-hour training session focused on the Science of Team Science (SciTS).

Training Description: Teamwork training had the objectives of helping participants 1) Understand the benefits and obstacles associated with Team Science, 2) Apply concepts of temporal sequencing to plan effective transition and action stages for Science Teams, and 3) Identify an effective approach to determining (a) who should be included in a Science Team and (b) how characteristics of team members combine and influence team processes. Training consisted of short lectures and small group activities.

Training Evaluation: A paper survey was distributed to all training participants (total responses = 87). The survey is one of three data collections planned over the course of the pilot grant funding period: (1) immediately after the workshop (this report); (2) midway through the funding cycle; and (3) at the end of the funding cycle. We focused on the following evaluation questions: a) To what extent did workshop participants perceive an improvement in their skills and knowledge related to team science? b) What is the perceived usefulness and overall quality of the workshop, and in what ways can it be improved for future cohorts? c) In what ways are the tools and/or skills demonstrated during the workshop used by participants over the course of the funding period?

Evaluation Results: In general, participants felt as though the workshop experience improved both their skillsets and knowledge related to team science with the majority of mean ratings ranging from 3.0 to 4.0 (on a scale of 1-5), or "Moderately Improved."

Reflecting on the team science process was perceived as the skill with which participants felt they had the highest average improvement ($M = 4.17$, $SD = 0.90$), while the differentiation between teamwork and taskwork was the most-improved knowledge area ($M = 4.17$, $SD = 1.0$). Participants tended to agree that the content of the workshop itself was appropriate and both the topics and examples were relevant to their day-to-day work ($M = 3.90$, 3.95 , and 4.03 , respectively). Participants tended to agree or strongly agree that the workshop should continue to be a requirement for the Team Science Pilot Grant Program with 57 out of the 70 who responded to this item ranking their agreement a 4 or 5. Qualitative data also provided critical information for improving future training sessions, including the potential benefit of training team members together to facilitate shared mental models and closely integrating training content with topical areas to be included in the Pilot Grant proposals.

Advancement of SciTS field: Helping scientists develop teamwork skills is critical for advancing Team Science. Our approach of Pilot Grant Funding that included hands-on teamwork training helped participants increase both knowledge and skill related to SciTS content and application.

Poster 17 - M&S, Mental Models and Collaborative Thinking

Authors: Judith Tavel

Narrative: This poster session has prompted me to address a topic, which I have been thinking about but which I have not been able to find a venue for discussion apart from friends and colleagues. It is the role that mental models play in scientific research. By mental models I am referring to all mental constructs that shape our understanding of the external world each of us experiences. Science has been guided by overarching mental constructs, such as paradigm shifts, which Thomas Kuhn examined and synthesized in his seminal text *The Structure of Scientific Revolution*. Prior to Kuhn, philosophers of science grappled with ways in which an overarching understanding of the natural

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world has evolved and changed through time. These overarching mental models are extremely important. However, I have become increasingly interested in what I believe is a more powerful kind of mental modeling, which is subtle, elusive and usually ignored. It is the kind of mental modeling, which the neurobiologist, Harry J. Jerison, expressed in his statement: "The work of the brain is to create a model of a possible world rather than to record and transmit to the mind a world that is metaphysically true."

My interest in subtle mental models that shape what we do and think, how we act and react, interpret, express, conduct research, etc. is a result of a commitment I made 9 years ago to writing a comprehensive, introductory text on Modeling and Simulation, M&S. At the time I was a Dean at DeVry and part of the launch of DeVry's Game and Simulation Program. There was simply no adequate introductory textbook for the program. Right after the launch, I retired and took on the challenge of pulling together the entirety of M&S and writing an introductory textbook. 2007 marked not only the start of my research but coincided with the first formal declaration of the importance of M&S. In July of 2007 the House of Representatives passed House Resolution #487, establishing M&S as a National Critical Technology, a technology which is essential for the safety and prosperity of the U.S. This, of course, will not come as a surprise to any scientist. Research that occurs in the virtual world of a computer is commonplace. Whether it is called *in silico* research, computer-based science, cyber-enabled exploration and experimentation, and so forth, most science is enabled and enhanced by working in the realm of emulated reality. I have chosen to call this the realm of emulated reality by reference to emulation, in which one electronic computer performs calculations in the manner of another. M&S-based scientific research performs real world activities within cyberspace based on mathematical models that represent the object of the research and mathematical manipulations that simulate real world activities. Being able to do this is extremely powerful: it saves money, resources, time

and even lives. However, it is also perilous. The peril is often seen only in terms of whether the models and the simulations have real world validity. This is crucial. However, the problems for which science seeks answers and the frontiers which science wishes to explore are becoming more and more complicated, complex and even wicked. Moreover, various disciplines need to be combined in order to address the multifaceted nature. Thus, teams are needed and it is essential to construct teams, which can rise to the challenges science is facing. The Science of Team Science is important for addressing these challenges.

My work with M&S in general has made me increasingly concerned that all of the mental models, which are behind the scenes when research teams are constituted and the research is being designed, developed, implemented and analyzed, may go unnoticed. Often mental models are only considered in terms of whether or not team members are compatible, "getting along" with one another and working efficiently to carry out the necessary tasks to produce results. The importance of this is indisputable and my interest in mental models in no way dismisses this importance. However, the object of this poster presentation is to initiate a deeper discussion of mental models. How can mental models be determined in order to enhance collaboration? How can the various mental models of various disciplines be combined to enhance collaboration? How is diversity of mental models important for success of a team's project? What role do mental models play in the design, development, implementation and analysis of a project?

Poster 18 - Enhancing Team Composition in Professional Networks: Problem Definitions and Fast Solutions

Authors: Liangyue Li, Hanghang Tong, Nan Cao, Kate Enrlich, Yu-Ru Lin, & Norbou Buchler

In this work, we study ways to enhance the composition of teams based on new requirements in a collaboration environment. A promising algorithmic approach to team composition treats a team as a subgraph embedded in a larger social network. We

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differentiate our work from previous efforts in three ways: (1) we alter the composition of an existing team based on new requirements; (2) we solve the problem in a principled approach with the notion of graph kernel; and (3) we design efficient algorithms to scale up the computation.

