SciTS

2018

ABSTRACTS

THEMATIC PAPER SESSIONS/PANELS

POSTER SESSIONS

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ABSTRACTS

FUTURE DIRECTIONS

Paper: Applying Artificial Intelligence, Neural Networks, and Machine Learning to SciTS

Author:
Stephanie Vasko (Michigan State University)

2017 saw prominent technology companies, including Google, Microsoft, and IBM, make tools and technologies based on artificial intelligence, neural networks, and machine learning publicly available. These tools have included conversational agents (CAs) and chatbots, as well as tools for text and video-based content and emotion analysis. These tools will have a variety of implications for the way that we conduct and study team science, including, but not limited to, the technological readiness of teams, the ways that teams and team scientists conduct research, and the composition of teams. This talk will present an accessible introduction to and overview of artificial intelligence (AI), neural networks, and machine learning technologies that can (and could in the future) be applied to the science of team science. As CAs are one of the most popular types of these technologies, I will explore technologies including various tools for conversational assistant/chatbot technologies from IBM Watson and Dialogflow (formerly API.AI), along with applications of these technologies to team science and community engagement (Vasko, 2017 presentation). I'll also present a summary of current work in the area of CAs and teams (Porcheron et al., 2017) and neural networks and teams (Dimas et al., 2017), as well as research efforts using new technologies to evaluate team dynamics from a variety of perspectives (Samrose et al., 2017), including emotion analysis (Rinkus et al., work in progress). I will conclude by summarizing benefits and opportunities to integration of artificial intelligence, neural networks, and machine learning into the science of team science research methodology toolkit.

FUTURE DIRECTIONS

Paper: Complex Adaptive Team Systems (CATS)

Authors:
John Turner, Rose Baker, & Kerry Romine (University of North Texas)

Complex adaptive systems (CAS) have been identified as being hard to comprehend, composed of multiple interacting components acting interdependently with overlapping functions aimed at adapting to external/environmental forces. The current theoretical model utilized the natural functions of teams, viewing teams as a complex adaptive system, to develop the structure of the theory of complex adaptive team systems (CATS). The CATS model was formulated around the components of complexity theory (interactions, nonlinearity, interdependency, heterogeneity, complex systems, emergence, self-organizing, adaptability) to show its utility across multiple domains (the role of leadership, organizational learning, organizational change, collective cognitive structures, innovation, cross-business-unit collaborations). In theorizing the CATS model, a new level of analysis was implemented: the interactions between agents as a move toward emergence in complex systems. The CATS model ultimately provides a model for organizations/institutions to drive knowledge creation and innovation while operating in today's complexity.

NON-ACADEMIC DIMENSIONS OF TEAM SCIENCE

Paper: The Integral Role of Non-Scientific Specialists: A UK Case Study

Authors:
Ruth Norris, Claire Smith, & Amanda Lamb (University of Manchester)

This retrospective, observational study examined the hypothesis that the inclusion of non-scientific skilled specialists (SS) in health informatics research increased the innovation, quality, and impact of the research outcomes: a qualitative study of the Centre for Health Informatics (CHI), the University of Manchester, UK. As is inherent to domains such as digital health, academic teams are typically cross- and multi-disciplinary. However, within the model used by CHI, a high proportion of SS were also embedded in teams or in leadership. This model has successfully taken the group from 4 members to >100 in 12 years, with income >£150 million, 25+ current grants, and c.100 publications in the year 2016-17. Alongside these traditional metrics, the innovative SS-inclusive approach has resulted in significant internationalization of research (e.g. Brazil and China Governments) and strategic partnerships including Intel and Microsoft Research. Sustainable, scalable commercial opportunities have also been established in the form of intellectual property and spin-outs (NWEH; Affigo.io). Team structures evolved over the study: where a higher proportion of SS involvement provided a step-change in high impact research, resulting in a significantly higher impact on national policy and UK-wide campaigns. The inclusion of SS in areas such as software, patient advocacy, communications, and project/programme/operational leadership has impacted research, policy, and practice. SS played key roles in the creation, design, and delivery of outputs influencing the UK's industrial strategy, national data-sharing opt-out programme, NHS interoperability, and public attitudes towards the use of health data. This research contributes further understanding of the application of team science theory from an international perspective, with particular emphasis on the value of SS; with this particular case study providing a working model from which to develop the contribution of SS to enhance and multiply academic endeavour, policy, and practice, which would not be possible with a purely academic team.

TUESDAY, MAY 22 – MORNING SESSION (11:00 – 12:00)

NON-ACADEMIC DIMENSIONS OF TEAM SCIENCE

Paper: Policy Levers to Open Federal Laboratories and Incentivize Public-Private R&D Collaborations

Author:
Vanessa Pena
(IDA Science and Technology Policy Institute)

The Federal Government offers a variety of mechanisms to incentivize private sector collaborations, including access to subject matter experts, data, and unique, world-class laboratories, available across the Federal R&D enterprise. Some Federal laboratories, particularly the Department of Energy user facilities, have operated as open facilities for use, (on a merit basis), by academic and private sectors for some time. More recently, Departments and Agencies are increasingly developing open campuses and making use of other mechanisms to open-up their laboratories to create an environment that facilitates multi-sector collaboration and enhances Federal R&D missions. One mechanism to enable open laboratories is the use of leases to develop and modernize underutilized Federal real property and infrastructure. This mechanism can be used to partner with private and other sectors in common R&D areas, bring non-Federal researchers in close proximity to Federal scientists and engineers, and leverage funding for built infrastructure, particularly from the private sector. This study investigates the use of this leasing mechanism, lessons experienced, and benefits accrued at various Departments and Agencies. This study also makes recommendations for how the Federal Government can maximize the use of these tools, in particular options for addressing policy constraints and implementation barriers.

COMMUNICATION IN TEAM SCIENCE - ANALYSIS AND FACILITATION

Paper: Information Sharing Techniques to Close Gaps in Distance Collaboration

Authors:
Laura Anderson (IBM Research – Almaden), Christine Bruce (James Cook University), Geoffrey Z. Liu (San Jose State University), Kristen Rebmann (San Jose State University), & Sharmistha Dey (Queensland University of Technology)

Scientific, biomedical, and technical team composition and collaboration continues to be increasingly heterogeneous across many dimensions, driven by multiple factors including problem complexity, globalization, computational methods, and the capabilities of communications technologies. This research explores the characterization of heterogeneity experienced as distance between collaborators as they work together, along the dimensions of discipline, geography, time zone, organization, role, project tenure, and others. These distances, individually and in combination, must be crossed in the collaboration work of a team to accomplish the project milestones, share ideas, build common ground, create innovation, avoid misunderstanding, and accomplish the overall goal of the work effort. The included figure provides a visualization of how a set of distances can accumulate, with the potential to impact the collaborative effort in both positive and negative ways, ranging from enriching to dividing the collaborative effort. There is power in a model which examines the cumulative effect of a set of heterogeneity factors, since that is how individuals experience these differences in a specific collaborative context. Fortunately, there are boundary-spanning approaches that can be applied to cross these distances in the work of a team. Particularly important is the strategic and intentional sharing of information over those distances as a force for capitalizing on the intrinsic heterogeneity, as well as closing those gaps. The strategies identified are based on an empirical study with a theoretical foundation using activity theory (also called cultural-historical activity theory, CHAT). Activity theory provides a systemic framework to analyze a collaborative group at multiple levels of granularity, from the individual to the entire group. This talk will review the theoretical and practical dimensions of this work, including the overall model and approach, information sharing strategies, and work management practices to address these compound distances for the benefit of collaborative team outcomes.

COMMUNICATION IN TEAM SCIENCE - ANALYSIS AND FACILITATION

Paper: Gaps and Overlaps in Healthcare Team Communication: Analysis of Speech

Authors:
Tayana Soukup (King's College London), Ged Murtagh (Imperial College London), Anish Bali (Royal Derby Hospital), Tasha Gandamihardja (Chelmsfor Hospital Breast Unit), Lord Ara Darzi (Imperial College London), James Green (Whipps Cross University Hospital), & Nick Sevdalis (King's College London)

Studying groups in their natural contexts can help build our understanding of complex organisational behaviours. This study focuses on cancer multidisciplinary team meetings (MDMs). Building on existing evidence (from the macro perspective) of unequal participation that can impact on the team's functioning, we set out to explore turn-transitioning between team-members on a micro-level using principles of Conversation Analysis. Breast, colorectal, and gynaecological cancer teams were video recorded over 12 weekly meetings and 822 patient-reviews with a cross-section transcribed using Jefferson notation. A low frequency of gaps between speakers (3%) and high frequency of no-gaps-no-overlaps (73%) was found. This points to fast turn-transitions, which with a high frequency of overlaps (24%), in particular competitive, secured predominantly with raised pitch and vocalizations, make for a highly interactive meeting environment. Securing one's turn to speak in a multi-speaker, fast-paced work group setting, such as a cancer MDM, can be challenging due to systemic reduction in turn-taking opportunities, hence unequal participation. Further research is needed to explore the role of authority gradients in MDMs and how members deal with incoming competing speakers. Implications for practice are to do with patient safety, since rapid turn-transitions for prolonged period of time may hinder effective communication and open up opportunity for error. Our findings contribute directly to narrowing the gap in the literature on healthcare teams that is to date largely focused on evaluating team-work from a macro-level perspective.

LEARNING ENVIRONMENTS FOR TEAM SCIENCE

Paper: Syncopated Pandemonium: Redesigning a College for Translational Science and Learning

Authors:
Christopher Wharton, Scott J. Leischow, Matthew Buman, Julie Liss, Tannah Broman, Mac McCullough, Adriana Sanchez, Marcus Jones, Rodger Kessler, Henry Barto, Matthew Scotch, Yuna Buhrman, & Deborah Helitzer (Arizona State University)

Creating solutions for health problems, and determining how to scale them, requires a more complex and transdisciplinary process than is normally applied in the traditional academic setting. Although efforts across the nation are underway to do just this, it might be possible to accelerate progress if translational science were not just an activity in which to participate, but a fundamental design attribute of the modern academic college. At Arizona State University, a team of diverse faculty and staff came together, with support from university leadership, to fully redesign ASU's College of Health Solutions with this notion in mind. As part of an exercise in 'syncopated pandemonium,' the team and its consultants engaged in an exhaustive series of activities meant to re-examine every level of traditional college structure. Activities included listening, challenging, breaking down, and rebuilding in order to design into the edifice of the College default mechanisms to: 1) drive team science, 2) eliminate barriers between innovative research and academic programs, and 3) ultimately translate science into action for population health solutions. The result is a New Academic Model in which translation is, by default, an aspect of how larger scale research activities are conducted and at the same time melded with curricular offerings for students. A key component of this design, and perhaps a novel one for an academic unit, is the inclusion of incentivized Translational Teams. Teams are designed to comprise research and teaching faculty, staff, external partners, and students. Their purpose is to drive innovative solutions to health problems not only through transdisciplinary research, but also through student-centered academic program development, community engagement, and more comprehensive career preparation. In aggregate, the newly designed College of Health Solutions more seamlessly blends disciplines, eliminates barriers between scholarship and learning, and inherently embraces community partners for actionable, scalable solutions development.

LEARNING ENVIRONMENTS FOR TEAM SCIENCE

Paper: Teaching Team Science

Authors:
Jennifer E. Cross, Hannah Love, & Ellen Fisher (Colorado State University)

SciTS emerged as a field because of the idea that we can tackle more complex problems when we are members of a team. However, the scientific literature still debates whether SciTS can be taught. More specifically, can we influence team development and process to result in different team outcomes? Recent literature in the learning sciences has theorized that we need to teach students collective cognitive responsibility. Collective cognitive responsibility is a theory that we can teach students skills they need to join scientific, business, industrial, and other teams that require complex systems thinking. This literature has a major gap, it has no examples of practical application and no empirical evidence that teaching collective cognitive responsibility works. In our study, we conducted a mixed-methods evaluation of capstone courses at Colorado State University to answer 1) how can we teach SciTS to undergraduate students and 2) what are the long-term learning outcomes from teaching SciTS? We collected data, social network surveys, student reflections, interviews, and learning outcomes survey from two departments and six course formats. We found strong scientific evidence that community-based research (CBR) and service-learning activities are preparing students for team science by developing their capacity for collective cognitive responsibility. Our results from the SNA showed that students formed teams to answer the community-based research questions and conduct service-learning projects. In addition, the student reflections indicate that the entire classroom functioned as a team, where students learned to rely on each other and co-create their learning. In interviews, students reported on the strong influence of their peers. Finally, in the alumni survey, respondents reported that CBR and service-learning classes taught them to be members of a team. These CBR courses provide an empirical example of how to teach team science and specifically how to cultivate the basic cognitive skills needed for team science.

PANEL – ESTABLISHING TRUST IN A DISTRIBUTED TEAM TO CULTIVATE SYSTEMIC CHANGE

Panelists:
Kennan Salinero (ReImagine Science), Anne Heberger Marino (National Academy of Sciences), Pips Veazey (University of Alaska Fairbanks), Mery Miguez (Social Presencing Theater), Ulrike Kloiber (Chumbe Island Coral Park), Andrea Chlopczik (Zurich University of Applied Sciences), & Kimberley Brown Magnan (Leadership and Teamwork Trainer)

Our poster 'Theory U Applied to Science: What's Possible?,' presented at the 2017 Science of Team Science conference, seeded the formation of a science hub for the MITx course u.lab: Leading From the Emerging Future. An international group of ten individuals met weekly for three months via zoom to explore new ways of connecting and learning together, while also engaging the course content individually. Our processes variously incorporated spaces for reflection, inquiry into intention, movement, sense-making, meditation, and the exploration of sometimes very new ways of knowing. We experienced an increase in trust, communication, support, and exploring deeper questions together in an intimate (though virtual) setting. We found that co-development and 'co-sensing' allowed us to experience our own space while developing our distributed team. This experience changed the way some of us communicate and interact in our own scientific settings. This panel, which will be presented by several who were part of this journey, will share how new approaches, ideas, and experiential exercises can generate team cohesiveness, co-learning, and unpredicted insights. Following Otto Scharmer and Arawana Hayashi's TheoryU processes, we will include participants in this panel presentation/participatory event, creating a space for participants to experience a slice of the unfamiliar, exploratory approach we found in the u process. Creating a different space, participants will help us change the structure of the room setting. We will thereby host this 'out of the box' conversation about systematic change in the world of science, with the invitation to do things differently. Attendees will have a chance to have a taste of how we as individuals experience the 'social body', relating and interacting as individuals and as 'group.' We feel the potential to disrupt science in this way might allow scientists to embrace and envision the highest future possibility for ourselves and for society.

LEADERSHIP

Paper: Introduction to Leadership Training for Pre-Doctoral Students Engaged in Team Science

Authors:
Celia Chao (University of Texas Medical Branch), Kevin Wooten (UTMB), Heidi Spratt (UTMB), Huda Sarraj (UTMB), Judith Aronson (UTMB), Jonathan Hommel (UTMB), Ross Ungerleider (MD Driscoll Children's Hospital), Jamie Ungerleider, & Mark Hellmich (UTMB)

Objectives: Interprofessional team science is increasingly recognized as a key driver for the most impactful way to translate scientific knowledge to improve public health. However, formal training in team leadership and project management is not routinely taught in biomedical research graduate training programs or medical schools. We present our initial experience with leadership training in predoctoral students engaged in team science.

Methods: We piloted an IRB-approved Leadership Training Workshop for graduate biomedical and medical students enrolled in our Interprofessional Research Design during the Summer Term of 2017. We devoted 12 hours of a 7-week course toward leadership training. To measure outcomes, we used a pre/post-workshop test, which asked open-ended questions and probed whether the students recognized their own leadership style and whether they are aware of communication methods that minimize conflict and maximize team productivity. We also included a validated self-efficacy survey.

Results: A total of 17 students were enrolled in the Interprofessional Research Design Course (12 medical students, 4 PhD students, 1 MD/PhD student) during the Summer Term of 2017 at the University of Texas Medical Branch Graduate School of Basic Sciences and the School of Medicine. The Kane-Baltes self-efficacy survey demonstrated improved leadership skills (pre- and post-training paired t-test, $p=0.04$).

Discussion: We successfully integrated a 12-hour leadership workshop into an introductory 7 week course on the practice of interprofessional team science. The students demonstrated self-awareness of their own leadership styles and further recognized that the styles differed under non-stressed versus stressed situations. Based on their own writings, some students developed an appreciation that team science outcomes are simply indicators of the processes that leaders themselves create.