Specifically, we address a family of problems under the scope of Team Enhancement, namely, (1) Team Member Replacement, which concerns the churn of team members. The central question is to find the best alternative from the rest network when a team member becomes unavailable. (2) Team Refinement, which considers refining a team by replacing one member with another with the desired skill sets and communication connections. (3) Team Expansion, to expand the team by adding a member with certain skill sets and communication structure. (4) Team Shrinkage, the size of a team needs to be reduced in response to new challenge such as a shortage of the available resource. In all the above four cases, the resulting disruption should be minimized.

By careful inspection, we identify the problem similarity among the above four cases and propose these problems can be formulated in a way to share common technical solutions. We propose to reduce the disruption induced by the team alteration by maintaining the team-level similarity between the original and the new teams, which includes skill similarity as well as structural similarity. The proposition is backed by some recent studies which show that team members prefer to work with people they have worked before and that distributed teams perform better when members know each other. Furthermore, research has shown that specific communication patterns among team members are critical for performance.

Armed with the above conjecture, we adopt the

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notion of graph similarity/kernel to characterize the team-level similarity for Team Enhancement. Through the lens of labeled graph for modeling teams, graph kernel can naturally capture the skill similarity and the structural similarity simultaneously. However, for a network with n individuals, a straightforward method would require $O(n)$ graph kernel computations for one team refinement/replacement/expansion, which is computationally intractable. For example, for the DBLP dataset with almost 1M users, we found that it would take 6,338s to find one replacement for a team of size 10. To address the computational challenges, we propose a family of fast algorithms by carefully designing the pruning strategies and metric analyses for exploring the smoothness and correspondence between the existing and the new teams. We perform extensive empirical evaluations to demonstrate the effectiveness and efficiency of our methods. Specifically, we find that (1) by encoding both the skill and structural matching, it leads to a much better replacement result. Compared with the best alternative choices, we achieve 27% and 24% net increase in average recall and precision, respectively; (2) our fast algorithms are orders of magnitude faster and scale sub-linearly. We also develop an interactive system called g-Miner that enables visual analysis of teams embedded in large-scale multivariate network data.

In conclusion, we define a family of problems under the scope of team enhancement to alter the composition of a team in the context of networks, where nodes carrying on multiple skills. We bring our expertise in data mining, network mining in particular to science of team science, and propose graph kernel based algorithms along with its fast solvers to address the proposed problems. Our project website is: <http://team-net-work.org>.

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Poster 19 - Preparing for a PhD: A Transactivity Approach

Authors: Anthony Hood, Crystal Allman, Zakiyyah Kennedy, & Alicja Foksinska

The current manuscript adopts a novel approach to addressing the issue of faculty diversity by framing it in part as a socio-cognitive problem. Integrating theoretical insights from the domains of transactive memory and transactive goal dynamics, we present a new framework referred to simply as transactivity.

We use this transactivity framework to advance understanding of the doctoral admissions process. We position transactivity as a socio-cognitive framework that describes the extent to which individuals develop a cognitive and behavioral division of labor to mobilize the tasks, expertise and people necessary to set and pursue goals—in the current manuscript, gaining admission to a doctoral program. We posit that by establishing such a cooperative arrangement for learning and employing the nuances of selecting, applying to and securing admission to doctoral programs, prospective doctoral students can minimize the likelihood of emotional overload, stress and fatigue that may delay or deter the admissions process. We employ this transactivity framework to organize insights gained from the authors' first person experiences with and observations of the Annual Conference of The Phd Project, a non-profit organization dedicated to increasing ethnic diversity in academia and the workplace. Implications, recommendations and directions for future research on the diversity of science teams are offered.

Poster 20 - Assessment of Professional Social Capital of Doctoral Students: Testing a New Framework of STI Evaluation

Authors: Olena Leonchuk

The NSF Industry/University Cooperative Research Centers (I/UCRCs) represent one of the most well-known long-term government investments in science, technology and innovation (STI). The I/UCRCs are mostly self-sustained as they represent an example of

industry-university partnership where industry pays membership fees to support university-based research. The NSF's role is to reinforce consortium model of the partnership and provide a comprehensive evaluation component for the program. This consortium model preserves the collaborative nature of the centers across organizational, sector and disciplinary boundaries.

Even though I/UCRCs' evaluation component has been recognized by the National Academy of Sciences as one of the best examples of the improvement evaluation, it is still limited to methods that focus on long-term outcomes (e.g. IP, publications) and microeconomic analysis. These metrics tend to omit the team science aspect of scientific process and, particularly, the extent to which graduate training helps students acquire professional social capital needed for their professional growth.

Current research project represents an application of the Scientific and Technical Human Capital (STHC) approach of Bozeman, Dietz and Gaughan (2001) to evaluation of graduate training of science & engineering students by measuring their professional social capital and other outcomes. A quasi-experiment included a matched sample of doctoral students in engineering and computer sciences trained at the I/UCRCs ($N = 173$) and doctorate students from the same universities who were not part of any research center ($N = 87$). The groups were compatible in: gender (23% female), age, immigration status (56% international, consistent with national average), disciplines, GPA and time spent in graduate school. The list of I/UCRC students was obtained from the I/UCRC directors and the list of non-center students (control group) was obtained by data mining corresponding universities' websites.

The findings showed a significant I/UCRC training effect on most components of professional social capital and other outcomes. Nevertheless, some of the I/UCRC effects were significantly mediated by immigration status (US vs. International) and dosage of the center involvement. In addition, the study showed a pattern where international students trained at I/UCRCs were

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more likely to plan to stay in the US after graduation. Both I/UCRC students, US and international, were significantly more satisfied with their training.

Overall, the study represents a comprehensive review of literature on social capital theory and STHC approach in its development of the Professional Social Capital scale for graduate students. It also sets the stage for applying the STHC framework to evaluation of scientific outcomes in the way that captures the social aspect of scientific process largely ignored by the existing metrics.

Poster 21 - Becoming a cross-disciplinary professional

Authors: Robin Adams & Richard Aleong

Professionals need to develop expertise in cross-disciplinary knowledge practices so they can create the conditions for successful cross-disciplinary collaborative work as well as recognize and self-manage their own learning to overcome challenges with this kind of work. They need to become cross-disciplinary professionals who can think and work across perspectives - attuning to and leveraging differences, seeing the broader system, and creating integrative frameworks for problem setting and solving. Here, cross-disciplinary is used to broadly characterize a collection of boundary spanning practices involved in multidisciplinary, interdisciplinary, and transdisciplinary inquiry. These movements across disciplinary and non-disciplinary boundaries are marked by significant challenges such as language differences, clashing paradigms or ways of seeing the world, loss of "home" or identity, and borrowing and translating ideas to new contexts.

This poster summarizes findings from previously published empirical research on the ways engineers experience working with others from different disciplines (engineering, scientific, business, liberal and performing arts), and the ways they make sense of these experiences as distinct ways of cross-disciplinary thinking, acting, and being. This research is grounded in a situated learning framework that characterizes how the process of becoming professionals entails

developing and refining an embodied understanding of professional practice that integrates knowing, acting, and being in the world. This embodied understanding gives meaning to the knowledge and skills being developed within professional practice, while also incorporating an understanding of the practice itself.

Using a developmental phenomenography approach with a strategic sampling strategy, four qualitatively distinct and hierarchically related categories, going from least to most comprehensive ways of experiencing and understanding cross-disciplinary practice were identified as 1) working together with people who have different training to find a better solution 2) as intentional learning so all gain (me, my team, stakeholders) 3) strategic leadership to enable work and facilitate a worthwhile outcome and 4) challenging and transforming practice to integrate systems. Research findings map broadly to existing work on multi/inter/transdisciplinary inquiry, collaboration, and identity.

Through this research, SciTS theory and practice may be advanced in the following critical ways:

- By taking a developmental phenomenographic perspective, the framework advances knowledge linking the social and collaborative aspects of cross-disciplinary work, the learning orientations that motivate participating in or leading cross-disciplinary projects, and the kinds of transformative learning that can occur through critically reflecting on notions of "difference" and "boundaries" that seek to separate rather than support integration.
- By identifying critical differences in learning and awareness of cross-disciplinary practice, the framework offers direct applications for designing collaborative environments that facilitate becoming a cross-disciplinary professional.
- By providing a schema and language for different trajectories of becoming a cross-disciplinary professional (including interpersonal, interapersonal, and epistemic difficulties

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- associated with the work), the framework offers research-based tools to support individuals in self-assessing and realizing learning goals in ways that support transfer of practice to new contexts.
- By integrating the epistemological and ontological dimensions of becoming a cross-disciplinary professional, the framework gives meaning not only to our knowing and how we act but also who we are as professionals.

The poster will embody scholarship of integration and user-centered principles to represent details of research outcomes and implications as a guide for professionals to recognize cross-disciplinary behavior and identify areas for professional growth. By presenting this work at this conference, we hope to advance new research-to-practice applications beyond current applications (cancer prevention research, engineering education, interdisciplinary design, etc.).

Poster 22 - Establishing a Professional Community of Practice & Research for Interdisciplinary Science Specialists

Authors: Christine Hendren, Holly J. Falk-Krzesinski, Gabriele Bammer, & Sharon Ku

There is a recognized, but thus far unaddressed need for a new type of role to be defined, established, institutionally supported and trained in order to optimize the success of interdisciplinary scientific endeavors. To address complex problems and effectively engage diverse knowledge bases, a specific expertise and skillset is needed to work at the interfaces between disciplines to translate, facilitate, and optimize research outcomes. These connective, synthetic knowledge broker functions are needed to cross the boundaries between otherwise separate groups in science teams in support of strengthened post-award science synthesis and advancement. Such functions may be currently carried out across a number of roles or in an ad-hoc, organically developed manner; however, we propose that to date, this has been suboptimal and fraught with challenges. Events

at the past three SciTS meetings touching on the topic have revealed an active interest shared by team science practitioners, researchers, and institutional supporters alike in acknowledging, defining and elevating this critical enabling role to a recognized career path. This concept has been introduced by a variety of different names: Interdisciplinary Executive Scientist (IES), Integration and Implementation Sciences (I2S) specialist, and Research Development Professionals (RDP). A ½ day seminar held at this year's SciTS meeting will serve as the inaugural meeting for interested practitioners and researchers alike to collectively define challenges, needs and next steps toward establishing an active community of research and practice to build and advocate increased understanding and stature of this new role. This poster would serve as an additional opportunity to engage potential members, to educate the SciTS community about this proposed role, and most importantly, to gather critical feedback from the community that may help shape the path forward.

Poster 23 - Including graduate students in interdisciplinary research

Authors: Jeni Cross & Hannah Love

Our poster will explore the role of graduate students in interdisciplinary research. It will develop a visual model to answer: How do we integrate graduate students into interdisciplinary research?

Often graduate students oversee the 'on-the ground research' conducting experiments, analyzing data, and are fundamental in the research process. However, graduate students are left out of the planning, process including PI meetings, leadership meetings, and other arenas where faculty create and transfer knowledge. The social networks for interdisciplinary research teams often look like the following:

The blue nodes are graduate students and red nodes are faculty. The graduate students are often huddled together and are not well-connected to the network.

So, we asked graduate students in the form of focus

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groups and individual interviews about how they would ideally be included in interdisciplinary research. With our data, we have developed a model for integrating graduate students into the interdisciplinary research process. Our poster presentation will provide visuals of common interdisciplinary research teams with graduate students, and a model for bridging the existing academic silos for graduate students.

Poster 24 - The study of multifunctional landscapes in Mexico: a transdisciplinary experience in education of team Science

Authors: Margarita Paras, Silvana Levi, Evangelina Bidegain, Claudia Hernandez, Edurne Bague, Jessica Arellano, Martin Dominguez, & Jessica Contreras

The paper informs the experience of a transdisciplinary educational approach designed for postgraduate students- team science (TS)- phasing a research question and thesis related to the study of cultural, multi functional, multi-scalar landscapes.

The expectation is to contribute to the convergence of social and natural sciences in the study of the transformations of complex socio-ecological systems featured in our cultural landscapes.

Some of the themes being addressed are related to water access, quality and spatial distribution; natural resources management and socio-environmental conflicts; health and sickness in households of urban habitats; spatial and semiotic approaches to indigenous people landscape and sky representations.(Work in progress).

An introductory seminar*deals with a referred review of approaches and methods regarding the study and management of multifunctional multi-scalar landscapes. TS have access to resources, methods and tools that encourage discussion, collaborative learning, consensus and scenario building encompassing spatial methods.

Poster 25 - Insights into Computer Science Academic

Careers

Authors: Dinesh Majeti, Salah Taamneh, Muhsin Ugur, Ashik Khatri, & Ioannis Pavlidis

Career quantification in academia is necessary to give promotions, raises and grants to professors at universities. In this paper, we report analysis of professors at various universities, through their three academic career stages: pre-tenure, post-tenure (associate professor years), and once they reach full professor. Our work will put to test the status quo that a professors' quality and quantity of work improves as s/he advances through her/his academic career.