LEADERSHIP

Paper: Contextual Factors Influencing Collaboration: Using a Followership Lens

Author:
Karen Schwab
(University of Texas Health San Antonio School of Nursing)

As part of a qualitative action research study introducing followership theory into the health care context, participants were asked to consider how followership theory influenced their views about inter-professional collaboration. Participants were nursing students. Data collection methods included two focus group interviews, ten individual interviews, and four weeks of online activities and reflections. The author transcribed all interviews using a verbatim approach. Domain analysis, memo writing, axial coding, and thematic analysis were used for data analysis. Four themes emerged across the data set. One theme is relevant to those with an interest in inter-professional collaboration. In this study, participants' willingness to follow was situational to contextual factors. These contextual factors have been identified by participants as personal, group, leader, and situational factors. Furthermore, the willingness to follow or an unwillingness to follow also represented participant engagement. When willingness to follow was present, participants expressed high levels of engagement in achieving goals. When not willing to follow, their expressed levels of engagement declined. The one exception to this pattern was when the act of not following was seen as a way to advocate. In this situation, the participants' unwillingness to follow also matched a high level of expressed engagement. Participants went on to describe role management of those occupying the leadership, follower, and fellow follower role as vital to collaboration. Failing to manage ones' role during collaboration was seen as a frequent contributor to collaboration failure as a whole. Finally, participants spoke of barriers they faced when attempting to collaborate. These barriers included a lack of voice, lack of experience, and uncertainty of boundaries. Study recommendations include fostering leadership, as well as followership skills to allow improved role management during collaboration. Also, learning the contextual factors influencing engagement will assist both leaders and followers when setting group goals.

LEADERSHIP

Paper: Team Emergence Leadership Development and Evaluation Model Using Complexity Theory

Authors:
John Turner, Rose Baker, & Kerry Romine (University of North Texas)

This paper presents a leadership development model published by Turner and Baker (2017) that is designed to utilize the self-organizing, self-managing, and self-regulating functions found in teams and small groups. This theoretical paper presents the Team Emergence Leadership Development and Evaluation (TELDE) model as a new dynamic leadership development model designed to function in complex and non-predictive environments. Complexity theory, complexity leadership theory, and emergence were utilized to connect this theoretical model to leadership development, team cognition and learning, and knowledge management. This new theoretical model provides a new way of viewing leadership development, by incorporating naturally occurring team processes as a means of replicating the characteristics traditionally viewed as being related to leadership development. Emergent events occur through distributed leadership among various agents and are defined by levels of meaning, providing new knowledge to the agents, and allowing for the collective to move onto the next step towards goal attainment. Connecting leadership development competencies with the environmental factors is critical for successful leadership development programs. The methods and procedures within the evaluation plan and protocols should move beyond a reliance on competency development as confirmation of leadership development. Complexity theory can help to shed light on the formation of these connections while aiding other agents to become potential emerging leaders themselves. The TELDE model can be implemented as a developmental tool for organizations that expand the utility of such tools founded on the principles provided by the SciTS.

TEAM PERFORMANCE METRICS

Paper: Team-Centered Informatics: Leveraging Team Science for Designing Effective Informatics Solutions

Authors:
Suresh Bhavnani (University of Texas Medical Branch), Bill Ameredes (UTMB), & Shyam Visweswaran (University of Pittsburgh)

Multidisciplinary translational teams (MTTs) have an increasing need to extract and make sense of massive amounts of health information for tasks such as designing multi-site clinical trials, and secondary data analysis of molecular and claims data. While recent team science research has identified key drivers of MTT success based on team structure and dynamics, there have been few attempts to leverage this understanding to design informatics solutions for tasks ranging from analyzing big healthcare data to designing precision medicine interventions. Here we explore Team-Centered Informatics, a framework which uses a top-down and bottom-up approach to guide the design of informatics solutions which are targeted towards the needs of MTTs. We demonstrate a case study of using this approach to design a novel system to help MTTs comprehend complex data associations.

TUESDAY, MAY 22 – AFTERNOON SESSION 1 (1:30 – 2:50)

TEAM PERFORMANCE METRICS

Paper: Scholar Plot: Well-Abstracted and Scalable Interface for Academic Performance

Authors:

Ioannis Pavlidis (University of Houston), Dinesh Majeti (University of Houston), Kyeongan Kwon (University of Houston), Ergun Akleman (Texas A&M University), Alexander Petersen (University of California), & Brian Uzzi (Northwestern University)

The ability to fairly assess academic performance is critical to rewarding academic merit, charting academic policy, and promoting science. Quintessential to performing these functions is first the ability to collect valid and current data through increasingly automated online interfaces. Moreover, it is crucial to remove disciplinary and other biases from these data, presenting them in ways that support insightful analysis at various levels. Existing systems fail in some of these respects. Here we present Scholar Plot (SP), an interface that harvests bibliographic and research funding data from online sources, unbiases the collected data, and combines them synergistically in a plot form for expert appraisal and a pictorial form for broader consumption. The design of SP's interface has three main goals: 1) Bring together the factors playing a key role in P&T, in a way that facilitates insightful evaluation. 2) Convey P&T factors in visual forms that appeal to different audiences, ranging from scholars to the public. 3) Construct visualizations of P&T factors that are scalable across the academic organizational structure (scholars →departments →colleges). Scholar Plot draws on publicly available data to synthesize a composite representation of the three P&T merit criteria (i.e., funding, citations, and publication quality tracked by journal Impact Factor), in a way that reveals their interrelationship. SP's plot and iconic forms are scalable, representing equally well individual scholars and their academic units, thus contributing to consistent ranking practices across the university organizational structure.

TEAM PERFORMANCE METRICS

Paper: Decoding Teams: Team Output and Individual Productivity

Authors:
Mohammad Ahmadpoor & Benjamin Jones (Northwestern University)

Teams increasingly dominate the production of science and invention. This paper estimates the mapping between individual inputs and team output, drawing on 32 million research articles and 5 million U.S. patents. We examine (1) how individual productivities combine to determine team output and (2) how individual productivities may be inferred when people work in teams. We find that team output is weighted towards the lower-productivity rather than the higher-productivity members of the team. This finding is universal across fields, with fields typically centering between the geometric and harmonic averages of individual productivities. An important implication is that the advantages of teamwork dissipate as the productivity differences between team members grow large. Consistent with this implication, we further show that teams tend to assemble among members of similar individual productivity in all fields. Our estimates for individual productivity, which account for the contributions of coauthors, have substantial advantages over existing measures in predicting out-of-sample paper and patent outcomes. Overall, the methodology uncovers universal regularities that inform team organization while also providing a tool for individual evaluation in the team production era.

TUESDAY, MAY 22 – AFTERNOON SESSION 1 (1:30 – 2:50)

PANEL – TEAM SCIENTISTS AS SUBJECTS: AN EXAMINATION OF THREE PRELIMINARY STUDIES

Paper 1: Evaluation of a Pilot Team Leadership Assessment Center for Team Scientists

Paper 2: An Exploration of How Emergent Collaboration Patterns Relate to Project Performance of Embedded Interdisciplinary mHealth Teams

Paper 3: Randomized Trials to Understand and Enhance Early-Career Collaboration in the CTSA Network: Refining Process and Outcomes

Authors:

Paper 1:
Kevin C. Wooten (University of Houston Clear Lake), Gwen Baillargeon (University of Texas Medical Branch), Eugene Frazier (UTMB), Marlon Sukol (UTMB), Faith Phillips (UTMB), Phillip Decker (UHCL), Cliff Mayfield (UHCL), Alex Milan (UHCL), & Lisa Sublet (UHCL)

Paper 2:
Bonnie Spring (Northwestern University), Phillip W. Rak (NU), Ekaterina A. Klyachko (NU), Angela Pfammatter (NU), H. Gene McFadden (NU), Mark Hansen (University of California Los Angeles), & Vivek Shetty (UCLA)

Paper 3:
Larry Hawk (University at Buffalo), Timothy Murphy (UB), Katherine Hartmann (Vanderbilt University), & Morgan Jusko (UB)

Background: While a substantial and sophisticated body of bibliometric literature characterizes the publication practices of team scientists who produce high impact scholarly work, less research has characterized how specific interventions can enhance team performance, facilitate collaboration, or enhance personal and team capacities.

Objective: This panel presentation will: 1) provide and in-depth perspective on three small scale pilot studies to optimize scientific team performance, illustrating their designs and preliminary results; 2) review methodological and operational problems experienced; and 3) facilitate an interactive discussion with the panel audience on a range of topics impacting the use of team scientists as subjects, illustrating common problems and solutions, and generating potential Best Practices.

Method: The first study by Kevin Wooten and associates will examine the pilot testing of a leadership assessment center for academic scientists, deployment of a multitrait-multimethod design, and changes in developmental self-efficacy. A second study by Bonnie Spring and associates will present the design and results of an intervention designed to identify communication trajectories in interdisciplinary teams that can be used to predict team performance by using network analysis. The third study by Larry Hawk and associates will discuss emerging randomized controlled trails (RCTs) to evaluate an intervention to facilitate collaboration in the development of scientific teams.

Results: A discussion by each author/presenter will involve their experience conducting research with team scientists when conducting these small pilot studies. Topics include difficulty in recruiting, use of scientists as subjects, and a range of methodological, ethical, and political issues (e.g., reliability and validity of outcome measures, ceiling effects, use of control groups, participation coercion). Audience input on each will be engaged by structured facilitation.

Significance: Attention to important methodological issues and approaches is critical for maximizing the advancement of evidence-based team science.

PANEL - CASE STUDIES AND LESSONS LEARNED IN PROMOTING TEAM SCIENCE IN CROSS-DISCIPLINARY COLLABORATIONS AND INSTITUTIONS

Overall: Although the value of working together as collaborative, cross-disciplinary research teams to have better outcomes has gained recognition by individuals, institutions and funders, there are many challenges that exist when working as teams. These challenges can be at different levels such as an individual, team and institutional. It is imperative to understand these challenges and potential ways to overcome them in order to develop successful collaborative teams and their sustainability over time. This panel will address some of the challenges, lessons learned and strategies they have used to facilitate collaborations (Dr. Ranwala); understand social mechanisms of individual and team level dynamics (Dr. Lotrecchiano); introduce evidence-based competencies to enhance team performance, innovate, and adapt to new challenges (Dr. Brasier); and discuss key leadership skills to lead effective teams as well as those practices that allow for a diversity of ideas and voices to be included (Dr. Travis). This panel is composed of four individuals from four different academic institutions who will use their own case studies and/or examples to disseminate what they have found and potential best practices. The panel is aiming to gather Science of Team Science conference attendees input in a brief pre-panel survey that will be specifically targeted under this panel theme to gather what other case studies/examples have been conducted by the attendees or in their institutions, methods and assessments used, interventions used, challenges, successes, lessons learned, strategies used to develop best practices and what are the next steps. The panel will organize an interactive discussion based on the pre-panel survey responses to determine a few key steps for future directions as a group. Dr. Ranwala will present an overview of the panel, key goals, introduce the panel members and moderate the panel.

Panel Abstract 1

Author:
Dayan Ranwala
(South Carolina Clinical and Translational Research Institute)

EXAMPLES OF MECHANISMS TO STIMULATE CROSS-DISCIPLINARY TEAM COLLABORATIONS

The NIH-funded Clinical and Translational Science Awards (CTSAs) play a significant role in catalyzing cross-disciplinary team collaborations. Our CTSA, South Carolina Clinical and Translational Research (SCTR) Institute, promotes team science in couple of different ways such as via the pilot project program's scientific retreats and funding mechanisms. We place a premium on cross-disciplinary team science and new collaborations. The retreats are organized based on a theme that is cross-cutting to provide a platform to investigators to promote networking with other investigators who are in different disciplines to generate novel research ideas and seek funding via the SCTR pilot project grant mechanisms or other funding mechanisms. The SCTR pilot project funding mechanisms are specifically aimed to provide funding support to newly formed cross-disciplinary teams to facilitate new and innovative translational research. I will present the formats of the retreats and funding mechanisms that we have used during the last couple of years, their success, challenges and lessons learned.

PANEL - CASE STUDIES AND LESSONS LEARNED IN PROMOTING TEAM SCIENCE IN CROSS-DISCIPLINARY COLLABORATIONS AND INSTITUTIONS (CONTINUED)

Panel Abstract 2

Author:
Gaetano R. Lotrecchiano (George Washington University)

UNDERSTANDING SOCIAL MECHANISMS OF TEAM SCIENCE: USING A CASE EXAMPLE OF INDIVIDUAL AND TEAM LEVEL ANALYSIS

Since the concept of team science gained recognition among biomedical researchers, social scientists have been challenged with investigating evidence of team mechanisms and functional dynamics within multidisciplinary teams for the purpose of constructing better practices for scientific teams. Identification of these mechanisms has lacked substantial research using grounded theory models to adequately describe their dynamic qualities. Research trends continue to favor the measurement of teams by isolating occurrences of production over relational mechanistic team tendencies. I will present the method and results of a social constructionist-grounded multilevel mixed methods project that identified social dynamics and mechanisms within a NIH-funded Rare Diseases Clinical Research Consortia (RDCRC) research team representing the US, Canada, and Switzerland of scientific and non-scientific multidisciplinary team. Qualitatively coded data from observations, interviews, and focus groups to show individual/team (micro/meso) level analyses were used to identify change, kinship, tension, and heritage - four social mechanisms dominated in the analysis. Each contains relational social dynamics. I will address the social mechanisms and dynamics that may be present within a biomedical scientific team that may help to inform problems of integration, praxis, and engagement in teams.

Panel Abstract 3

Author:
Allan Brasier (University of Texas Medical Branch)

STRATEGIES AND CHALLENGES IN APPLICATION OF THE EVIDENCE BASE TO PROMOTE TRANSLATIONAL TEAM SCIENCE

Charged with developing and disseminating new approaches to address roadblocks in the translational research pipeline to improve health, the National Clinical and Translational Science Award (CTSA) has embraced an approach promoting interprofessional teams. In this panel, I will present our local CTSA experience that has focused on operationalizing an integrated approach to Translational Teams. I will discuss our experience and view that Translational Teams are a special case of interprofessional teams with unique design characteristics, processes and outputs. We view translational Teams are self-assembled groups of collaborating scientists, clinicians, trainees and health care providers who engage in scientific research, including aspects of training and mentoring and yet develop industry-like translational products. This results in a hybrid model, with characteristics of academic interprofessional teams combined with aspects of industry-like product development teams. A structured model of translational teams informs training programs and evaluation metrics to promote and assess team performance. Effective teamwork and the development of team skills is a combination of attitudes, behaviors, and cognitions; these skills can be taught. In addition, Translational Teams differ from interprofessional science teams in that they may include community members, patient stakeholders, health care providers and others. These members vary in collaboration readiness, hierarchy, and promotive voice. Accordingly, leaders of Translational Teams require greater skill in promoting perspective seeking and integrative capacity than do leaders of academic interdisciplinary science teams. I will introduce an evidence-based formulation three inter-related competency sets that provide behaviors needed for TSTs to enhance their performance, innovate, and adapt to new challenges. Panel discussion will include challenges identifying, testing and disseminating models of effective team training in the CTSAs.

PANEL - CASE STUDIES AND LESSONS LEARNED IN PROMOTING TEAM SCIENCE IN CROSS-DISCIPLINARY COLLABORATIONS AND INSTITUTIONS (CONTINUED)

Panel Abstract 4

Author:
Elizabeth Travis
(University of Texas MD Anderson Cancer Center)

TEAM SCIENCE, NOT ONLY ABOUT SCIENCE

Currently, science has become a team effort in addition to the traditional image of the lone scientist in the lab, managing post-doctoral and graduate students, and not necessarily interacting with colleagues as a team. Developing and managing teams effectively requires a skill set that none of us were taught, neither team leaders or team members. Coupled with the challenge to build and manage diverse teams, now known to provide better solutions to complex problems than the best performing homogeneous teams, adds a level of complexity for which few leaders are prepared. We will discuss key leadership skills to lead effective teams, as well as those practices that allow for a diversity of ideas and voices to be included.

BUILDING TEAMS IN A BIOMEDICAL CONTEXT

Paper: Interprofessional Team Approach for Developing Sexual Assault Assessment Training

Author:
Wendy Lee
(University of Texas Health San Antonio)

Problem: Medical assessment of sexual assault (SA) is challenging because SA patients are often hesitant to disclose information and because of provider unease in conducting SA exams. These challenges are compounded because medical students lag behind graduate advanced practice nursing (APRN) students in both SA training and confidence in SA assessment.

Objectives: To determine whether an interprofessional team approach would result in the development of an effective simulation scenario to foster SA interview skills, communication with SA patients, and confidence in treating SA patients.

Methods: The interprofessional team included representatives from the Uniformed Services University of Health Sciences (USUHS) School of Medicine and Graduate School of Nursing, independent experts in SA assessment, and 'standardized patients' (SPs) - actors trained to play the role of the SA victim and to evaluate students. Learners were USUHS medicine (n=165) and nursing (n=30) students, who each conducted a SA assessment on a SP, and were assessed on SA interview skills, communication skills, and confidence in SA assessment. Data were analyzed with ANOVA at $p<.05$.