Poster 26 - Developing and Implementing a Contextualized Leadership Training Program for Team Science

Authors: Kevin Wooten, Allan Brasier, Barlon Sukol, Eugene Frazier, Faith Robin, Mark Hellmich, & Lori Wiseman

Objective: The purpose of this poster is to describe the development of a contextual leadership training program developed for team scientists. Considerable literature exists relative to general leader development (McCall, 2010; Day, 2011) as well as the unique needs for leader development within team science (Börner, et al., 2010; Falk-Krzesinski, et al., 2011; Stokols, Misra, Hall, & Taylor, 2008). We build upon the most widely used contemporary leadership theory, "The Leadership Challenge" by Kouzes and Posner (2012), and depict the development of a training program designed to accomplish five goals: 1) to provide Team Leaders (PIs) and Team Project Managers (PMs) the opportunity to diagnose their own leadership strengths and weaknesses through use of a formal 360° feedback process; 2) to provide project managers the opportunity to develop and implement a leadership "Individual Development Plan and Application Planner" with mentoring and coaching from their Team Leaders and designated mentors; 3) to develop an understanding of transformative and shared leadership through mastery of concepts from "The Leadership

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Challenge" model; 4) to conceptualize and build a set of practices applicable to translational team leadership based on "The Leadership Challenge" model; and 5) to apply and test leadership concepts and practices that relate to translational team leadership, and reflect upon further refinement and application.

Method and Findings: Two pedagogical methods are illustrated in relation to leader training for team science.

First, the use of a "Flipped Classroom" is demonstrated (e.g., web-based platform to construct team science examples of leadership practices), and second, a constructivist leader development model is described (Figure 1) by tying personal goals and assessment to contextual theory, and subsequently to application.

Illustration of specific techniques (e.g., 360° assessment, individual development plans, and reflective exercises) will also be shown.

Poster 27 - Development of an Assessment Center for Team Science Leaders

Authors: Kevin Wooten, Allan Brasier, Marlon Sukol, Eugene Frazier, Faith Robin, Mark Hellmich, & Lori Wiseman

The purpose of this poster is to describe the application of assessment center methods (Thornton & Rupp, 2006; Moses & Bynum, 2013) for the development of scientific team leaders. Assessment center processes have been empirically shown as a valid methodology for leader prediction in industry and the military (Gangler, Rosenthal, Thornton, & Bentson, 1987; Arthur, Day, McNelly, & Edens, 2003), but relatively little work has been done in the scientific or academic environments. Rather than focus upon selection and development of leaders involving traditional leader traits, skills, and abilities, we describe the development of an assessment center for team science leaders in an academic medical center to provide actionable needs identification and development planning for team leaders as well as trainees (i.e., post-doctoral students and new assistant professors).

Method: Table 1 illustrates the five broad assessment dimensions to be used for the assessment center, as well as the four assessment methods proposed.

Findings: Specific assessment criteria will be defined (e.g., learning capacity, empathy, etc.) for all dimensions, and specific assessment methods (e.g., Harvard cases, commercial 360° assessment inventories, etc.) will be depicted in relation to the production of assessment center data to develop Individual Development Plans for team science leaders.

Poster 28 - Community Engagement Model: Diverse Teams Collaborate to Develop a New STEM-C Curriculum in Restoration Science

Authors: Erica Watson-Currie, Michelle Molina, & Lauren Birney

Demand for job skills in scientific and technological fields continues to rise; however, the number of students entering higher education STEM-C pathways is low. Thus, employment opportunities in Science, Technology, Engineering, Math, and Computer Sciences (STEM-C) are swiftly outpacing supply of qualified applicants. New models for increasing students' interest, efficacy, and intentions to pursue STEM-C careers are being designed and tested. One multi-faceted approach currently being developed and refined is the Curriculum + Community Enterprise Model for Restoration Sciences, funded by a grant from the National Science Foundation (NSF). The partners are: Pace University, Columbia University Lamont-Doherty Earth Observatory, New York Harbor Foundation, New York Academy of Sciences, University of Maryland Center for Environmental Science, New York City Department of Education, New York Aquarium, The River Project, and Good Shepherd Services. Extensive collaboration efforts are underway to develop and implement a sustainable project-based learning curriculum for urban middle school students. Project-based science (PBS) emphasizes reforming pedagogy to motivate students to learn

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through inquiry and finding solutions to real world problems. Activities designed around Bybee's 5 E Model encourage students to construct meaningful understandings instead of memorizing facts. The goal is to enhance STEM-C education by engaging participants in long term restoration ecology and environmental monitoring projects. Partners will develop a replicable model for other restoration projects as suited to local environmental conditions surrounding other public schools. The model has five programmatic pillars: 1) Teacher Training Continuing Education Program in implementing PBS lesson plans and activities; 2) Student curriculum of STEM-C lesson plans conducting authentic environmental fieldwork; 3) Digital platform archiving lesson plans with a mobile application for students' data entry and citizen science observations; 4) Afterschool program with doctoral students mentoring middle school students using hands-on environmental science activities; 5) Community exhibits with wet-lab education at local marine science institutions. This large scale training and teaching initiative teams scientists with educators and practitioners in order to produce and disseminate a new model for curriculum development through community engagement. As teams enter their second year of partnership, members have expressed they are already beginning to achieve synergy in the lessons, activities, and materials their collaborative efforts are producing.

Poster 29 - Transdisciplinary Collaboration for STEM-C Education and Environmental Restoration – The Curriculum + Community Enterprise for Restoration Science (CCERS)

Authors: Michelle Molina, Erica Watson-Currie, & Lauren Birney

The Curriculum + Community Enterprise for Restoration Science (CCERS) offers a new partnership model tying restoration science activities to core Science, Technology, Engineering, Mathematics, and Computer Science (STEM-C) concepts. Multiple cross-disciplinary teams are developing lesson plans, activities, exhibits, and interactive computer programs for urban middle

school students. This paper will first describe the CCERS Model; then discuss how partners from nine separate organizations (i.e., universities, foundations, K-12 institutions, community organizations, and cultural institutions) are collaborating towards one shared vision; and finally provide potential mechanisms for sustainability and replication from project leaders' perspectives. The authors' intent is to answer the following research questions:

- 1.What comprises the "curriculum plus community enterprise" local model?
- 2.Do the five programmatic pillars function independently and/or collectively as a system of interrelated STEM-C content delivery vehicles that are effective in changing educator and student disposition toward STEM-C content and environmental restoration and stewardship?
- 3.What are mechanisms for creating sustainability and scalability of the model locally during and beyond its three-year implementation?
- 4.What core aspects of the model are replicable?