Results: The interprofessional team approach was successful. Post-simulation SP and student self-evaluations showed good agreement, demonstrating acceptable levels of interview and communication skills for both medical and nursing students. Most importantly, medical students were significantly lower than nursing students pre-simulation, but the simulation event closed the confidence gap in SA assessment, such that medical and nursing students were statistically indistinguishable following the simulation event.

Importance to the SciTS Field: The interprofessional team strategy resulted in a successful simulation teaching event and closed the confidence gap between medical and nursing students. These findings support the efficacy of an interprofessional development team approach to train emerging healthcare providers.

BUILDING TEAMS IN A BIOMEDICAL CONTEXT

Paper: Fault Lines and Best Practices in the Treatment of Substance Abuse

Do science teams with faultlines make better or worse adoption decisions? We use a sample of teams from 218 substance abuse treatment centers treating opioid and other addictions. While teams of science managers had trouble in making adoption decisions, science teams with patient contact made more evidence-based decisions.

Authors:
Chester Spell (Rutgers University), Katerina Bezrukova (University at Buffalo), Terry C. Blum (Georgia Institute of Technology), Paul M. Roman (University of Georgia), & Huiru Yang (University at Buffalo)

BUILDING TEAMS IN A BIOMEDICAL CONTEXT

Paper: Using TL1 Teams to Transform Clinical & Translational Science Training

Authors:
Wayne McCormack, Yu Su, Alena Prikhidko, Hailey Kuang, & Linda Behar-Horenstein (University of Florida)

The UF Clinical & Translational Science (CTS) PhD program is based on the premise that training grounded in a team science framework enhances research effectiveness. Unique to our TL1 training grant mechanism is the provision of support for teams of trainees. PhD and dual-degree students propose collaborative research as 'TL1 Teams' comprised of two or more students from different degree programs across colleges. Teams develop specific yet complementary aims based on a common research interest, e.g., a human disease investigated at different levels (molecular to population), use of different experimental approaches or data analysis methods, and/or at different stages of the translational research continuum, to expand the scope of individual dissertations. Team training is supported by courses that strengthen research skills through experiential work that require collaboration. In the 'Translational Research & Therapeutics: Bench, Bedside, Community, & Policy' course, multidisciplinary teams identify unmet medical needs, experience team-based learning, and develop research proposals at T0-T4 stages of translational research to address unmet medical needs. In the 'Team Science' course, students practice skills for team assembly, leadership, management, and performance monitoring on their actual research teams for dissertation research, i.e., TL1 Teams, or research groups, if not TL1 trainees. Mentored dissertation research includes specific clinical or translational research aims. Lessons learned include a need to redesign the TL1 application process (provide networking opportunities for interested applicants, require joint letters of support by co-mentors, conduct team interviews, and score teams rather than individual applicants) and to revise the Team Science course to ensure broader application. Early results reveal that TL1 trainees recognize the benefits of participation, attain a more comprehensive understanding of translational research, experience the positive impact of TL1 Team and other collaborative interactions on their research, and appreciate acquiring information and skills from required courses. Quantitative assessments for the second TL1 cohort revealed significant positive changes on participants' self-ratings of the benefits of collaboration among scientists from other disciplines and Clinical Research Appraisal Inventory items such as (a) designing the best data analysis strategy for the study analysis, (b) writing the results and discussions sections of a research, (c) describing the proposal review and award process for a major funding agency, (d) identifying faculty collaborators from within and outside the discipline, and (e) describing ethical concerns related to using placebos in clinical research. We suggest that this team training model may be well suited for interdisciplinary doctoral training programs although additional inquiry is needed. We recommend that future research compare the outcomes and experiences among PhD biomedical students trained in the team science model and those not trained within this framework. Supported by TL1TR001428 and UL1TR001427.

BUILDING TEAMS IN A BIOMEDICAL CONTEXT

Paper: Will They, or Not? Factors Associated with Consulting a CTSA

Authors:
Felichism Kabo & George Mashour (University of Michigan)

Investigators who consult with the Clinical and Translational Science Award (CTSA) at a leading research university are not only more likely to get funded, but they are also more likely to receive larger awards. On this basis we would expect that a majority of investigators, especially those preparing proposals to external sponsors, would consult with the CTSA in order to boost the likelihood of a successful award and the size of the award. The benefits of consulting with the CTSA for help with research design, proposal preparation and submission, and award administration should be apparent to all investigators. However, on average, fewer than 10% of investigators preparing proposals to external sponsors consult with the CTSA in any year. The goal of this study is to describe the factors that are associated with an investigator consulting with the CTSA cross-sectionally and longitudinally over a five-year period. Our sample was investigators at the university that submitted proposals to external sponsors in the year 2006. We ran logistic cross-sectional and panel regressions for the time period 2006-2010, where the dependent variable was whether an investigator consulted with the CTSA. The independent variables were network size (two-step reach), organizational affiliation (school/college) and job status (for example, 'assistant-level faculty,' 'administrator,' 'fellow,' etc.). We included controls for gender and race. Investigators with larger networks and that were affiliated with the Medical School were more likely to consult with the CTSA. There were no significant differences between investigators by job status, such as between faculty at the 'assistant,' 'associate,' and 'full' levels. Gender and race had no significant effects. The results suggest an unmet opportunity for the CTSA to work with non-Medical School investigators. This study advances the SciTS field by expanding our knowledge of which factors, such as network size and affiliation, shape help-seeking by investigators.

TEAM SCIENCE – THE STUDENT PERSPECTIVE

Paper: Student Perceptions Before and After Interprofessional Experiences in Biomedical Training

Authors:
Joon Moon, August Schaeffer, Corri Levine, Maria Ansar, Andrea Dimet, Austin Miller, Christopher Rice, Jourdan Andersson, Shaunte Ekpo-Out, Erica McGrath, & Huda Sarraj (University of Texas Medical Branch)

Interprofessional Experiences (IPE) in healthcare education garner positive receptions from the students involved. IPE focuses on improving collaboration and interprofessional respect when providing healthcare. To our knowledge, the effects of IPE in groups of graduate and medical students has yet to be described. Our study examines the attitudes of graduate and medical students after completion of a year-long IPE curriculum. Students participated in several IPE Problem Based Learning (PBL) classes as part of their medical/graduate training. A cohort of ten students participated: six graduate students, three medical students, and one MD-PhD student. After completing the IPE curriculum, each participant composed a narrative detailing the strengths and challenges of IPE. The constant comparative method of qualitative analysis was used, and emerging themes were identified. Prior to engaging in IPE-PBL, the preconceived notions students held centered on three major areas. First, students felt a major disconnect between the field of clinical medicine and medical science. This perceived gap was a major motivation for students joining the program. Second, students tended to have negative biases towards the other field. Finally, students were skeptical about the benefits of group work. After participation in IPE, students felt they were better suited to work with members of the other field. There was also a sense of camaraderie that developed between the students. Lastly, students valued the group work and felt the experiences were beneficial to the development their careers. Training programs with IPE between graduate and medical students can nurture relationships between these two fields. Better communication and understanding of the other group will support future multidisciplinary collaborations and improve the quality and variety of research performed.

TEAM SCIENCE – THE STUDENT PERSPECTIVE

Paper: Student Reflections of Interprofessional Experiences in the Biomedical Sciences

Authors:
August Schaeffer, Joon Moon, Corri Levine, Maria Ansar, Andrea Dimet, Austin Miller, Christopher Rice, Jourdan Andersson, Shaunte Ekpo-Out, Erica McGrath, & Huda Sarraj (University of Texas Medical Branch)

Interprofessional Experiences (IPE) in healthcare have been well-established and researched. The implementation of healthcare provider-based IPE results in improved patient outcomes and satisfaction. Less well developed is the use of IPE to improve the development and implementation of medical research. We sought out to examine a curriculum focused on fostering IPE between medical students and PhD candidates. Students interviewed after completing this program expressed satisfactions; however, limitations still existed. The aim of this research project was to identify challenges faced by the students in order to facilitate long-term improvement of team science within biomedical education. Six graduate students, three medical students and one MD/PhD student participated. Within a one-year curriculum, students were exposed to IPE in the form of Problem Based Learning (PBL) classes. Students collated their experiences into narratives that described the strengths and challenges they saw in the program. Using the constant comparative method of qualitative analysis, narratives were revised, analyzed, and coded. Themes regarding program limitations were identified. The limitations expressed were divided into three major categories: (1) interpersonal, (2) structural, and (3) administrative. Within the interpersonal category, students encountered personal conflicts between group members. It is important to note that this is common in group work and not limited to these students. The structural challenges centered on different long-term education goals of each group. Most notably, when the MD students were exposed to new information, they would often extract out the clinically relevant information while the graduate students tended to focus on molecular pathways. Finally, administrative limitations included incomplete integration of graduate students into the school of medicine. This fostered a lack of access to resources and feelings of isolation. Challenges identified from this study may inform improved development and implementation of IPE medical research.

TEAM SCIENCE – THE STUDENT PERSPECTIVE

Paper: Case Study of Interdisciplinary Student Research Teams: Factors, Outcomes, and Lessons Learned

Author:
Brent Ladd
(Purdue University)

Objective: From 2011-2017 the Center for Science of Information (NSF-STC), with a goal of fostering a community of practice (Wenger et. al., 2002), emphasized research collaborations across eleven member universities. This paper focuses on graduate student collaborations and research teams. Pathways for collaboration were developed. Guiding questions included: 1. Is there a relationship between collaboration and scholarly outputs? 2. Do factors of research funding source, university, gender, or length of Center membership influence collaborations? 3. What lessons can be learned from student research team formation and interactions, and their ability to address interdisciplinary questions? and 4. To what extent can a community of young scholars with large geographic distribution productively collaborate together?

Methods: A survey instrument was designed to capture detailed annual research outputs, collaboration levels, and associated factors. A general linear mixed model with repeated measures procedure for unbalanced longitudinal data was used to account for interdependence of individuals across sampling years, n=264 (West, et. al. 2015). Annually, a formal pathway for collaboration is offered, whereby students participate in a summer intensive. Teams form around viable research projects, with opportunity to receive funding and continue collaborations for a minimum of one year. Workshops are evaluated for effectiveness. Long-term activity and outputs of teams are monitored and documented.

Results: Results show significant and positive relationship between community-based research collaborations and scholarly outputs. Length of time as a community member is also positively related to scholarly output, whereas gender, university, and funding factors have no influence. Multi-year team collaborations have resulted, several with generational impacts multiplying the results. Given careful consideration of support and training, with viable pathways across domains and institutions, our community has learned that students can achieve research collaboration success typically shown only at the faculty level (Leahey, 2016). Additional lessons learned will be presented.

TEAM SCIENCE – THE STUDENT PERSPECTIVE

Paper: Collaborative Team Science Supports Integrative Research in the Chesapeake Bay

Authors:
Suzanne Spitzer, William Dennison, & E. Caroline Donovan (University of Maryland)

Citizen science encourages public inclusion in the creation and use of environmental science data, and it affords scientists and members of the public the opportunity to collaborate on research projects that address specific socio-environmental problems. Scientists recognize that collaborations with citizen groups are instrumental in understanding complex socioecological systems, and are increasingly inviting volunteer groups to contribute their data towards comprehensive, large-scale watershed health assessments. However, research goals of professional and citizen scientists often differ, and this perceived misalignment of priorities can discourage citizens from engaging and sharing data with professional scientists, stifling knowledge production. This talk shares results from two comparison analyses used to investigate the monitoring goals of both professional and citizen scientists in the Chesapeake Bay watershed, and it highlights areas of consensus where citizen and professional scientists can work together to answer research questions and simultaneously fulfill scientific and community needs. Exploratory analyses of interview and survey responses conclude that many citizen scientists' goals initially appear to be unrelated to the goals of traditional scientists; however, further investigation reveals that these differing goals can be reached with the same re-purposed data. Similarly, a second comparison analysis of volunteer-collected data and the professional scientists' defined goals reveals substantial overlap. Collaboration between professional and citizen scientists has demonstrated potential to support research that is not only more comprehensive and thus better able to inform policy and management decisions that improve the environment, but also more inclusive and useful for the public. To effectively collaborate, scientists should make efforts to understand and legitimize citizen monitoring objectives, facilitate collaborative dialogue, and actively create opportunities that empower citizen scientists to contribute to the development of a new, more integrative understanding of the Bay.

PANEL - THE TOOLBOX DIALOGUE INITIATIVE: EVIDENCE OF EFFECTIVENESS AND NEW DIRECTIONS

Panelists:
Graham Hubbs (University of Idaho), Bethany Laursen (Michigan State University), Marisa A. Rinkus (MSU), Brian Robinson (Texas A&M University – Kingsville), & Stephanie E. Vasko (MSU)

The Toolbox Dialogue Initiative (TDI), now run out of Michigan State University's recently-founded Center for Interdisciplinarity, has been an active part of the SciTS community for several years. The aim of TDI is to foster inter- and transdisciplinary activity through structured dialogue and to research ways of enhancing communication in a variety of settings, including team science. The purpose of this panel is to update the SciTS community on some of TDI's most recent research, including studies of the effectiveness of its method. The panel will present both quantitative and qualitative analyses of TDI's work as well as some of the results from a recent external review. The panel also will discuss new directions for TDI that are being pursued in light of this recent research.

Quantitative Results: To assess the effectiveness of fostering integration among teams of trans-disciplinary scientists, we conducted a quantitative analysis of group meta-cognition, i.e., how accurately team members understand the underlying worldviews of their collaborators. Integration in team science requires group meta-cognition. We found that after a TDI workshop, teams show a significant improvement in group meta-cognition.

Qualitative Results: Qualitative coding of dialogue session transcripts examined how workshop participants challenged, refined, and built upon ideas leading toward shared cognition by documenting the presence of themes and threaded ideas. This analysis identified exchanges that manifest evidence of negotiated mutual understanding, reflexivity, and perspective seeking among dialogue participants. Both reflexivity and perspective seeking are considered key capabilities for successful interdisciplinary team performance. Examples from the data will be discussed along with the role of qualitative data in contributing to SciTS and areas for further research.

External Evaluation: In 2017, the Evaluation Center at Western Michigan University conducted an external evaluation of the impacts of TDI to date. The evaluation showed positive impacts on participant reactions, learning, behaviors, and work products. However, there is room for improvement, and some impacts are stronger than others. Results will be presented and discussed in relation to the major shift in TDI design around 2014, the ecosystem surrounding a research team, and new TDI efforts.

Future Directions: Originally, the TDI approach was applied primarily to research teams and in educational settings. Newer applications of the approach have expanded the potential audiences and timeframes with which TDI operates. Case studies on TDI's longitudinal partnerships with traditional and non-traditional academic partners will be presented, as well as TDI's work on strategic planning with academic and nonacademic partners. Thoughts on new partnerships and opportunities will be presented. New tools and technologies that TDI is exploring for research and facilitation will also be discussed.

BIG DATA BIBLIOGRAPHY

Paper: Mendeley Science of Team Science (SciTS) Library

Author:
Holly J. Falk-Krzesinski
(Elsevier)

Team science initiatives are characterized by cross-disciplinary collaboration focused on complex problem-, project-, or product-oriented research. Over the last decade, academia has generated an upsurge in team science initiatives, while external funding agencies in the United States and around the globe have made more collaborative and team-based science funding opportunities available. Studies on research centers funded by the National Science Foundation (NSF) and National Institutes of Health (NIH) have demonstrated that team science initiatives entail significant coordination costs. As a result, team science takes more time, at least proximally, than individual research; however, studies have also demonstrated a distal payoff in terms of research acceleration. Consequently, it is imperative that team science leaders and practitioners can easily draw from the growing science of team science literature as an evidence base for the most effective praxis of team science. The Mendeley Science of Team Science (SciTS) Library (https://www.mendeley.com/community/science-of-team-science-(scits)/) is the most comprehensive and authoritative source of empirical literature on team science and scientific collaboration in the world. It is a free, public group available via the web and through the free Mendeley Desktop software providing over 2,300 references, most curated and organized into over three dozen practice-oriented folders. As a public group, any member of the community can directly add references to the library in a crowdsourcing fashion, including creating new folders, and anyone with a basic Mendeley profile can access the library in its entirety. The Mendeley Science of Team Science (SciTS) Library is the source of references for the NIH's Team Science Toolkit, was used by the National Research Council of the National Academy of Science to conduct their consensus report on the science of team science, 'Enhancing the Effectiveness of Team Science,' and the Academy of Medical Sciences team science report, 'Improving Recognition of Team Science Contributions in Biomedical Research Careers,' and it constitutes the primary reference library for the Canadian Academy of Health Science Team Science Panel.

TUESDAY, MAY 22 – AFTERNOON SESSION 3 (5:00 - 6:00)

BIG DATA BIBLIOGRAPHY

Paper: First Steps to Systematic Review of Very Large Biomedical Research Teams

Authors:
Yulia Tyshchuk & Griffin Weber (Harvard Medical School)

There has been a recent and rapid rise in the number of very large biomedical research teams (VLBRTs) publishing articles with 50+ authors. While very large teams have been common in physics and astronomy for several decades, there were only 26 biomedical publications with 50+ authors before 2000. Today, there are hundreds of VLBRT publications per year, with some even having 1000+ authors. However, there has been no systematic study of what types of research VLBRTs are doing, why they need so many people, how they came together, or what their impact is, either on the production of knowledge or on their members' careers. In this presentation, we discuss our work in studying VLBRTs, including some initial findings as well as challenges in analyzing scientific teams that can have hundreds of members. (1) Identifying VLBRTs. Due to different authorship and reporting conventions (e.g., listing consortia names vs individual authors) across journals and publication databases (e.g., PubMed vs Scopus), it can be difficult to determine the actual number of people who contributed to an article. The term 'team' might not even be appropriate, since there could be authors of VLBRTs that have never met each other. (2) Research areas and products produced by VLBRTs. (3) Collaboration between VLBRTs. Almost all VLBRTs (93%) are weakly (<25%) interconnected with each other through co-authorship; and, teams with strong (>25%) overlap are publishing results from the same studies with corrections or different confounding variables. (4) Impact of VLBRTs. We find that VLBRT publications have disproportionally high citation counts, though self-citation might inflate these numbers.

TOOLS FOR TEAM SCIENCE

Paper: Exploring Visual Analytics as Boundary Objects in Multidisciplinary Science Teams

Authors:
Suresh Bhavnani (University of Texas Medical Branch) & Shyam Visweswaran (University of Pittsburgh)

Many multidisciplinary science teams encounter a tension between disciplinary heterogeneity necessary for solving complex problems, and disciplinary collaboration necessary for innovation targeted towards a common goal (Star and Griesemer, 1989). For example, multidisciplinary translational teams (MTTs) consisting of physicians, biologists, statisticians, and informaticians aim to integrate biological and clinical knowledge leading to innovations for improving health outcomes. However, MTTs encounter several hurdles including disciplinary coordination and leadership (Ameredes et al., 2015; Wooten et al., 2015). One approach to address such disciplinary tensions is the concept of a boundary object defined as "an object which lives in multiple social worlds and which has different identities in each", and which "act as anchors or bridges" for the team members (Star and Griesemer, 1989, p. 409). Here we discuss two case studies to explore the role that visual analytical representations can play as boundary objects to help (1) integrate molecular and clinical information within a specific MTT to enable novel insights, and (2) comprehend and evaluate the structure and dynamics of multiple MTTs in an organization.

Method and Results:

Case Study 1: We introduced bipartite network analysis in an MTT to help integrate biological, and clinical knowledge. Nodes in the network represented patients or genes, and the color of the patient nodes represented clinical outcomes (cases=red, controls=green). The network helped to identify genes that clustered mainly with cases or with controls. This integration of information enabled the biologist and physician on the team to infer a biological pathway that potentially precipitates preterm births.

Case Study 2: We used the same bipartite network representation to analyze 11 multidisciplinary translational teams consisting of 119 members from 26 different affiliations. Nodes in the network represented teams or members, and the edges between nodes represented membership. The network was presented to a team of principal investigators (PIs) managing the MTTs in a Clinical and Translational Award (CTSA) site, who collaboratively analyzed the network for insights related to team design and management. The analysis revealed patterns related to team overlap, homogeneity, and size. For example, four teams in the center of the network shared four or more members, three teams shared at least two members, and two teams shared no members. The shared members were mostly methodologists (e.g., biostatisticians, proteomics analysts), or were PIs of the CTSA. Furthermore, when the network was shown to the individual teams, it helped them to comprehend how their team compared in size and overlap to the other teams in the organization.
Conclusion: The results suggest that bipartite network visualizations can be an effective boundary object to enable MTTs to arrive at innovative insights that integrate biological and molecular knowledge, in addition to enabling managers to comprehend and evaluate team structure and dynamics of multiple teams in an organization.

TOOLS FOR TEAM SCIENCE

Paper: Team Disciplinary Diversity: Open Innovation of a Widget

Authors:
Brooke Struck, Philippe Deschamps, & David Campbell (Science-Metrix Inc.)

One way to assess multidisciplinary collaboration is to measure three dimensions: the number of disciplines involved in the team (variety), the proportionate representation of these disciplines within the team (balance), and the intellectual proximity of those disciplines (diversity). The score integrating these dimensions is known as the Rao-Stirling index, and it has been applied mainly in a bibliometric context to inform broad, high-level decisions about research policy. However, this technique can also be used to inform more local decisions about team composition. This presentation will introduce a free online widget (already live at: http://science-metrix.com/td/) that enables individual teams to measure their own disciplinary diversity, simply by inputting the disciplinary background of each team member. The widget's outputs can provide insights into what is driving the team's score and the most potent levers to affect it. The widget provides the following outputs:

- A total score
- A table with each subfield represented and the number of representatives
- A matrix with the intellectual proximity scores for each disciplinary pair
- A list of the three subfields that would increase disciplinary diversity the most, if members were to be added to the team.

In the spirit of open innovation, we would like to engage the team science community in discussions about the applications of this widget that would be most valuable to the community, and what design modifications would make the widget best suited to fulfill those functions.

TOOLS FOR TEAM SCIENCE

Paper: Assessing Quality Improvement Team Processes - A Meeting Observation Tool

Authors:
Emily Sedlock (University of Texas Health Science Center at Houston), Jason Etchegaray (RAND Corporation), Andrada Tomoaia-Cotisel (RAND), Susan Straus (RAND), Nikhil Jaiswal (UTHSCH), & Eric Thomas (UTHSCH)

Our purpose was to create a tool to assess the effectiveness of quality improvement (QI) team meetings. To date, there is no published observational tool that has been used to assess QI teams' processes. We used several sources to create the MOAT (Meeting Observational Assessment Tool), a checklist to assess team processes and determine whether teams are using skills learned in QI training. Two research team members attended 80 meetings held by three QI teams beginning in April 2017 and evaluated teams using MOAT. The teams were comprised of multidisciplinary clinical members in a Neonatal Intensive Care Unit, who were trained in Six Sigma, Lean, and change management (Robust Process Improvement©). Data collected included quantitative and qualitative measures reflecting frequency and/or effectiveness of use of QI tools, meeting facilitation, teamwork behaviors, patient/family engagement, and descriptions of barriers the teams encounter and resources needed for success. MOAT allowed us to document the skills and tools that teams used during their meetings and identify ways strategies for improvement. For example, one team discussed the purpose of the meeting in only 20% of meetings (n=35 meetings), failed to use other meeting facilitation skills (i.e., plus/delta charts), and had wide variability in use of meeting roles assignments (leader - 92% of meetings; scribes - 56% of meetings; process checkers - 8% of meetings). MOAT allowed us to document use of QI tools used within the Six Sigma Define-Measure-Analyze-Improve-Control (DMAIC) framework; e.g., one team used eleven QI tools across this framework. Institutions can employ observers to document team experiences using MOAT, which can be used to provide objective information to teams to foster improvement. Further research can examine impacts of MOAT feedback on team processes and outcomes and the use of MOAT for other types of interdisciplinary teams solving complex problems.

TUESDAY, MAY 22 – AFTERNOON SESSION 3 (5:00 - 6:00)

COLLABORATORS – WHO AND HOW

Paper: Stages in the Formation of Laboratory Research Groups

Author:
Jose Ortiz (London School of Economics)

This study intends to contribute to the understanding of group research by presenting a novel characterisation of the stages laboratory groups go through during their first years of existence. While the development of groups has been studied from an organisational perspective, it is unclear whether this approach applies to laboratory groups. Research on laboratories, on the other hand, takes an epistemological approach focused on the social construction of knowledge that leaves unanswered questions of how these groups are socially formed. This study draws from both approaches in order understand what stages laboratory groups go through during their first years of existence. To answer this question, the study follows the trajectory of the two main objectives research laboratories have: producing knowledge and training people. This is a non-participant on-site observational study of scientific practices as they happen. This method is complemented with semi-structured interviews and with secondary data collected from the laboratories such as experiment protocols, laboratory meetings' agendas other similar documents. The research strategy considers the construction of an 'ideal type' based on the complementary analysis of all laboratories studied. The study identifies four stages in the formation of laboratories: the assembling stage, in which the different elements necessary to give life to the lab are put together; the defining stage in which the research projects are transformed into 'doable problems'; the decision-making stage in which most of the experimental work occurs; and the telling stage in which work is focused on generating an appealing narrative to external actors. The passage from one stage to the next is marked by 'punctuated' external events that puts pressure on the timing and pace of labs' internal dynamics. These findings contribute to the understanding of early research team dynamics and to the research methods for the study of research teams.

COLLABORATORS – WHO AND HOW

Paper: Research Collaboration in the Life Sciences

Authors:
Kyuseon Lee, Phillip G. Pardey, & Steve J. Miller (University of Minnesota)

Despite the increasing professional and policy interest in multi-disciplinary and team-based research, we still know comparatively little about the nature of these collaborations and the features of researchers, their institutional circumstances, and the nature of their research that may affect the propensity to collaborate. In this paper we examine institutional, researcher and research attributes that affect the nature and propensity to collaborate in the life sciences, using a unique, purpose-built data set spanning 3,777 scientists from three large academic units within the University of Minnesota. We used co-authorship data to examine the patterns of internal and external collaboration and how these patterns have changed over time. We accessed confidential personal data to identify the individual characteristics of UMN researchers, and mapped these data to a compilation of publication and co-authorship evidence we developed using data drawn from Scopus for the years 1999 to 2014. A set of researcher attributes was developed using a number of research-related and personal characteristics. We also used the subject categories of journals in the Web of Sciences, drawing on both publication references and publication titles, to examine whether, and to what extent, the "knowledge attributes" of individual researchers have changed over time. Our findings reveal that researchers have become more inclined to collaborate, most notably with researchers outside of their own departmental and institutional boundaries. We also find that the attributes of researchers who collaborate have changed over time. Most notably, researchers have bigger networks and teams in 2014 than in 1999, while the knowledge attributes of individual researchers remain relatively stable.

TEAM EVALUATION

Paper: The Connection Between Team Development and Team Outcomes

Authors:
Hannah Love, Jennifer E. Cross, & Ellen Fisher (Colorado State University)

Scientists often work on interdisciplinary research teams where they combine knowledge to solve scientific questions. Conducting research in teams across academic disciplines can be challenging. What makes a successful interdisciplinary scientific team? Often, success is measured in metrics like publications, grants, and invention patents. However, these metrics may take years to gather. What if you needed to know 'in the moment' if the team was engaging in a meaningful way to have a long-term impact? To answer this question, Wooten et al have used a development and process evaluation to study team interactions, meetings, and engagement as indicators of long-term success (2014). At Colorado State University, from 2015-2017, we conducted a mixed-methods development and process evaluation study of eight interdisciplinary research teams to examine the science of team science. We administered a social network survey at three time points to understand team development and dynamics. To support the social network data, we collected qualitative data to including: participant observation and turn-taking data during meetings, and focus groups. Finally, we collected outcome metrics at nine time points to further distinguish between successful and non-successful teams. Analysis of the various sources of data (social networks, turn-taking data, and participant observation) revealed a connection between a strong process evaluation and the final outcome metrics. More specifically, successful teams formed dense mentoring and advice networks which encouraged knowledge sharing and promoted trust. This paper will provide a unique methodological perspective by providing mixed-methods data about the team process as it connects to team outcomes.

TEAM EVALUATION

Paper: Employing a Communication Chemistry Framework to Advance Team-Based Cancer Research

Authors:
Breeana Mitchell & Catherine A. Dayger (Oregon Health & Science University)

Multidisciplinary teams can accelerate innovation to solve complex and intractable problems such as the early detection of cancer. Detecting cancer early radically increases the chances of survival after a cancer diagnosis, making effective teams essential to decreasing suffering from cancer. The Knight Cancer Institute Cancer Early Detection Advanced Research (CEDAR) Center seeks to accelerate breakthroughs through a team-based approach to scientific research. CEDAR researchers develop projects in multidisciplinary teams of 4-8 people, which are evaluated against milestones proposed by the team. We hypothesize that the composition of teams and communication between members can be enhanced by considering not only background and training of the members but their natural communication and work styles. To intelligently develop our workforce, we described an ideal breakdown of our total hires based originally on Quinn's Competing Values Framework (Quinn, 1988) and later using the very similar Deloitte Business Chemistry system (Johnson, Vickberg & Christfort, 2017). The Business Chemistry system characterizes workers into 4 categories - Pioneer, Driver, Integrator, Guardian - based on communication style and other factors. To test this hypothesis, we partnered with Deloitte to host a 2-hour training to improve interactions with different Business Chemistry categories with 50 computational and bench research, administrative, and leadership roles represented. We present a case-study of 2 teams that formed in the 2 months following the training, 14 members total. We characterized each team based on member perception of team functioning using a preliminary survey developed with the OHSU program evaluation core and on milestones met. Teams generally had positive views of the training's usefulness, but still identified challenges to optimal functioning of their teams. Based on the case studies, systems such as Business Chemistry can be used as a component, but not the entirety, of a program to improve team function and the satisfaction of team members.

TEAM EVALUATION

Paper: Do Interventions for Academic Scientific Teams Matter?

Authors:
Ellen Fisher, Jennifer E. Cross, & Hannah Love (Colorado State University)

Despite significant time, energy, and money spent on collaboration and interdisciplinary research, scientists and administrators do not know how team performance can be improved by providing additional support for transdisciplinary scientific teams including training, facilitation, and data about their team process. At Colorado State University, the Office of the Vice President for Research (OVPR) embarked on a new program to promote the formation of interdisciplinary research teams to enhance institutional effectiveness in competing for large, multimillion dollar extramural funding opportunities, often focused on wicked problems. As part of this effort, from 2015-2017 we conducted a mixed methods process evaluation of eight interdisciplinary research teams to study the science of team science (SciTS). The team administered a social network analysis (SNA) at three times, and collected qualitative data to support the SNA data including: participant observation, turn-taking data during team meetings, and focus groups. Nine times during the study, we also collected team metrics such as publications, extramural grants received, and funding requests submitted. Conducting a process evaluation allowed for teams to adjust and improve collaboration based on the feedback provided by the researchers. For the process evaluation, teams were presented with the SNA results twice. We also provided interventions with teams at different time points. Two of the teams had interventions at regular time intervals points and requested as much data feedback as possible. We provided interventions to one team early on, but then they did not request further intervention. Finally, two teams requested no interventions and no data feedback. Our results will describe the interventions and provide insights about how team interventions affected the development, process, and outcomes of the team. Second, we will report on implications for best practices in fostering effective institutional structure and culture for team science.

PANEL - TEAM SCIENCE FOR ALL: BUT HOW DO WE MAKE IT WORK?

Panelists:
Nana Coleman (Baylor College of Medicine), Margaret E. Conner (BCM), Kyler M. Godwin (BCM), Anne Gill (BCM), LeChauncy Woodard (BCM), Alana Newell (BCM), Christopher Burnett (University of Houston), Fernanda Simone Tiu (BCM), & Nancy Moreno (BCM)

Overall:
Team science has been demonstrated to underlie success across scientific disciplines and industries. At Baylor College of Medicine (BCM), a health sciences university, we have further identified that team science is a driver of excellence across our research, clinical and education mission areas. Through Team Launch, our institutional teamwork skills training course, we provide foundational training in team science and related skills to our students, faculty and staff. Our model for training in team science is characterized by an instructional methodology in which the identification of essential learner outcomes grounds curriculum development and a rigorous outcomes-driven assessment process with application of novel rubrics based on validated team training heuristics. Through this panel discussion, we consider the value of team science to advancement and innovation in science disciplines; how to successfully engage individuals around the concept of teamwork skills as a core professional competency; how to effectively deliver a team science training curriculum; and lastly, how to assess skill acquisition, outcomes and institutional impact for such a program. Team Launch, the Baylor College of Medicine institutional team science and teamwork training course, is comprised of three components, which together provide foundational training, experiential application and assessment of teamwork skills. We share our experience of developing and implementing a course to enhance team science awareness and knowledge within our academic community. Key areas to be addressed during this panel presentation include strategies for institutional engagement; models for curriculum design and delivery; development of assessment instruments and rubrics; and measures of success. Recognizing that team science is a critical factor to maintaining collaboration and innovation in scientific disciplines, we believe that our approach to delivering training in this area is both novel and adaptable to other environments.