To address these questions researchers employed Longitudinal Qualitative Interviews (LQI) to explore how partners and organizations on the project "experience, interpret, and respond to change" by examining themes across time (Hermanozicz, 2013, p. 189). Twenty-four project leaders from the nine partnering organizations also completed a Collaboration Survey assessing their current and optimal levels of integration with partner organizations based on Gajda's (2004) Strategic Alliance Formative Assessment Rubric.

Findings from the first two rounds of interviews show that partners collaborate through five programmatic pillars (Figure 2), which can be thought of as work groups, in which organizations share responsibility for specific outcomes (Sundstrom, De Meuse, & Futrell, 1990). Furthermore, project leaders shared insights into creating effective transdisciplinary collaborations: (1) clearly defined goals and (2) a streamlined decision making processes. Researchers are currently analyzing the third set of interviews and survey responses. These

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will further clarify how partners are collaborating; as well as explore mechanisms for sustainability, scalability, and replicability; and provide further suggestions from partners on how to develop and strengthen effective partnerships.

Pillar 1: Teacher Fellowship

- Columbia University - Lamont-Doherty Earth Observatory
- Pace University
- New York Harbor Foundation

Pillar 2: Student Curriculum

- Pace University

- New York Harbor Foundation
- NYC Department of Education

Pillar 3: Digital Platform

- University of Maryland – Center for Environmental Science

Pillar 4: Afterschool/ Mentoring

- Good Shepherd Services
- New York Academy of Science

Pillar 5: Community Exhibits

- New York Aquarium
- The River Project

Thematic Poster Group #5

Team Science to Address Health and Improve Healthcare

Poster 30 - Teaming-Up for Patient Safety: A Case Study of Social Interactions Among Team Members

Authors: Michelle Leak

Despite increased awareness of the link between teamwork and medical errors, and increased development of interventions aimed at improving team performance, the incidence of preventable errors in hospitals, and in the surgical environment particularly, remains high. Absent from interdisciplinary team development efforts is empirical evidence informed by the voices of surgical team members specific to their day- to- day experiences of teamwork. For this reason, a case study of interdisciplinary teamwork among Orthopedic Surgery team members was conducted from June to December 2013 to: (a) discover how teamwork behaviors are enacted in the surgical environment to affect the incidence of preventable surgical errors; and (b) understand the experience of teamwork from the perspective of surgical team members.

The case study data included 37 one-on-one interviews

with Orthopedic Surgery team members (including two supervisors), and observations by the researcher guided by the Observational Teamwork Assessment for Surgery (OTAS) instrument. This study finds that while mindfulness is a prerequisite to traditional teamwork behaviors found among and between high performance surgical teams and team members, a dynamic interplay exists between processes of collective mindfulness and teamwork safety behaviors wherein one continuously informs, shapes, and reinforces the other (Figure1). Noting contributions of this study to practice, education, research, the opportunity exists to expand the present inquiry to other surgical and non-surgical teams within the hospital and clinic environments.

Poster 31 - The Academic Cartography of Sugar Sweetened Beverages: Interdisciplinarity in Research Between Scientific and Legal Fields

Authors: Lexi White

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It has long been noted that there are crucial differences between the functions of the law and science. Difference in function leads to different logics and processes of enacting law and science, including the system for generating a body of peer-reviewed research. This research uses an overarching anthropological approach to address academic communication between two powerful and influential social groups: scientists and legal scholars. In phase one of this research, to be presented in poster form, the researcher will use citation analyses and network analyses to examine social structure of citation patterns between articles on sugar sweetened beverages across two key databases: SCOPUS and LexisNexis. This research will also use machine learning techniques (latent Dirichlet allocation) to examine the textual structure of these articles. This will allow researchers to see whether, in addition to structural divides in patterns of citations between legal academic and scientific publishing, there are also language and contextual differences. By investigating these key issues we will not only expand the applications of these well validated scientometric techniques to new areas, but also we will explore the intersection of two academic publication areas, the way they communicate, and how information across both is being targeted at influencing policy.

Poster 32- Ideal Hospital Discharge Process: A Systematic Review

Authors: Fares Alahdab, Shalak Gunjal, Zhen Wang, Jehad Almasri, Lindsey Lehman, Larry Prokop, & M. Hassan Murad

Objective: Interventions that improve patient experience during and after hospital discharge, reduce the risk of readmission and post discharge complications are needed. We conducted a systematic review to identify such interventions and appraise the quality of evidence supporting their adoption.

Description of research methods: We conducted a comprehensive literature search of six databases, including Medline In-Process & Other Non-Indexed

Citations, MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Scopus, from each database's inception to Week 50, 2015. Primary studies evaluating hospital discharge planning process were included, regardless of patients' characteristics, or underlying disease. Systematic reviews were used to identify additional relevant studies. We used a qualitative meta-narrative approach and developed an analytic framework to summarize evidence. The systematic review team included a clinical epidemiologist, a librarian, a statistician, an administrator, a medical doctor and career scientists specialized in health services research.

Summary of findings: 86 out of 1173 studies met the inclusion criteria. We developed an analytic framework (Figure 1). 36 hospital discharge processes appeared and were summarized across 4 stages of hospitalization, at admission, during hospitalization, at discharge, and after discharge (Table 1).

Statement of how the research advances the SciTS field: The research team that performed this study was multidisciplinary and engaged stakeholders. Systematic approaches, including carefully planning, patient monitoring and follow-up, collaboration with a multidisciplinary team, and advanced information technology, are necessary for an optimized hospital discharge process.

Poster 33 - Data Analysis of Smoking Trends in New York

Authors: Shilpa Balan, Joseph Otto, & Pooja Sarang

The disease risks from cigarette smoking have increased in the United States among both male and female smokers. The issue of smoking has been a continuing concern. This research identifies the trends in smoking intensity in the New York state after the year 2002. Given the high population and the poor air quality, we specifically look at smoking trends in the New York state in this research. Despite significant declines in the rate of smoking in the New York state, smoking seems to be a continuing concern with the rapid

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rate of deaths and diseases caused due to smoking. Smoking can cause diseases such as lung cancer, heart disease, and type 2 diabetes among others. The significance of this topic requires an immediate need for data analysis on the current smoking trends. Big Data has rapidly evolved and large sets of data are now available for free online. In this research, we use a data analytics software named Tableau to analyze our data set. Tableau is a business intelligence software that enables an individual to understand and visualize the data easily. Using Tableau, interesting patterns and trends in smoking were found that may have otherwise been more difficult using manual methods. Manual methods are time-consuming and can lead to errors in data analysis. For example, from the New York data set we were able to analyze the percentage of current trends of male vs female smokers, the average age of smokers and the job status of smokers using Tableau. Our analysis indicated that the percentage of female smokers are more than the male smokers in the New York state. Most of the smokers in the New York state are found to be employed and the highest number of smokers are above 40 years. A greater awareness of the negative effects of smoking will motivate smokers to quit smoking. This research will advance the SciTS field by illuminating the need for emphasis on research on this topic, exploring the latest big data and business intelligence technologies and its implementation for data analysis, and by improving the health of the people.

Poster 34 - Identifying Successful Inter-Team Communication between the Frozen Section Laboratory and Breast Surgery Team

Authors: Heidi McLeod, Katherine Carroll, Jessica Mesman, Gary Keeney, & Judy C. Boughey

Objective: The successful clinical and technical collaboration between the Frozen Section Laboratory (FSL) and Breast Surgery Team at Mayo Clinic, Rochester Minnesota has been described previously and follows a linear flow of the specimen from the patient in the operating room to FSL pathology to enable an accurate

and timely intraoperative evaluation of margins of breast cancer specimens. These successes are made possible through the social and communicational practices of the personnel on both teams. The goal of this research was to identify the critical intra and inter-team communication that contributes to their successful practice. To achieve this goal, members of the Breast Surgery Team, Frozen Section Laboratory and three health services researchers collaborated to identify the complex web of communication that supports the technical and scientific collaboration of these teams.

Research Methods: Video Reflexive Ethnography, a collaborative qualitative methodology that uses video ethnography and reflexivity as a tool for practice improvement was employed. Ten hours of communication work associated with specimen resections and diagnoses in a breast surgery team and frozen section laboratory was video recorded over a two-week period at Mayo Clinic, Rochester Minnesota. The video reflexivity phase of the study brought 57 staff from the breast surgery and frozen section laboratory teams together for four one-hour video reflexivity sessions to view one another's practices and to collaboratively analyze their communication. These sessions were video recorded, transcribed, coded and thematically analyzed by three health service researchers. The identified themes were then further analyzed as practical implications for practice improvement.

Summary of Findings: Video reflexivity enabled staff to see and articulate the complexity of their collaborative communication practices that support the flow of the specimen from surgical resection through to FSL pathological evaluation and reporting. Communication was characterized as flexible, inter-disciplinary, cross-hierarchical and multi-functional. Flexibility in the mode of communication (in-person, intercom, pager or phone) supports team collaboration. Verbal and visual cues aid prioritization, making the process more efficient. The close proximity of the teams facilitates the physical flow of the specimen and the web of

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communication allows team members to engage in non-linear and cross-hierarchical positions within both teams.

Poster 35 - Systematic evaluation of radiologist performance with reduced dose computed tomography protocols

Authors: Rickey E. Carter, David R. Holmes, Adam C. Bartley, Phillip K. Edwards, Ronald A. Karwoski, Amy K. Hara, Jeff L. Fidler, David Delone, David Levin, Gregory J. Michalak, Tammy A. Drees, Lifeng Yu, Shuai Leng, Cynthia H. McCollough, & Joel G. Fletcher

As new imaging modalities and protocols are developed, researchers evaluate how well radiologists can review image(s) for the detection of disease within patients. Radiologist performance, often simply denoted as observer performance, is a combination of diagnostic performance (e.g., correctly detecting, locating and classifying abnormalities) and human factors (e.g., reader experience, fatigue and confidence). In the context of computed tomography, lower-dose and high resolution protocols are desired for patient care to reduce concerns related to risk of ionizing radiation exposure. To insure altered imaging protocols do not degrade observer performance, it is imperative to rigorously evaluate these imaging approaches prior to routine use on patients.

A team of scientists with expertise in biostatistics, computer science, CT image acquisition and reconstruction, dosimetry, and diagnostic radiology has been assembled to address the need to accelerate the development and evaluation of lower dose computed tomography protocols. This team has built a sophisticated workflow utilizing advanced computerized systems to automate the data collection aspects of these multi-reader studies. The workflow's development required a critical evaluation of existing approaches to studying observer performance and the development of new technologies to support innovative approaches in study design and rapid testing of altered dose configurations. In particular, we developed a new study design for screening candidate

imaging protocols observer performance studies, created a robust computerized workstation to integrate the presentation imaging dataset and the collection of observer performance data, and developed a data pipeline that enabled rapid evaluation of observer performance. This infrastructure has been successfully utilized on over 10 studies. We will highlight lessons learned from these studies and illustrate how the diverse skills of the team have worked collaboratively to advance the availability of tested, lower dose computed tomography imaging protocols.

Poster 36 - The Effects of Organizational Commitment and Employee Empowerment on Patient Safety Culture Using Physician Cohort

Authors: Sujin Horwitz & Irwin Horwitz

Our study investigates a crucial yet understudied link between patient safety culture and two employee attitudinal constructs, the affective component of organizational commitment and empowerment, as means to promoting patient safety culture in health care organizations. More specifically, our study examined main and interaction effects of affective commitment and empowerment on the perception of patient safety culture using a cohort of physicians. Support was found for the main effects of affective commitment and empowerment on patient safety culture. However, the interaction effects of the two variables were not found contrary to our expectation. The limitations and implications of our findings for future work are also discussed.

Poster 37 - Using Team Science to Demonstrate the Value of a Unique Clinical Practice in Breast Surgery

Authors: Elizabeth Habermann, Gary Keeney, & Judy Boughey

Research Goal: The Mayo Clinic in Rochester, Minnesota is one of only two institutions in the world that routinely utilize intraoperative frozen section margin analysis for patients undergoing surgery for breast cancer. Through this unique practice, surgeons and

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pathologists communicate extensively during the operation to ensure a margin negative resection is achieved. The pathologist evaluates the margins of the lumpectomy specimen and determines if there is any tumor at the cut edge and at which margin(s). If so, the surgeon excises further tissue from that/those margin(s) during the same operation to achieve negative margins within one operation. At most other institutions, the cancer margin status remains unknown until after the patient has left the operating room, and the pathology report is available days to weeks later. When positive margins are detected, excision to obtain negative margins necessitates a second trip to the operating room. The goal of this team science initiative was to develop quantitative metrics to demonstrate the value of this clinical practice through the collaborations of a breast surgeon, frozen section pathologist, and health services researcher.