PANEL - TEAM SCIENCE FOR ALL: BUT HOW DO WE MAKE IT WORK? (CONTINUED)

Panel Abstract 1

Authors:
Nana Coleman & Margaret E. Conner (Baylor College of Medicine)

TEAM SCIENCE FOR ALL: CONCEPTION

Teamwork is now ubiquitous in the health sciences. Groundbreaking advances in science and medicine generally involve teams, which require perspectives and expertise from multiple disciplines. Yet, few pre- or post-doctoral trainees receive training in teamwork skills. In 2016, Baylor College of Medicine initiated a quality enhancement plan as part of its institutional reaffirmation of accreditation designed to meet the emerging professional development and educational needs of its learners. Teamwork skills were identified across learner groups, faculty and institutional leaders as the critical competency most desired at BCM. Through now three years of implementation, we have successfully delivered team science and teamwork training to students, staff and faculty across BCM. Team Launch, provides foundational knowledge and professional transferable skills in team science. Through participation in this course, students are expected to have an increased understanding of intrapersonal dynamics and how to interact more effectively with mentors and other team members, how to coordinate their work within a team, and to acquire increased skills in team communication, coordination, cooperation, and conflict response. These skills, incorporated with the acquisition of their other professional and research competencies, will optimize their training and future career success in academic or other settings.

Beginning in 2019, all matriculating students within all of the College's schools and programs, will be required to attain competencies in teamwork skills, through Team Launch. The measurement of success of this course and learner outcomes are presented in the additional components of this panel presentation. Our process of institutional engagement, curriculum design and delivery of Team Launch offers a model which may be adapted for use in other educational settings.

PANEL - TEAM SCIENCE FOR ALL: BUT HOW DO WE MAKE IT WORK? (CONTINUED)

Panel Abstract 2

Authors:
Kyler M. Godwin, Anne Gill, & LeChauncy Woodard (Baylor College of Medicine)

TEAM SCIENCE FOR ALL: IMPLEMENTATION

Team Launch is an integrated teamwork curriculum comprised of three courses for students, faculty, and staff at Baylor College of Medicine. The Team Launch student learning objectives are to: 1) Perform effectively in different team roles and 2) Organize and communicate information generated by a team in written and verbal formats.
Faculty met weekly for 6 months to develop content for the interrelated courses framed within the 8 C's of team work, developed by Eduardo Salas. The first course, Launch Pad, was conceptualized and piloted as four, three-hour-long modules consisting of brief theory bursts, active learning, and reflective exercises focused on team skills: Foundations of Teamwork (e.g., team science overview and marshmallow challenge); Building High-performing Teams (e.g., developing shared mental models and jigsaw puzzle activity); Optimizing Team Performance 1 (e.g., psychological safety and coaching); and, Optimizing Team Performance 2 (e.g., application of teamwork skills through simulated activities). Teamwork knowledge and skills were assessed through multi-level rubrics and instruments designed specifically for the course. After each iteration, faculty reviewed learner feedback, restructuring the course to better meet learner needs, including streamlining content and decreasing session length to meet scheduling challenges across disciplines. Launch Pad is enriched by two elective opportunities, Team Projects and Team Discovery. Team Projects, provides students with an authentic and immersive course experience where they apply teamwork skills to simulated real-world problems in interdisciplinary teams. Team Discovery sessions, offered almost monthly, introduce all members of the academic community to core teamwork concepts through engaging seminars and workshops led by subject matter experts. This curriculum has been well received and has demonstrated effectiveness at increasing teamwork knowledge, skills, and attitudes. This robust curriculum imparts necessary teamwork skills to varied multidisciplinary learners and serves as a model for implementing large, institutional courses.

PANEL - TEAM SCIENCE FOR ALL: BUT HOW DO WE MAKE IT WORK? (CONTINUED)

Panel Abstract 3

Authors:
Alana Newell (Baylor College of Medicine), Christopher Burnett (University of Houston), Fernanda Simone Tiu (BCM), & Nancy Moreno (BCM)

TEAM SCIENCE FOR ALL: ASSESSMENT

Advances in healthcare and biomedical research now routinely rely on teamwork. Accordingly, Baylor College of Medicine recently designed, implemented and evaluated a set of teamwork skills courses to increase students' understanding and abilities to apply research-based attributes of high-performing teams—based on Salas' 8-C heuristic: Cooperation, Communication, Conflict Response, Coordination, Coaching and Leadership, Cognition, Capabilities and Conditions. We developed the courses using "backwards design" to align objectives, instructional activities, and assessments. For assessment, we developed two instruments—the Team Effectiveness and Team Member Rubrics—to support student understanding and evaluate effective behaviors as members of multidisciplinary teams. Based upon the Comprehensive Assessment of Team Member Effectiveness (CATME) rubric, we aligned our rubrics with the evidence-based behaviors underlying each C, and utilized them as both instructional aids and evaluative tools. The rubrics serve as valuable learning tools by empowering students with a framework to analyze simulated and authentic teams, and encouraging them to pinpoint ineffectiveness. Additionally, they enable learners to reflect on their own skills and identify how to proceed to successive levels. Initially, students practice application of the rubrics by analyzing other teams and discussing the results. Further, students calibrate their reflective capabilities by comparing self-evaluations with peer and instructor evaluations. The rubrics also serve an important evaluative component for the courses. By focusing on the observable elements of effective teams, course designers can objectively ensure the curriculum is meeting the instructional goals. These rubrics—as applied by students, instructors, and others—demonstrate the strongest evidence of effective educational experiences. They not only track demonstrable student improvement on the targeted course learning outcomes, but can be utilized to improve multidisciplinary skills that transfer across academic and professional contexts. Through Team Launch, we provide an example of how robust, evidence-based tools can support effective instruction and assessment of valuable teamwork skills.

TEAM SCIENCE – ANALYTICS

Paper: Collaboration Capacity: Measuring the Impact of Cyberinfrastructure-Enabled Collaboration Networks

Authors:
Jian Qin, Jeff Hemsley, & Sarah Bratt (Syracuse University)

This paper reports a study of the incremental impact of evolving cyberinfrastructure (CI)-enabled collaboration networks on scientific capacity and knowledge diffusion. While ample research shows how collaboration contributes to greater productivity, higher-quality scientific outputs, and increased probability of breakthroughs, it is unclear how the early stages of collaboration on data creation supports knowledge generation and diffusion. Further, it is not known whether the ability to garner larger inputs increases collaboration capacity and subsequently accelerates the rate of knowledge diffusion. Given that the collaboration capacity of a science team is largely dependent upon the Scientific and Technical (S&T) Human Capital, the greater a researcher's S&T human capital, the greater the opportunity to collaborate and access resources. We use 'Collaboration Capacity' to refer to this measure of S&T human capital. In this study, we collected metadata for molecular sequences in GenBank from 1990-2013. The data contain details about sequences, submission date, submitter(s), and associated publications and authors. Based on the collaboration capacity framework (Figure 1), we focused on the relationship between collaboration network size and research productivity and the role of CI-enabled data repositories in accelerating collaboration capacity. Our preliminary results show that the size of CI-enabled collaboration networks at data creation stage was positively related to research productivity as measured by sequence data production, and the extent and rate of knowledge diffusion, represented by patent applications. Shrinking time gaps between data submissions and patent applications support the hypothesis that CI-enabled data repositories are an accelerating factor in incremental collaboration capacity.

TEAM SCIENCE – ANALYTICS

Paper: Interactive Bibliometric Network Mapping for Evaluating Interdisciplinary Research Groups

Author:
Michael Burnman-Fink
(Arizona State University)

Evaluating interdisciplinary research groups is challenging. An ideal detailed qualitative study takes time and funding that is often not available, and even then, it is difficult to compare qualitative evaluations performed under different circumstances to develop a systematic understanding of the processes that support interdisciplinary research. The science of team science needs maps to guide evaluations, to point out the key players in a research group, and to provide indicators of people and collaborations which may be particularly interesting. Scientific publications provide a wealth of data which can be used to understand the nature of the collaborations which produce novel research. This paper compares six NSF IGERT grants, using coauthorship and cocitation networks to evaluate how well the grants achieved their stated policy goal of fostering novel methods in graduate training. I will explain how to collect bibliographic data, how to calculate measures of interdisciplinary integration such as the Rao-Stirling index, and how to produce visual mappings which make it easy to capture relationships at a glance and explore a research group in detail. While network analysis is a longstanding technique in scientometric research, ongoing increases in computational power allow the study of larger and more complex networks. Interactive mapping offers a way to gain insights into large numbers of groups with low marginal costs.

TEAM SCIENCE – ANALYTICS

Paper: Accelerating Innovation in Multidisciplinary Scientific Teams through Visual Analytics

Authors:
Suresh Bhavnani (University of Texas Medical Branch), Shyam Visweswaran (University of Pittsburgh), & Rohit Divekar (Mayo Clinic)

A critical goal of multidisciplinary scientific teams is to integrate knowledge from diverse disciplines for the purpose of developing novel insights and innovations. For example, multidisciplinary translational teams (MTTs) consisting of physicians, biologists, statisticians and informaticians, aim to integrate biological and clinical knowledge leading to innovations for improving health outcomes. However, such teams face numerous barriers in integrating interdisciplinary knowledge which is further exacerbated by the explosion of molecular and clinical data generated from millions of patients. Here we explore the use of a visual analytical representation to help MTTs integrate biological and clinical data with the goal of accelerating translational insights. The results suggest that the visual analytical representation functioned as a "boundary object" which (1) evolved through several emergent states progressively helping to integrate diverse disciplinary knowledge, (2) enabled team members to play primary and secondary roles in evolving the data representation resulting in a more egalitarian team structure, and (3) enabled the team to arrive at novel translational insights leading to domain and methodology publications. However, the interventions also revealed limitations in the approach motivating new visual analytical approaches. These results suggest theoretical, practical, and pedagogical implications for improving the ability of multidisciplinary scientific teams to arrive at novel insights through the use of evolving visual analytical representations.

ENABLING COLLABORATION – COMMUNITY STRUCTURE

Paper: Key Factors for Success of Transdisciplinary Research Teams

Authors:

Paul Dodd (University of California Davis), Jennifer Dunne (Santa Fe Institute), & Whitney Cheung (UC Davis)

How best can interdisciplinary or transdisciplinary research be catalyzed, and sustained in research institutions? In this paper we will examine two orthogonal approaches to advancing interdisciplinary research, from University of California, Davis (UC Davis), and the Santa Fe Institute (SFI). Whereas UC Davis is a large, comprehensive public research university with over 4,000 academics spread across 100 academic departments, SFI is a much smaller, bespoke institute established with a focused mission to advance certain interdisciplinary endeavors. SFI self-identifies as the independent world headquarters for complexity science, comprising 25 resident scientists whom take advantage of local intense interactions to anchor an extended global network.

SFI was designed to both ideologically and physically surpass disciplinary silos between the sciences with extensions to the humanities and arts, providing an alternative to traditional academic settings with an emphasis on discussion and a core identity of transdisciplinary in daily interactions.

UC Davis implemented unique interdisciplinary graduate groups to cross over the established boundaries of undergraduate colleges and professional Schools. It has also launched successful programs to bridge the disciplines through the establishment of Organized Research Units, and large scale seed funding mechanism to provide initial start-up support for new team-based research initiatives.

Both organizations have established successful interdisciplinary research programs, but with very different boundary conditions and challenges. SFI has a mission-driven organizational response to traditional disciplinary barriers, whereas the broader UC Davis mission necessitates deliberate creation of structures to catalyze interdisciplinary activities within the bounds of a traditional university structure. Insight can be gleaned from both models in designing new approaches to the science of team science. From our collective experiences, inter- and transdisciplinary research rarely spontaneously assembles, and in this paper we will share our ideas on key factors that might enable success.

ENABLING COLLABORATION – COMMUNITY STRUCTURE

Paper: A HATENATHON Approach Report on Promoting SciTS in Japan

Authors:
GE Wang (Japan Science & Technology Agency) & Ken-ichi Sato (Kyoto Sangyo University))

In the past year, we have taken different approaches to promote Science of Team Science (SciTS) in Japan. For example, (1) we conducted literature reviews and interviews about SciTS and Transdisciplinary Research as well as disseminated those findings promptly; (2) we made proposals for both funding agencies and R&D institutions or individual researchers to help them formulate R&D projects on SciTS; (3) we held a question-driven consensus study based on the workshop series called 'Hatenathon on promoting Science of Team Science in Japan' to identify the questions, challenges and possible solutions to incubate SciTS in Japan. By working through above approaches, we aim to introduce SciTS into Japan and stimulate discussions, potential stakeholders, knowledge, and investment on SciTS actively in Japan. In this presentation, we will give an overview on the progress of promoting SciTS in Japan first, and then a focus report on Hatenathon, which includes how and what kind of questions or challenges being raised from this question driven consensus workshop series. The purpose of this paper is twofold. First, it aims to share and develop new understandings about SciTS. Second, it aims to obtain ideas on how to initiate SciTS in an international context.

ENABLING COLLABORATION – COMMUNITY STRUCTURE

Paper: Facilitating and Implementing Team Science During the ECHO's Developmental Phase

Authors:
Christina Park (NIH), Kaja LeWinn (University of California), Shelby Epps (Duke Clinical Research Institute) & Catherine Monk (Columbia University Medical Center)

The NIH's Environmental influences on Child Health Outcomes (ECHO) program funds, among its awardees, multiple longitudinal studies of children with a focus on five primary outcomes: pre- peri- and postnatal outcomes, neurodevelopment, upper and lower airway conditions, obesity, and positive health. ECHO creates a data platform tapestry from 84 existing cohorts and supports additional participant enrollment and new data collection. While promising great benefits, this program's distinctive design combines extant and new study components, creating competing priorities and complex challenges. Major challenges during the developmental phase since September 2016 have included communication; engaging diverse perspectives; competing demands for investigator time; balancing ECHO-wide vs. cohort-specific research interests; sharing of data and biospecimen samples; data harmonization; and determining common data elements to collect that balance comprehensiveness and feasibility. ECHO formed a team science subcommittee to address these challenges and facilitate collaboration. We began with organized presentations by a team science expert, and then facilitated action-oriented, ECHO-specific small group brief exercises. We asked attendees to develop innovative solutions to the challenges related to tasks such as the development of the ECHO-wide Cohort Data Collection Protocol. Team science facilitators translated these solutions into actions, many of which were implemented by designated teams to improve the collaborative process and task completion. As ECHO investigators progressed from the 'storming' to 'norming' stage of team development, our activities focused on collaborative scientific products via flash talks, which enhanced the spirit of team science as investigators recognized the potential for the whole being greater than the sum of its parts. Successful accomplishments to date include highly engaged and productive committees, working groups, and task forces; communication channels that meet varying 'receiver' needs; establishing and agreeing on publication, data sharing, biospecimen processing and sharing policies; development and ratification of the ECHO-wide Protocol; and development of collective analyses and publications.

ENABLING COLLABORATION – COMMUNITY STRUCTURE

Paper: Encouraging Self-Organized Collaborations at an Interdisciplinary Research Institute

Author:
Kristine Fowler (University of Minnesota)

Beyond issues of effective team formation and management in hierarchical/authoritarian contexts, settings such as universities where the researchers have a high degree of autonomy face a fundamental challenge in actualizing the interdisciplinary research they value. Few studies have been done about organizational practices and attributes that successfully encourage autonomous researchers from different fields to collaborate. In order to explore effective institutional promotion of collaborative research, this case study investigates an interdisciplinary institute that, as among the first of its kind, has relatively long experience in that arena. Qualitative methods were used to explore how the Institute for Mathematics and its Applications (IMA), which has brought together thousands of top scientists, engineers and mathematicians from academia and industry over more than 35 years, has influenced collaborations among its visiting researchers. Selected leaders and participants were interviewed about the IMA's strategies, attributes, and processes that have been important in stimulating and supporting research collaborations, especially interdisciplinary ones. Thematic analysis was used to develop an emergent model of self-organized research collaborations, which expands previous models particularly in the early stages that determine whether a collaboration is actually initiated. Several stages where the institute plays a significant role are identified and the relevant attributes and practices of the IMA are discussed, which could be used to inform practices at other organizations with similar interdisciplinary aims and contexts.

PANEL - TRANSLATING TEAM TRAINING FROM HEALTHCARE AND EDUCATION TO CTSA RESEARCH TEAMS

Panelists:
Erin Blakeney, Brenda K. Zierler, & Jennifer Sprecher (University of Washington)

Overall:
Objective: Provide an interactive panel approach interspersing didactic presentations describing team science training in various contexts with interactive activities to facilitate knowledge and collaboration.