Research Methods: Initial discussions regarding the value of this clinical practice were lengthy as the health services researcher aimed to better understand the clinical language and the clinicians learned about various data sources available for benchmarking. Two team research projects have been completed to date. The first compared thirty-day reoperation rates following breast surgery by utilizing the institutional and national American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) data. The second project involved economic modeling based on Medicare data to determine the economic impacts to payers and providers if full dissemination

of this clinical practice was to occur to all institutions performing breast cancer surgery.

Summary of Findings: An analysis of ACS-NSQIP data published in *Surgery* in 2014 showed lower 30-day reoperation rates in breast cancer lumpectomy patients at our institution, which performs intraoperative frozen section margin analysis, compared to other participating hospitals (3.6% vs 13.2%, $p<0.001$). Upon multivariable logistic regression analysis, patients in the national ACS-NSQIP data set were over four times as likely to undergo reoperation as those at our institution (odds ratio 4.19, 95% confidence interval 2.29-7.66, $p<0.001$).

The *Journal of Oncology Practice* published our economic analysis in February 2016 which reported that expanding this clinical practice to all US breast surgery practices would result in net annual cost savings of \$90.9 million for Medicare, Medicaid and private payers, and \$1.8 million for providers.

Advancement of the Science of Team Science (SciTS) Field: A team comprised of clinicians and researchers was built with the shared goal of demonstrating the value of a unique institutional clinical practice using quantitative data, resulting in two medical publications to date. Our team work continues with the goal of identifying best practices in the surgical care of breast cancer patients.

Thematic Poster Group #6

Innovative Approaches to Team Science

Poster 38 - Team Writing and Institutional Science Documents

Authors: Sara Parks

Rather than understanding institutional guidelines as a framework that teams who write institutional

documents must navigate, this project suggests that institutions co-construct these documents with teams. This project shows institutions may use guidelines as a proxy and persuasive, controlling member of teams. However, identifying institutional co-construction has

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implications for team science writing. In particular this hidden institutional member raises questions of assumed scientific and reporting objectivity.

This preliminary study analyzes the most recent five years of National Science Foundation (NSF) annual report guidelines from the Experimental Program to Stimulate Competitive Research (EPSCoR) grant. Qualitative thematic analysis suggests the NSF is infusing the guidelines with its renewed commitment to public, persuasive science communication. The guidelines require team science writers to use pre-determined content styles and pre-determined narrative arcs to frame the grant's impact. Changes to the guidelines from 2012-2016 show NSF administrators understand the political risk and potential safeguard of insisting institutional objectives frame report materials in a narrative form. Ideally, these objectives work to co-construct reports that are more accessible and persuasive than tables of specialist knowledge and data.

This study's approach is novel to SciTS because it comes from the communication field's work on team writing and a rhetorical point of view from the humanities. This scholarship suggests that all documents are co-constructed through minor changes and repetition that builds group recognition of distinct genres. If teams understand the co-constructed nature of their documents, they might better be able to identify the hidden members on their teams and more easily negotiate institutional writing requirements.

Poster 39 - Addressing Interdisciplinary Challenges with Emotional Intelligence and Leadership

Authors: Margaret Hinrichs, Thomas Seager, Sarah Tracy, & Mark Hannah

Research demonstrates the importance of affect in regard to organizational outcomes. People in a positive state of affect are more willing to engage in prosocial behaviors with teammates, resolve conflict in constructive ways, and think outside the box for more creative, innovative solutions. On the other

hand, negative emotion reduces organizational members' willingness to entertain new ideas and increases burnout and absenteeism. While it is true that people have feelings which occur intrapersonally and do not go beyond individual experience, in organizational, group, and team settings emotions often occur interpersonally, are expressed to others and subsequently incorporated into the social fabric of a group, shaping future communication, interactions, productivity, and creativity. The emotional, relational component of collaboration and its effect on a team's productivity and creativity have important implications for teams working in highly innovative contexts like scientific research and development. And yet, most people assume scientific breakthroughs will result from more efficient management of scientists. However, this efficiency view neglects attention to the emotional facets of innovating and creating in diverse groups. Despite the widespread understanding of the importance and social nature of emotion in organizational contexts, these findings have not been fully translated to, explored, or ratified within interdisciplinary science.

In April 2015, the National Academies released a report titled Enhancing the Effectiveness of Team Science which focused primarily on cognitive dimensions of collaboration. These dimensions included task and role diversity of team members, availability of institutional and organizational resources to support collaboration, and quantitative evaluation of bibliometric outputs from team science. Apart from citing sources in passing which recommend attention to socio-emotional needs of teams, the report did not explore emotional, affective facets of scientific collaboration, nor does it analyze or recommend a focus on understanding situated, relational processes between group members. Drawing upon literature in emotions, leadership, communication, and knowledge work, this poster presents recommendations to enhance the findings from the National Academies report, as summarized in the table below. These findings also draw upon

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ethnographic and participant observation data collected in the past 18 months on four different grant-funded projects. It is not enough to focus solely on cognitive aspects of interdisciplinary collaboration. Future research in the areas of team creativity, productivity, and innovation must also include the emotional, relational components of collaboration and the ways in which communication creates these realities for interdisciplinary team members. A key goal of this poster is to begin and encourage conversations around these topics during SciTS 2016.

Poster 40 - A Natural Language Processing Approach to Content Analysis of CSR Survey Responses

Authors: Charles Dumais, Mary Ann Guadagno, Calvin Johnson, & Dan Russ

CSR has recently conducted pilot studies using short surveys with stakeholders. We are evaluating respondent sentiment on Peer Review related issues using Likert type scales and an open text box for general comments. In the early stages of this effort, the number of respondents providing general comments was small enough to manually establish a taxonomy of categories and evaluate the specific polarity of each comment. In subsequent studies, as the respondent population has increased, manual content analysis has become infeasible. In order to analyze thousands of textual comments, CSR is collaborating with CIT to use innovative, computational linguistics to automate the process of capturing and categorizing stakeholder responses as well as assessing the sentiment expressed in these responses. We initially trained a set of linguistic models using a set of manually annotated text fragments from the first pilot study. Then, we have refined the predictive accuracy and reliability of the model using data from subsequent pilot studies. When the comment text presents as a need or suggestion we have trained the software to capture these important issues as well. We are currently performing cluster-based analysis to understand the dominant needs and suggestions identified by the respondents. This automated approach to content analysis will allow

CSR to evaluate thousands of records of stakeholder sentiment with accuracy and speed on a broad range of issues. The model will also capture stakeholder needs and suggestions for further study, demonstrating the potential use of computational linguistics in informing NIH leadership.