Background and Context: We have trained health professions educators and healthcare teams for > ten years to improve team functioning and patient care. Innovative strategies (known as 'Liberating Structures' (LS's)) have been used to build collaborative competencies among teams; identify improvement goals; increase shared knowledge of roles and perspectives; and promote positive relationships and culture change. In this workshop we will describe and practice the use of LS and facilitate discussion of translating team science training into CTSAs.

Interactive Learning Strategies: A brief didactic overview of healthcare, education, and research projects using LS approaches, followed by practice of LS, and a final debrief will be presented.

Panel Abstract #1:
TEAM TRAINING WITH INTERPROFESSIONAL HEALTH PROFESSIONS FACULTY

Objective: In this abstract, the first of three being presented as part of our panel, we will briefly describe how we have used an interprofessional team and project-based approach to identify and deliver core content to health professions faculty during a 3.5-day training followed by a year of coaching, webinars, and resource exchange. The content and structure that we developed for this interprofessional faculty development program provides the foundation from which we've adapted our training for CTSA research teams.

Background/Context: In 2011, competencies for interprofessional collaborative practice for health professions students (e.g., medical, nursing, pharmacy, dentistry, public health and social work) were published and shortly thereafter, were required for accreditation of these professional programs. In order to meet these interprofessional education (IPE) competencies, there was a need to equip faculty leaders with the knowledge and skills to lead IPE across the learning continuum (from classroom to clinical practice). We developed and implemented a national faculty development training program utilizing team science and IPE competencies.

PANEL - TRANSLATING TEAM TRAINING FROM HEALTHCARE AND EDUCATION TO CTSA RESEARCH TEAMS (CONTINUED)

Panel Abstract #2:
TEAM TRAINING WITH PRACTICING HEALTHCARE TEAMS

Objective: In this abstract, the second of three, we will briefly describe how we have worked with clinical teams to identify team structures, functioning, challenges, and opportunities for improvement. We will also discuss the similarities in team challenges experienced by clinical and research teams.

Background/Context: We have been working with heart failure (HF) clinical care teams since 2014 to improve communication, relationships, and patient care through introduction of team training and process improvements (structured IP bedside rounding (SIBR), TeamSTEPPS communication training, leadership development, and change team formation). We used highly interactive approaches to facilitate opportunities for improvement in team functioning and workflow processes. The healthcare team used several liberating structures (LS) to flatten hierarchy among the team members and to generate ideas for how their team functioning could improve. In collaboration with the HF clinical care teams, we developed, implemented, and evaluated changes in HF practice and team functioning. Mixed methods evaluation of outcomes demonstrates improvements in team communication and relationships, work efficiency, and patient and nurse satisfaction. Changes in team-based approaches to care have been sustained and are now being scaled-up within and beyond our healthcare system.

Panel Abstract #3:
INCORPORATION OF LEAN-R INTO TEAM SCIENCE

Objectives: The objectives of this third of three abstracts in our panel are to demonstrate the linkage between Lean-R (process improvement for research) and Team Science and to demonstrate how inclusion of Lean-R concepts into team science training can increase success

Background/Context: The science of team science (SciTS) encompasses strategies aimed at understanding and enhancing the processes and outcomes of collaborative, team-based research. Lean-R is a methodology used to improve research processes. This presentation is designed to introduce a concept of integration of Lean-R and Team Science. A surprising number of projects fail for a variety of reasons. This failure rate jeopardizes effective implementation of team science findings.

Approach: A brief presentation describing our experience integrating team science and Lean-R, and an interactive activity in which participants can interact with Lean-R and team science.

IDENTIFYING TASKS AND ROLES TO ENHANCE TEAM SCIENCE

Paper: The Role(s) of the Consultant in Team Science

Authors:

Joseph Kotarba, Emma Tumilty, & Evelyn McKinney (University of Texas Medical Branch)

Problem: The consultant in the evolving world of team science has gained importance if not analysis. To date, the role of the consultant has been largely dissolved into the identity of the substance of their work (e.g., scientific discipline or statistical analysis). The purpose of the present study is to examine the consultant in terms of their organizational relationships with the team.

Methods: This material for this analysis is derived from three sources. The first is the authors' personal experience as consultants for or as providers of consulting services to translational research at UTMB-Galveston. The second is our discussions with other consultants or research team leaders in order to arrive art their perceptions of the role(s) and contributions of consultants to team science. Thus, our analysis is multi-perspectival (Douglas, 1976).

Findings: Team science consultants can maintain any of three organizational relationships with teams:

- Inside consultant... is appointed to or serves as a regular member of the team. The consultant's membership could be dictated by conditions of the grant, policy of the broader institution, etc. The consultants' self-orientation is to the goals and work of the team, leading them to adopt the issues and language of the team over time, in order to be a good team member and worthwhile contributor. An example a member of the ethics support team who is an attorney as well as a public health expert. They are in demand for a range of grant-required skills.
- Outside consultant... can be seen metaphorically as an intruder to teams. Their charge comes from the broader organization, to accomplish the organization's goals. A good example is the consultant skilled in research methods who is charged to enter teams for the purpose of conducting evaluation studies. The outside consultant's self-orientation leans towards their home discipline and their work is a direct application of their skills.
- Situational consultant... occupies the role as needed by the team. An example is a member of the ethics support team who may be invited to serve on a research team for very immediate, discrete, and practical considerations, such as Title 9 or HIPAA issues.

Advances to Team Science: Over the course of a grant or contract, a consultant may rotate among all three styles as needed. In fact, movement can be seen as intrinsic feature of team science, as projects such as the CTSA are predicated on the establishment and maintenance of multiple teams. Thus, the consultant must remain liquid in terms of readiness to move among teams that are forming or established, with varying leadership styles, and take varying approaches to their consultants. A strength of the team consultant, especially when qualitatively oriented, is immediate and personal access to an array of teams and team members for the possible purpose of conducting basic organizational or social psychological research. For example, this broad access to teams may lend itself well to the longitudinal study of organizational culture change, at the everyday-life level, resulting from the advent of translational science.

IDENTIFYING TASKS AND ROLES TO ENHANCE TEAM SCIENCE

Paper: Enhancing Team Science Through Mobilizing the Diversity-Creativity Tension

Authors:
Marshall Poole, Samuel Wilson, Luisa Ruge-Jones, & William Barley (University of Illinois Urbana-Champaign)

It is increasingly recognized that diverse teams have the potential to foster creative projects to address the world's most pressing scientific challenges (Cook et al., 2015). Yet research on diverse collaboration suggests these teams face a considerable dilemma: the very features that set these teams up to innovate are associated with elevated communication challenges that hinder their success (Milliken et al., 2003). Research on creativity and interdisciplinarity shows certain conditions increase the probability of hatching transformative and successful research ideas. We describe a theoretical framework for managing the opportunities and challenges of diversity in the generation of ideas for team science research projects, and a structured procedure that implements these conditions. These conditions include: (1) interaction of multiple, radically different perspectives on a research problem; (2) engagement in consciously-orchestrated collaboration processes that spark widespread search for 'idea kernels,' creative recombination of ideas, and novel frames; and (3) work through cycles of (i) intensive ideation (which highlights urgent features of the problem and suggests ideas and solution components); (ii) gestation (parties go their own ways, think about the problem and solutions, pull in new resources/people, work in subsets); and (iii) crystallization (parties reconvene to distill best ideas, recalibrate the nature of the challenge, and prepare for implementation). The procedure will be illustrated in a case study in which a diverse group of scientists (drawn from American Indian Tribal Colleges, Historically Black Colleges and Universities, Hispanic-Serving Colleges and Universities, and a Land Grant University, and representing multiple disciplines) is guided through the generation of projects and formation of research teams related to climate resilience. Our analysis of outcomes yielded promising results and provides opportunities for refinement of the procedure. The project promises to yield a novel procedure for promoting creative projects in team science.

IDENTIFYING TASKS AND ROLES TO ENHANCE TEAM SCIENCE

Paper: Is Collaboration a Scientific Virtue?

Author:
Stephen Crowley (Boise State University)

The 'Scientific Virtues' approach (1) provides a framework for thinking about and providing training for scientific ethics. I suggest that in its current format it does not pay sufficient attention to collaboration (arguably the key team science virtue) and suggest ways that lack might be rectified. This work is conceptual in nature. I aim to build on it in an empirical fashion as soon as possible. According to the SV approach ideal scientific behavior is to be identified with stable character traits rather than with sets of rules. We can 'spot' SV's in various ways; by paying attention to the behavior of exemplary scientists, or in dialogue based workshops discussing character traits that are optimal for doing good science. One significant advantage of the SV approach is that it provides a unified framework for thinking about scientific best practices. How that might play out will depend on just what counts as a SV. Current work on SV, '... focus[es] on traits scientists should have as individuals' ...' and development of SV training materials addresses SV's such as curiosity, honesty, courage, perseverance, and humility to evidence; which all have an individual focus. Given the importance of team science, this suggests that the current SV approach is limited and requires extension to address best practices (i.e. virtues) at the team level. A critical ability for successful team science is that participants be 'good team players'. Recent work on collaboration readiness makes clear how complex the motives for teamwork in the sciences are which suggests that collaboration is too sensitive to context to be a virtue. I argue, however, that Aristotle's work on friendship provides resources for developing an account of collaboration as an SV.

CREATING INNOVATORS

Paper: Building Interdisciplinary Capacity for Team Science: The Interdisciplinary Translation Initiative

Author:
Andi Hess (Arizona State University)

Through the inclusion and integration of multiple diverse perspectives, interdisciplinarity is often thought to address the complexity of the challenges facing society today. However, team science is a high-risk, high reward endeavor, and achieving effective integration can be challenging. Yet, when properly executed, interdisciplinary research can produce innovative outcomes. The literature suggests a need for approaches to enhance the effectiveness of such interdisciplinary endeavors. I propose a new method, Interdisciplinary Translation, aimed at increasing the effectiveness of interdisciplinary teams by actively facilitating the translation of disciplinary languages in research settings. The Interdisciplinary Translation and Integration Sciences Initiative supports interdisciplinary research teams through the use of 'Interdisciplinary Translators.' The use of translators mediates the high risk of interdisciplinary projects and assists teams in bridging disciplinary boundaries and producing increased interdisciplinary integration and more effective outcomes. A second major component of the Initiative is teaching this skill set. Our new undergraduate Certificate in Interdisciplinary Translation aims to train students to take on this translator role in research teams. It focuses on teaching the languages of disciplines in a way that allows students to work fluidly across them and then translate disciplinary insights in a way that everyone can understand, as well as to help translate results for disciplinary dissemination (traditional publications, institutional audiences, etc.) and to whichever audience is intended (stakeholders, publics, etc.). Interdisciplinary Translation allows each participant to focus on providing his or her expertise while the translator facilitates the conversation to create a shared sense of understanding. The translator assists the team with communicating to each other as well as framing the research outcomes in more effective ways for particular audiences, including disciplinary and institutional audiences and to stakeholders and relevant publics.

CREATING INNOVATORS

Paper: Some Like It Cool: Tracking Changing Temperatures of Interdisciplinary Team Dynamics

Author:
Rebecca Freeth (Leuphana University)

Inspired by the work of Donella Meadows (2008), a collaborative interdisciplinary research project, Leverage Points for Sustainability Transformation, is investigating deep sources of leverage (Abson et al., 2016). Cognizant of the multiple challenges of conducting research in interdisciplinary collaborations, the project designers created a team role to study the team and support its learning-while-doing. They called this role formative accompanying research (FAR). Bozeman et al (2016: 241) have written about the SciTS gap in studying research teams 'as a unit'. This is a contribution that FAR attempts to make, by looking at collective experiences and dynamics beyond the experiences of individual researchers. The aim of formative accompanying research (FAR) is to learn about, for, and with the team as an example of collaborative interdisciplinary research in the field of sustainability. We have conceptualized FAR positionality as movement between the perspectives afforded by being both inside the project and outside, as a member of the Methodology Center. Over the course of the past two years, the researcher has used participant observation methods and interviews, periodically presenting material to the team for reflexive conversations and shared meaning making. One area of emerging interest relates to changing intensities of engagement, both epistemic and social, in interdisciplinary research. The metaphor of temperature - from cool, to lukewarm, to heated - is enabling us to track these patterns. This presentation will include some 'hot' stories from the FAR vantage point and share our working hypotheses about team dynamics that regulate heat, and what degrees of heat can 'leverage' team members out of more habitual forms of individual research into potentially more productive and meaningful (in the context of sustainability research) interdisciplinary collaborative research.

CREATING INNOVATORS

Paper: Only Diamond Can Cut Diamond in Science

Authors:
Lingfei Wu (University of Chicago), Jie Tang (Tsinghua University), Dashun Wang (Northwestern University), & James A. Evans (University of Chicago)

The career of a scientist typically comprises of two stages: the training phase, which involves meeting the training requirements under the mentorship of senior scholars; and the professional phase, which involves mentoring the next generation of scholars. This naturally brings up the question on how team performance would change with the mixture of training and professional scholars. We analyze 18 million research articles of 3 million scholars in the past century and identify their career roles from these records. We find that teams of more professional scholars search deeper backward in time to draw upon small ideas and create more innovative work. In contrast, an increase in the number of training scholars makes the team more likely to chase recent, trending ideas and seek for impact rather than novelty. To interpret these observations, we assume the existence of multiple professional scholars enhances team democracy and allows for critical thinking, challenging assumptions, and imagining alternatives, all of which are characteristic features of 'hot-groups' and are necessary for innovative changes. The stimulating effect of a professional scholar to another reminds us of an old saying that 'only diamond can cut diamond.' Our findings on the impact of team composition on performance could influence science and technology policy by increasing appreciation on the collaboration between professional scholars, the less financial and time constraints of training scholars, and actions towards more democratic, open discussion environment in research institutions.

IMPROVING OUR PRACTICES

Paper: Measuring Cognitive Integration Capability in Teams: Scale Development and Validation

Authors:
Maritza Salazar (University of California Irvine), Daniel Slyngstad (Claremont Graduate University), & Theresa K. Lant (Pace University)

Collective cognition in contemporary teamwork increasingly mandates the use of complex communication processes to integrate the distributed expertise of members into joint, innovative solutions to multifaceted problems. This is particularly true of newly formed teams of expertise-diverse individuals, whose highly specialized members possess task-relevant perspectives that are intellectually distant from their teammates, but individuals have had very limited prior interaction. While many communication behaviors associated with innovative outcomes have been documented, little is known about the underlying individual cognitive processes triggered during group interaction, such as evaluation and modification of one's own knowledge, which subsequently influences collective creative output. This theoretical gap is due, in part, to limited measurement alternatives with which to assess specific changes to task-relevant perspectives of team members that precede team level outcomes, such as the extent to which members consider or incorporate their teammates' perspectives into their own—their cognitive integrative capability (CIC). To address this, we conducted a three-phase, five-study investigation in four independent samples of online respondents, and newly formed student, and professional interdisciplinary teams to create a valid, reliable, and generalizable measure of CIC. Results of Studies 1-3 demonstrate that the CIC index (CICI) has two dimensions: knowledge consideration and knowledge accommodation/assimilation, while Study 4 reveals its associations with extant constructs. Lastly, Study 5 provides empirical support for the mediating role of CIC in the relationship between communication behaviors and innovation in medical interdisciplinary research teams.

IMPROVING OUR PRACTICES

Paper: Evidence for Integrative Reasoning in Interdisciplinary Team Science

Authors:
Bethany Laursen & Michael O'Rourke (Michigan State University)

Integration has been described as the 'primary methodology of interdisciplinarity' [1, p.283] because it is required to ensure that disciplinary inputs are combined into interdisciplinary outputs. Although the nature of integrative combination remains underdescribed in the interdisciplinary literature, it has been the subject of development in cognitive psychology (e.g., [2]) and the philosophy of science (e.g., [3]). In [4], the authors sought to combine these literatures and generate a conception of integration that could apply across these contexts. We follow [4] in understanding integration according to the input-process-output (IPO) heuristic, according to which it can be understood as involving relational association of inputs that generates output, where the number of outputs is smaller than the number of inputs. Our goal in this paper is to make progress toward a more detailed and complete conception of interdisciplinary integration by concentrating on the communicative interactions of members of interdisciplinary science teams. We agree with [5] that there are too few detailed discussions of specific moments in the life of interdisciplinary collaborations, and we seek to join their effort by conducting discourse analysis on transcripts that derive from interdisciplinary team conversations. Specifically, we will focus our attention on transcripts from Toolbox workshops (http://tdi.msu.edu/, [6]). Toolbox workshops consist of dialogue structured by philosophical prompts designed to enable collaborators to articulate and share their implicit research commitments. Although Toolbox workshops do not resemble typical team meetings, participants will typically talk about their collaborative project in a way that is guided by the Toolbox prompts. This supports reflection by the team on their similarities and differences. Over the course of a Toolbox workshop, collaborators have an opportunity to explore their own research worldviews, learn about those of others, and collectively work toward greater mutual understanding. The goal of a Toolbox workshop is to enable collaborators to see the research landscape through each other's eyes [7]. We examine several Toolbox workshop transcripts for evidence of interdisciplinary integration across research worldviews. This evidence arises from conversational exchanges used for collaborative, interdisciplinary reasoning [8]. We use the tools of discourse analysis to examine instances of such reasoning. Specifically, we reconstruct the argument the participants develop in each instance and categorize the integrative relations (e.g., subsumption, sequencing) occurring in utterances that contribute to the argument. We conclude by presenting an initial sketch of a general account of these relations.

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IMPROVING OUR PRACTICES

Paper: Interdisciplinary Team Science Proposal Development

Author:
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(Elsevier)

Interdisciplinary team science grant proposals differ along two facets from standard research grants: application components and review criteria. Team science proposals tend to be all-around more complex, necessitate unique application sections, and require special attention to activities such as project management and team building activities. In addition, funders, such as the National Institutes of Health and the National Science Foundation, are shifting to provide more explicit guidance related to the review criteria used for team science proposal evaluation, criteria that differ from well-known, standard research proposal review criteria. It is thus essential for researchers and research administrators to understand the unique aspects of interdisciplinary team science funding opportunities. By systematically examining the unique aspects of interdisciplinary team science grants – both application components and review criteria – this session will provide participants with the necessary foundational knowledge to develop more innovative and competitive interdisciplinary team science proposals.

SciTS 2018

POSTER SESSION ABSTRACTS

TRAINING AND CURRICULUM

Poster 1: The Team Science Program at the University of North Texas

Authors:
John Turner, Rose M. Baker, & Kerry Romine (University of North Texas)

Through the efforts of the National Institute of Health (NIH) and the National Cancer Institute (NCI), the Science of Team Science (SciTS) was formed as an effort to understand and manage 'circumstances that facilitate or hinder the effectiveness of large-scale, cross-disciplinary, collaborative research initiatives' (Falk-Krzesinski, 2012, The Science). From this effort, team science (TSci) evolved, identifying evidence-based methods to aid collaborative research and to produce problem-solving methodologies and techniques. The field of TSci has expanded to include a broad knowledge base relating to how people interact, behave, and manage in teams and small groups. Team science provides evidence-based research that can be applied to today's workplace. Given that teams in the workplace include a large variety of issues (e.g., behavior, motivation, interaction, leadership & mentoring, supporting technology, training, performance), it has become a multidisciplinary field. Team science draws from numerous disciplines (e.g., archeology, leadership, management, psychology, sociology). In sum, the following definition of team science is best associated with the team science program at the University of North Texas: Team science is a multidisciplinary field that utilizes evidence-based research to develop and apply new practices and technologies to improve how teams and small groups perform more efficiently and effectively in the workplace.

Course Foundations: The team science program is organized around the SciTS concept map (Falk-Krzesinski et al., 2010). These foundations are divided into four main categories: Meta-Issues, The Team, Nuts & Bolts of the Team, and Support. The sub-categories of each main category are listed below followed by Table 1 showing which foundations are applied to the eight-team science courses for the UNT-TSci program offered at the University of North Texas and the New College at Frisco-UNT. 1) Meta-Issues a. Definitions & Models of Team Science b. Measurement & Evaluation of Team Science 2) The Team a. Disciplinary Dynamics & Team Science 3) The Nuts & Bolts of The Team a. Structure & Context for Teams b. Characteristics & Dynamics of Teams 4) Support a. Institutional Support & Professional Development for Teams b. Management & Organization for Teams Team Science Program-Courses The following courses and course matrix identify how each course meets the four foundational sub-categories for the team science program. Eight courses make up the team science curriculum. The first four courses constitute Team Science Characteristics and the second set of courses represent Team Science Foundations courses. Impact of UNTTSci Program TSci, A 2012 estimate by the World Bank reported: 'that capital investment in teams represented approximately 20% of the world's economy' (Salas, & Rico, 2017, Forward). However, programs in team science have yet to flourish with very few disciplines (i.e., engineering, engineering technology, healthcare, management, nursing) incorporating team science related courses into their curriculum. This program, the UNT-TSci program, will be the first of its kind in the country, internationally, and could tap into this potential 20% of the world's economy. The UNT-TSci program will be the first program to focus on team science issues in the workplace, utilizing evidence-based research to help organizations better deal with complex problems and human resources while operating in interdisciplinary, cross-cultural, and global environments.

TRAINING AND CURRICULUM

Poster 2: Online Team Science Training for Health and Medical Professionals: Teamscience.net

Authors:
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Objective: Teamscience.net, a suite of online, open-access learning modules to foster cross-disciplinary, collaborative research in the health sciences, has been considered a gold standard resource for team science training. The current objective was to investigate patterns of use and any effects of the first generation modules on team science knowledge, attitudes, and self-efficacy.

Methods: Users can register to enter four training modules: overview of the science of team science, and three practical modules where users navigate research problems in behavioral, basic biomedical, and clinical medical sciences while serving in the roles of senior scientist, early stage scientist, or research development officer. Users self-guide through multimedia curricula, make decisions, and receive feedback on practical problems involving team assembly, launch, and maturation. Pre- and post-tests were available for each module. Generalized linear models were applied to evaluate and compare change in performance between users from biomedical and nonbiomedical disciplines who voluntarily completed pre- and post-tests.

Results: From 2011 through 2017, the site attracted 16,280 unique visitors, with annual site traffic steadily growing. Half of users (51%) accessed the teamscience.net directly. The remaining users accessed the website by way of search engines (20%) or were referred via external links (29%). Roughly 20% of visitors (2686) chose to register and provide demographic information. Most registered users were female (66%). The modal registrant identified as working in a biomedical field (47%), in an academic institution (72%), and endorsed interest in the practice (rather than the science) of team science (67%). Among 2686 who provided demographic data, 989 voluntarily completed pre- and post-tests for at least one of the four modules. Results showed improvement in knowledge, attitudes, and self-efficacy for all modules (attitudes in modules 2 and 4 $p < .005$, all others $p < .001$) except module 1 for which improvement in knowledge and attitudes were nonsignificant. Biomedical and other health professionals improved comparably, except that test takers in medical fields averaged significantly higher gains in content knowledge after the clinical medicine module ($p < .01$). In the qualitative exit interview, all of the modules received positive reviews, and the majority of responders (82%) indicated that taking teamscience.net would substantially impact their future research plans.
Conclusion: Teamscience.net remains the first and only open-access, online training in team science for the health and medical professionals. Evaluation of the first generation modules indicates widespread use and positive outcomes. The next generation modules were updated in January of 2018 based on these results and user feedback.

TRAINING AND CURRICULUM

Poster 3: Developing Future LEADers: The Leadership Emerging in Academic Departments Program

Authors:
Helen Yin, Christina Ahn, Marissa Hansen, Traci Barros, Britany Singleton, Suzanne Farmer, & Byron Cryer (University of Texas Southwestern Medical Center)

Leadership is an essential and recognized competency for faculty success in patient care and research arenas, particularly in current interdisciplinary team based enterprises. The UT Southwestern Office of Faculty Diversity & Development and Office of Women's Careers, in collaboration with the HR Organizational Development and Training program, launched the Leadership Emerging in Academic Departments (LEAD) program in 2013. It is a yearlong program that targets assistant professors and early associate professors of both genders in the UTSW's Medical, Graduate & Health Professions Schools. Goals are (1) to provide personal and professional development opportunities for participants; (2) to create a platform for integrating multiple disciplines and fostering inter-professional relations; (3) to promote organization change from the bottom up, and (4) to develop future leaders for succession planning. Instructors are mostly local experts and academic leaders.

- Positive impact on our junior Faculty and their career development.
- Achieved many of its stated goals and fulfilled institutional needs.
- Demonstrated successful return on investment.

The Leadership Emerging in Academic Departments Program develops our Junior Faculty into great leaders with the help of team self and team leadership tools, which are critical to the success of Team Science.

TRAINING AND CURRICULUM

Poster 4: The Transdisciplinary Research in Energetics and Cancer (TREC) Training Workshop

Authors:
Diana Lowry (Fred Hutchinson Cancer Research Center), Melinda L. Irwin (Yale University School of Public Health), Marian L. Neuhouser (Fred Hutchinson Cancer Research Center), Ruth E. Patterson (University of California San Diego), Jennifer Ligibel (Dana-Farber Cancer Institute), Kathryn Schmitz (Penn State Cancer Institute), Graham Colditz (Washington University in St. Louis), & Linda Nebeling (National Cancer Institute)

Purpose: Obesity, poor diet, and physical inactivity appear to substantially increase the risk of many cancers. In addition to public health efforts to improve these behaviors, it is critical that scientists receive training in conducting rigorous and impactful research to lower the prevalence of these risk factors. To address this need, we developed an NCI-funded team science education program in which we aim to offer, evaluate and eventually disseminate an annual 5-day transdisciplinary research in energetics and cancer (TREC) training course for postdoctoral fellows and junior faculty (R25CA203650). The goal of this program is to enhance the ability of participants to conduct innovative, transdisciplinary, and team-based research in energy balance and cancer and its translation to clinical care.

Methods: The course builds upon the 2005 to 2016 NCI TREC Initiative, which was a major scientific research effort that covered topics across the cancer control continuum, including prevention, detection, diagnosis, treatment and survivorship. The annual 5-day course, delivered June 2017-2021, provides evidence-based energetics and cancer education and team-science training. A transdisciplinary team of ~20 expert faculty members with complementary expertise participates each year as TREC Faculty. Details regarding the course agenda and an application to participate as a TREC Fellow are available via a website (www.trectraining.yale.edu). Finally, we assess knowledge and skills in transdisciplinary research in energetics and cancer before and immediately after the 5-day workshop via questionnaires that are analyzed with the Wilcoxon Signed Rank Test.
Results: Information about the course was shared with approximately 30 organizations, resulting in 77 applications for the inaugural 2017 year. Twenty academically diverse TREC Fellows were accepted into the program, including 3 basic, 7 clinical, and 10 population scientists. Fifteen of the TREC fellows were junior faculty and 5 were postdoctoral fellows. The 5-day course included over 50 lectures, presentations, small-group team breakouts and one-on-one faculty-fellow sessions. The training was held at a resort, which facilitated focused opportunities for informal conversations, mentoring, and relationship building among faculty and Fellows. After participating in the TREC Training Workshop, knowledge related to conducting energy balance and cancer research, as well as transdisciplinary research competencies, significantly improved in 37 out of 39 competencies (94.8%).

Conclusion: Our course is innovative in that no training opportunity, course, or workshop currently exists that focuses on team science in energetics and cancer. The impact of this transdisciplinary training course will be defined by the degree to which course participants produce novel and innovative team research approaches and discoveries that may improve the health of the population at risk for cancer, as well as cancer survivors.

INTERPROFESSIONAL COLLABORATION

Poster 5: User-Centered Mobile Telestroke Platform Development using Clinical Simulation-Based Usability Testing

Authors:
Tsion Habtamu (Virginia Commonwealth University), Mirinda Gormley (VCU), Alfred Brown, Pamela Brown (Simmons College), Michelle Stockner (VCU), Joshna Seelam (VCU), & Sherita Chapman-Smith (VCU)

Stroke remains the leading cause of disability worldwide, and the only acute treatment is reperfusion, which is time-dependent. The odds of a favorable outcome decrease with every additional minute of delay prior to reperfusion making treatment success critically time dependent. Mobile ambulance-based telemedicine presents a novel solution to improving both the accuracy of prehospital stroke diagnosis and the timeliness of treatment. Implementation and sustainability of such innovative technology can be made difficult by the complexities of healthcare organizations, work practices and physical environments. This study aims to 1) understand perceptions of a mobile prehospital telestroke system from all users and 2) evaluate system usability during ambulance transport. Over a 24-month period, a multi-stakeholder team with representation from the VCU Departments of Neurology and Emergency Medicine, Office of Telemedicine, Center of Human Simulation and Patient Safety, local EMS agency and swyMED (a telemedicine developer company) collaborated to develop a mobile prehospital telestroke system. Modifications to telemedicine equipment, teleconferencing software and protocol were implemented based on the results of serial clinical simulation-based Plan-Do-Study-Act (PDSA) cycles and dry runs. We used data collected via direct observation notes, survey results and informal interviews during each clinical simulation-based PDSA cycle to test changes to improve our mobile system. During the clinical simulations, an ambulance was equipped with a mobile telemedicine system to perform remote stroke assessments. Scripted scenarios were performed by actors during transport and evaluated by physicians using the National Institute of Health Stroke Scale (NIHSS). Scores obtained during transport were compared with original scripted NIHSS scores. Participants completed the System Usability Scale (SUS), NASA task load index (NASA TLX), audio-video quality scale and a modified Acceptability of Technology survey to assess perceptions and usability. In addition, interviews were conducted to evaluate users' experience. Descriptive analysis was used for all surveys. Weighted kappa statistics to compare the agreement in NIHSS scores. We used data collected via direct observation notes, survey results and informal interviews during each clinical simulation-based PDSA cycle to test changes to improve our mobile system. Between March 2016 and June 2017, 105 scenarios (65 mobile evaluations and 40 bedside evaluations) were conducted. Ninety-one percent (59/65) of mobile and all bedside evaluations were completed. Overall, comparison of NIHSS scores between mobile simulations and original scripted scenarios showed moderate agreement [weighted kappa=0.46 (95% CI: 0.33-0.60, p=0.0018)]. NIHSS scores between bedside simulations and original scripted scenarios revealed moderate agreement [weighted kappa=0.62 (95% CI: 0.47-0.76, p=0.63)]. The median time to complete each scenario was 9 minutes (range 4-17, SD 3.7). The overall SUS score was 68.8 (SD = 15.9). The overall NASA TXL unweighted workload rating increased for mobile evaluations compared to bedside evaluations. Content analysis of open-ended comments identified strengths, usability issues, and safety concerns. Before making financial investment and implementation in a mobile prehospital telestroke program, it is important to consider the use of combined clinical simulation and PSDA methodology. It can improve the quality and optimization of the system.

INTERPROFESSIONAL COLLABORATION

Poster 6: The Faith Health and Family Collaborative: A Community-Based Transdisciplinary Partnership

Authors:
Kamisha Escoto, Chloe Dorsey, Crystal Roberson, & Lorna H. McNeill (The University of Texas MD Anderson Cancer Center)

Objective: Transdisciplinary approaches to addressing health disparities, particularly the disproportionate burden of obesity in African Americans, are critical due to the broad and complex causes. Creating models for successful community-based transdisciplinary research is necessary. Integrating the community in scientific research is imperative, yet not without its own unique challenges. The objective of this poster is to describe the development of the Faith, Health and Family Collaborative, an academic-community partnership team formed to collectively address obesity among African American families using participatory principles and community involvement. The Faith, Health and Family Collaborative was built on an existing partnership between The University of Texas MD Anderson Cancer Center and Windsor Village United Methodist Church, recognizing the Institute of Medicine's recommendation of community mobilization by various partners, including faith-based groups, to effectively reduce obesity. We will present a description of the partnership, its major activities and strategies used for sustainability.

Research Methods: The Faith, Health and Family Collaborative utilized community-based participatory research as a guiding foundational framework. Specific principles included 1) building on resources and strengths of the community, 2) integrating knowledge and action, 3) promoting a co-learning process to ensure bi-directional knowledge sharing, and 4) facilitating collaborative, equitable involvement in all phases of the project. We developed a multidisciplinary advisory board, with representation from academic institutions, clinics, community-based organizations, and faith-based organizations. The advisory board provided overall guidance and direction to the collaborative and helped expand our reach into the community by identifying relevant community organizations and churches to engage as stakeholder partners. Collaborative activities included capacity building trainings for community members; needs assessment data collection from African American parents, youth, and church clergy and staff regarding obesity in the African American community; church audits (of physical space for obesity programming); and community forums for health education and results dissemination.

Findings: The Faith, Health and Family Collaborative set the groundwork for future community-based transdisciplinary research projects. The Collaborative held 14 advisory board meetings, formed a network of over 20 stakeholder partners and grew to over 100 churches in its network, and hosted nearly 20 events (e.g., clinical trials education). Interview and focus group data were collected from African American parents, youth, and clergy and church staff (n=125) to understand how varied constituents viewed the issue of obesity in the community. The Collaborative culminated with small group academic-community discussions of elements needed for faith-based obesity programming and research. Advisory Board members have continued involvement in newly funded grants at MD Anderson.
How the Research Advances the SciTS Field: Addressing obesity in African American families requires transdisciplinary collaboration and can only be effective if communities are genuinely engaged. This poster presents a model for engagement of the African American faith-based community, a pre-cursor to developing and implementing research to successfully combat health disparities.