Poster 41 - Closing the Gap between the Rhetoric and Practice: An Analysis of Interdisciplinary Team Science to Confront Global Change in the Americas

Authors: Lily House-Peters, Gabriela Alonso-Yanez, Jeremy Pittman, Martin Garcia-Cartagena, Michelle Farfan, Sebastian Bonelli, & Ignacio Lorenzo

The need to address rapid environmental change has created strong rhetorical support for increased interdisciplinary (ID) collaboration across the social, natural, and engineering sciences. As collaborative social-ecological research groups (1) increase in number, (2) become more interdisciplinary and (3) more distributed across geographical regions, additional research examining the difficulties, advantages, and shifting circumstances of ID teamwork is needed. Our research demonstrates that in practice, ID teamwork often fails to produce desired policy shifts and environmental management outcomes. Rather, a gap exists between rhetoric and practice.

This research introduces a conceptual and analytical framework to examine the dynamics of ID collaboration. We focus explicitly on how these dynamics influence the development and application of strategies aimed at producing outcomes for policy and practice. Our research draws on the advances of previously described SciTS scholarship. As a field, SciTS has brought together various disciplinary approaches and research frameworks to better understand and enhance the processes and outcomes of scientific collaboration. Of note, however, is the comparatively little work that has focused on researching teams engaged in sustainability problems and environmental management in social-ecological systems. These teams involve increasingly complex collaborative relationships, including non-academic stakeholders,

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and aim to close the rhetoric-practice gap by informing policy and on-the-ground management to confront wicked sustainability problems. The framework proposed in this study relates individual team member characteristics (cognitive, conative, and affective) and collective team attributes (structure and composition) to three categories of ID teamwork outcomes (science impact, policy impact, and environmental management impact). The framework is applied to analyze 23 interdisciplinary team research projects undertaken across the Americas.

Findings suggest that affective dimensions (e.g., face-to-face interaction, trust, and empathy) and cognitive dimensions (e.g., communication via a common language, epistemological openness, and learning) are important factors for effective ID teamwork that lead to beneficial outcomes. Additionally, we find that science outcomes are prioritized over policy and environmental management outcomes due to three types of common constraints: institutional, temporal, and financial. The findings of this research advance understanding of the existing gap between rhetoric and practice in ID teamwork and the implications for navigating rapid change in social-ecological systems. The contribution of the work is twofold: 1) broadens the scope of SciTS scholarship focused on collaborative teams addressing socio-environmental challenges; and 2) advances existing SciTS conceptual frameworks by presenting a model that explicitly links individual and collective team attributes to teamwork outcomes through the integration of qualitative and quantitative research methods.

Poster 42 - The Sound of Cooperation: Musical Influences on Cooperative Behavior

Authors: Kevin Kniffin, Jubo Yan, Brian Wansink, & William Schulze

Objective: Music as an environmental influence has been closely studied with respect to consumer behavior while sparse attention has been given to its relevance for employee behavior. Given the importance of cooperation within teams, we focus on the influence

of music upon cooperative behavior in non-retail, workplace contexts.

Methods: 188 participants were randomly assigned into one of three conditions in which they were exposed to either Happy Music ($n = 60$) or Unhappy Music ($n = 69$) or the no-music Control ($n = 59$) while participating in a 20-round public goods game. As is typical for research informed by experimental economics, participants were incentivized to make realistic decisions since their compensation depended on their decisions to (not) contribute to the public good during each of the 20 rounds. We also measured participants' moods before, during, and after the experiment.

Summary of Findings: Happy music significantly and positively influences cooperative behavior when compared with patterns found through both the Unhappy and no-music Control conditions. We also find a significant positive correlation between mood and cooperative behavior although the strength of that relationship appears relatively limited.

How the Research Advances the SciTS field: The relevance of atmospheric variables has not been closely studied in relation to the behavior of professional employees. The experimental findings that we present highlight the potential for low-cost environmental adjustments involving music to enhance cooperation among teammates across the sciences.

Poster 43 - Signatures of Learning by Information-Processing and Decision-Making Human Systems

Authors: Christina Ting & Jeff Tsao

Human systems are constantly navigating problem-rich environments, ranging from soldiers navigating a battlefield to scientific teams navigating a research domain. As these systems navigate, they are constantly processing information, making decisions, and generating new knowledge. Perhaps as importantly, they are also learning how to improve on information-processing and decision-making. Understanding how these systems learn is non-trivial, however, not just

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because the environment itself is a moving target, but because information-processing and decision-making involve multiple time scales, heterogeneous implicit/explicit information, emotional factors, and complex feedback mechanisms.

We bring to this challenging problem unique perspectives from two distinct fields spanning our own research team. First, we are developing a model of a learning system based on an emerging theory of the irreversible thermodynamics of self-organizing living systems [JL England, *Nature Nanotechnology* 10, 919 (2015)]. In that theory, adaptation of a system is directly connected to entrainment with its environment, defined here as resonances or synchronization with input from external stimuli. Second, we are applying data-science algorithms to look for patterns and signatures of entrainment, which may involve any combination of the team restructuring, reforming goals or repositioning itself in its environment.

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Team Science Toolkit

Discover. Contribute. Connect.



What Is The Team Science Toolkit?

The **Team Science Toolkit** is an interactive website that provides resources to help users manage, support, and conduct team-based research. It also provides resources for evaluating or studying team science.

The Toolkit includes:

- A user-generated collection of resources recommended by experts across disciplines
- Publically available resources such as practical tools to enhance research collaboration, measures for studying team-based research, and recommended readings
- A platform to connect with colleagues and stay up to date on news and events

How Can You Use The Toolkit?

You can use the **Team Science Toolkit** to:

- **Discover.** Learn from colleagues by exploring available resources to support your team science goals, and download them or link to them online.
- **Contribute.** Share your knowledge by uploading documents, links, information, or comments on resources that support the practice or study of team science.
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