INTERPROFESSIONAL COLLABORATION

Poster 7: Development of a Multi-Disciplinary Team to Study Preoperative Anxiety in Spine Surgery: A Case Study

Authors:
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Interdisciplinary teams provide utility in clinical research due to the many advantages conferred by drawing upon the knowledge in different fields of expertise and pooling resources to promote time- and cost-efficiency. This case study discusses the development of a multi-disciplinary team of researchers, the methods used to maintain its function, and the result of research endeavors at on year following the team's inception. Called the Spine Preoperative Anxiety Research Taskforce (SPARTA), a team of students and faculty from the University of Southern California's and University of California Irvine's departments of orthopaedic surgery, neurological surgery, anesthesiology, and psychiatry was assembled to research an under-studied phenomenon in spine surgery - preoperative anxiety. Given that preoperative anxiety affects surgical outcome, anesthesia response, analgesic consumption, and describes a patient's mental state, it was expected that a team of surgeons, anesthesiologists, and psychiatrists would be well-suited to study preoperative anxiety and its management in patients scheduled to undergo spine surgery. Moreover, SPARTA members were chosen for their expertise in different areas of the perioperative care continuum, interest in studying preoperative anxiety, previous experience working together, and 'fit.' Leadership of SPARTA was shared between one student and one faculty member to promote understanding and communication. In-person activities involved meetings and conferences to review team activities, communicate key developments, and share decision-making. Virtual communications were maintained via electronic mail, video conferencing, phone calls, and text messaging. An electronic mail listserv was used to send updates to members of SPARTA and maintain a historical log of all team activities. Research began with the development of an introductory cross-sectional study to determine current best practices of preoperative anxiety management according to orthopaedic and neurological surgeons who conduct spine surgery. Data were stored in an online database, study documents were stored online in a cloud-based drive, and a web-based office suite was used to collaboratively write or edit study documents, surveys, conference abstracts, and manuscripts. After one year of activity, SPARTA produced research leading to two podium presentations, one poster presentation, and one manuscript under review by a peer-reviewed scientific journal. Plans for further development and maintenance of SPARTA were made, including the submission of a grant application for future funding and support. The presentation of this study, which describes practical application of team science to develop, maintain, and work effectively as a multi-disciplinary team to conduct clinical research, may serve as an aid in developing future research teams.

INTERPROFESSIONAL COLLABORATION

Poster 8: Using RE-AIM to Evaluate Mobile Prehospital Telestroke Intervention

Authors:
Joshna Seelam (Virginia Commonwealth University), Tsion Habtamu (VCU), Michelle Stockner (VCU), Pamela Brown (Simmons College), Alfred Brown, Mirinda Gormley (VCU), & Sherita Chapman-Smith (VCU))

Mobile prehospital telestroke presents a novel solution to improve stroke diagnosis and reduce treatment times. Over a 24-month period, a multi-stakeholder team with representation from the VCU's Department of Neurology and Department of Emergency Medicine, Office of Telemedicine, Center of Human Simulation and Patient Safety, a local Emergency Medical Service (EMS) and SwyMED (a telemedicine developer company) collaborated to develop a Mobile Prehospital Telestroke system. This study's goal was to obtain feedback from key stakeholders concerning the feasibility of the proposed PRE-ALERT (Pre-hospital Rapid Evaluation via Ambulance Lead Emergency Remote Telemedicine) study and Mobile Prehospital Telestroke system. This assessment used a mixed-method approach consisting of both qualitative and formative research in collaboration with VCU Department of Neurology and Research Unlimited (RU), specialize in participant recruitment and retention for research studies. Twenty-nine healthcare providers and community members participated in the focus groups, and five healthcare personnel and administrators participated in the informal interviews.
Five focus groups were performed, with four to eight participants each. Five informal interviews were also conducted via telephone. Assessment questions were developed using the RE-AIM framework (reach, effectiveness, adoption, implementation and maintenance) examining at the individual and organizational levels. Subcategories further explored barriers and challenges, facilitators and benefits, and keys to moving forward. The focus groups lasted 45-75 minutes; informal interviews lasted 20-45 minutes. Recordings from focus groups and interviews were transcribed verbatim and then coded individually by two RU qualitative data analysis experts. Responses from participants were described using code names and then used to develop major categories and sub-categories. The researchers used open coding to compare and categorize major themes and axial coding to identify connections between categories and patterns of meaning. According to the data collected, strengths of this research include: improvement of patient-provider experiences and outcomes; and applications to other areas of healthcare. Challenges and limitations include: processes and protocols of training staff; connectivity; patient and provider relationship; and agency resources. Equipment quality, features, and functionality were listed in both categories. Keys to moving forward include: community outreach and education; healthcare provider buy-in with both hospital and prehospital staff; organizational buy-in with cost reduction and statistical evidence of improved outcomes; and sustainability of the equipment and protocols. This study reveals the benefits of collaborative formal research using a systematic process. The results will be used to develop a RE-AIM mobile prehospital telestroke intervention.

MENTORSHIP IN TEAM SCIENCE

Poster 9: Mosaic Mentoring and Cross-Cultural Training for Medical Professionals

Author:
Sujin Horwitz (University of St. Thomas)

The importance of optimizing medical care to patients of different cultures is an increasingly important skill in health care. Prior research has demonstrated that the ability of health care professionals to acquire cross-cultural skills affect the quality of health outcomes. This study examined a medical resident cohort to identify training needs for improving medical care among culturally diverse racial and ethnic patient populations. This study also identified the effectiveness of mosaic mentoring for increasing cross-cultural competency among the resident cohort. A modified version of the Residency Training in Cross-Cultural Survey (Betancourt and Weissman, 2003) was administered to 63 medical residents. An additional survey obtained data on the residents' gender and Post Graduate Year (PGY) to be assessed in conjunction with the Cross Cultural Survey. Of the respondents, 47 (75%) were male and 16 (25%) were female, with the average age being 29.9 years of age (SD = 2.8). The PGY groups were dichotomized into junior residents consisting of PGY's 1 and 2 (n = 28, 44%) and senior residents of PGY's 3-5 (n =35, 56%). Of those surveyed, 58 (92%) chose to report their ethnicities. While the vast majority of residents (95%) indicated that it was important to consider the patient's culture in providing care, those who were of non-Caucasian ethnicity scored significantly higher than Caucasians on the importance of considering a patient's culture when providing care ($t = 2.47$, $p < .05$). There were no significant differences between the junior and senior PGY groups regarding the importance of considering the patient's culture when providing care ($t = .06$, $p = .95$) and the importance of practicing in a culturally diverse patient mix ($t = .44$, $p = .66$). Similarly, female residents did not differ significantly from males regarding these two aspects of cross cultural care ($t = .99$, $p = .32$, $t = 1.36$, $p = .18$, respectively). Many of the residents indicated that difficulties in understanding different cultures resulted in longer office visits (35%), unnecessary office visits (19%), delays in obtaining informed consent (40 %) and patient noncompliance (19.0%). Residents with two or more mentors adept in providing cross-cultural care scored significantly higher than respondents having only one mentor on the importance of considering the patients culture when providing care ($t = 3.21$, $p < .01$) and on the importance of practicing in a diverse racial and ethnic patient mix ($t =2.31$, $p < .05$). Almost half of the residents (47%) felt they were unprepared to treat patients who are new immigrants and about a quarter (24%) indicated they were unprepared to deal with those holding beliefs at odds with Western medicine. The results indicate that resident training in cross cultural care should be included in medical educational curriculums. Many residents indicated that important areas of patient care could be improved with a greater understanding of patient diversity. Of particular note was the importance of multiple mentors in providing leadership training in such areas and should thus be included as an important part of medical education. Increasing the interaction between ethnically diverse residents may also increase sensitivity to the care of patients from differing cultural backgrounds.

MENTORSHIP IN TEAM SCIENCE

Poster 10: Role of Mentors in Multidisciplinary Innovation and Design Student Teams

Authors:
Ashlynn Kogut, Michele Norton, Amanda Garr, & Michael Beyerlein (Texas A&M University)

Core competencies for many disciplines are evolving to include working in interdisciplinary teams to produce innovative solutions. For example, engineering and business have initiated capstone design projects, innovation labs, makerspaces, entrepreneurship programs, and weekend design challenges in an attempt to bridge the gap between the work environment and the classroom. As this focus on experiential learning has filtered into the curriculum, students are spending more time with multidisciplinary teams to create solutions or generate new ideas. Those designing these experiences have assumed that having a mentor will be beneficial, but there is limited research literature connecting mentoring to multidisciplinary, innovation-focused student teams. According to Rhodes and DuBois (2008), mentors can influence student processes in three core competency areas: socio-emotional development, cognitive development, and identity development. While mentors have the ability to address the core competencies needed to work in interdisciplinary teams to create innovative solutions, the role, best practices, and the impact of the mentors on these types of teams is unknown. In order to address this gap in the research, this poster presents the findings of a mapping review of the literature on the role of mentors on multidisciplinary student teams, the role of mentors on creative student teams, and the role of mentors on student teams. First, we use the mapping review method to systematically search the literature. Mapping the available literature will enable us to see how the three research areas relate and identify areas for future development. Then, we connect the literature to the Rhodes and DuBois (2008) model. The research questions guiding this review include:

- What does research say about mentors in developing competencies of student teams?
- What does research say about best practices mentors use to develop competencies for multidisciplinary student teams?
- What does research say about the role of mentors in developing entrepreneurship, innovation or engineering design competencies for multidisciplinary students' teams?

A preliminary analysis of the literature evaluating the role of mentors for interdisciplinary teams reveals conflicting results. Paretti, Layton, Laguette and Speegle (2011) found a critical question to be whether mentors should be concerned with deploying technical knowledge or with professional issues such as team dynamics, communication and interpersonal skills. To assist teams in working across interdisciplinary boundaries, Morse, Nielsen-Pincus, Force, and Wulfhorst (2007) advised to have mentors focus on issues of team dynamics. However, more recent programs still utilize mentors for disciplinary content knowledge and provide support for learning team dynamics separately in the form of workshops led by facilitators, not mentors (Jiji, Schofeld, & Smith, 2015; Sturner, Bishop, & Lenhart, 2017). Preliminary connections between the literature and the Rhodes and DuBois (2008) model show that research on mentors for interdisciplinary and innovation focused teams has not addressed the socioemotional, cognitive, and identity development of students. As many disciplines are moving toward interdisciplinary teams as a central part of their curriculum and the use of mentors as a teaching strategy, it is important to design mentoring programs that train mentors to address these issues.

NETWORK ANALYSIS

Poster 11: From Networks to Research Funding: Transformative Impacts of a CTSA

Authors:
Felichism Kabo, Xiao Shi, & George Mashour (University of Michigan)

The Clinical and Translational Science Awards (CTSA) Program at the National Institutes of Health (NIH) supports a national network of 57 leading medical research institutions that are intended to function as key hubs in the translational research process. The hubs are intended to collaboratively catalyze innovative training, research tools, and processes at the local and regional levels. We focus on the Michigan Institute for Clinical and Health Research (MICHR) in order to ascertain how it is transforming the clinical and translational science landscape at the University of Michigan (U-M). Previous studies have shown that CTSAs are positively associated with changes in the collaboration networks of their parent universities. Other studies have demonstrated a significant association between interacting with a CTSA and successful research awards. However, there have been no studies of the link from how interacting with a CTSA impacts the social networks of individual investigators, and subsequently how the network changes may relate to outcomes such as research funding. We address this gap through simultaneous analysis of the changes in investigator's ego networks following their interaction with MICHR, and contingently whether an investigator receives a research award, and the number of research awards associated with the investigator. Our hypothesis is that interacting with MICHR positively transforms the ego networks of individual investigators, and this positive network transformation is in turn correlated with the likelihood of an investigator receiving a research award, and the number of awards that the investigator receives. We sampled U-M investigators who submitted proposals to external sponsors in the year 2006. We measured the yearly impact of interacting with MICHR for individual investigators for the time period 2004-2012 by running cross-sectional models by year. The dependent variables (DVs) are: a) the two-step reach (TSR) of an ego network; b) a dichotomous variable that measured whether or not the investigator received a research award in a given year ('Award'), and; c) a count variable that measured the number of research awards that the investigator received in a given year ('NumberAwards'). The independent variable (IV) is whether an investigator consulted with MICHR in each of the years 2004-2012. We ran two sets of Heckman sample selection models as follows. The first set ('Set A') were probit models where the selection equation DV was TSR and the outcome equation was Award. The second set ('Set B') were maximum likelihood models where the selection equation DV was TSR and the outcome equation was NumberAwards. The Set A models showed that consulting with MICHR was consistently and significantly associated with an ego network's TSR, and contingently it was significantly correlated with likelihood of an investigator receiving a research award. The Set B models showed that in some years there was a significant association between consulting with MICHR and TSR, and contingently the number of awards that an investigator received. This research advances the SciTS field by demonstrating that one of the ways by which CTSAs are likely impacting outcomes in clinical and translational science is through transforming individual ego networks.

NETWORK ANALYSIS

Poster 12: Using Graph Networks to Manage Cross-Institution, Cross-Discipline Research Programs

Authors:
Carrie Roever, Casey Blair, Xiaogang Ma, Ashley Bogar, & Luke Sheneman (University of Idaho)

Research teams that span disciplines and institutional boundaries are increasing in all areas of science. These multi-university research teams often tackle broad-scale, complex research questions resulting in high-impact publications. While geographic distance is proving to be less of an obstacle to collaborative output, social distance is of increasing importance. However, discovering, understanding, and fostering social connections between researchers at differing universities or in different disciplines presents a unique set of challenges for administrators of large, team science programs. Here, we present a project management tool that uses social network analysis and graph theory to connect researchers, to foster collaborative products, and to more effectively report collaborative efforts to funding agencies. We developed a web-based, graph search tool to visually display the social connections and research activities of a large, team science program. The tool was developed to manage the research efforts of the Managing Idaho Lands for Ecosystem Services (MILES) program which was funded by the National Science Foundation (NSF) Established Program to Stimulate Competitive Research (EPSCoR; grant number IIA-1301792). The program included three Idaho universities: Boise State University, Idaho State University, and the University of Idaho, along with six state colleges, the Coeur d'Alene Tribe, and various local, state, and federal government agencies. We designed the graph database with four main nodes: 1) researchers (People), 2) their research questions (Question), 3) data needed to answer those questions (Data), and 4) the resulting publications (Publication). Each of the main nodes also had descriptive nodes and descriptive attributes, and all were connected by relationships (i.e. edges). We found the graph database allowed us to more effectively communicate research activities to project participants and to external funding agencies. For researchers looking for collaborators, the graph provided an easy-to-understand overview of all MILES research activities, so relationship-building could begin early in the idea-forming stage of any research initiative. For researchers in need of data, the graph provided an easy-to-use interface to find and download data products both used and produced by other MILES participants, increasing data exchange. For administrators trying to quantify program goals of increasing state-wide collaborative output, the graph provided a visually impactful measure of success. Overall, the graph afforded unique program insights which could not have been attained by a traditional, tabular database. Team-based research is increasingly important in all fields of science, and we as program administrators need new and innovative ways to manage the ever-increasing complexity that team science presents. Graph databases and social network analysis transform program data into knowledge. By emphasizing the social relationships between entities, we can intuitively tackle some of the toughest challenges facing large, team-science initiatives.

NETWORK ANALYSIS

Poster 13: Impact of Pilot Project Funding on Collaborations: An Assessment of Team Science Using Research Network Analysis

Authors:

Damayanthi (Dayan) Ranwala, Jihad S. Obeid, Tami L. Crawford, & Perry V. Halushka (Medical University of South Carolina)

The South Carolina Clinical and Translational Research (SCTR) Institute, funded by the Clinical and Translational Science Award (CTSA), has adopted Profiles, a research network system (RNS). We are using data from Profiles to assess outcomes of collaborative teams over time. The more common or traditional ways of assessing the outcome of collaborations are based on number of publications and grant awards received by the teams. However, the number of publications and grant awards do not necessarily show the trajectory of team collaborations over time. We think that the RNS analysis will help to provide meaningful metrics of assessing the impact of collaborations. Our CTSA pilot project program provides funding for newly formed, cross-disciplinary research teams to conduct translational research projects. Our objective is to determine the team science outcomes of the pilot project funded investigators as compared to non-funded investigators (those who have applied to receive pilot project funding but were not awarded, control group) using the network analysis. The analysis includes degree centrality (unique co-authors per individual), cross-disciplinarity and MeSH term profiles. We plan to examine the ratios of basic science (T1) related MeSH terms to translational (T2, T3) MeSH terms across the two groups. We will present these data to show the impact of pilot project funding on the increasing trend in collaborations and translational research. The RNS analysis may provide a way to assess the impact of funding mechanisms on collaboration development over time.

DEFINING AND REVIEWING FOR TEAM SCIENCE

Poster 14: The Central Role of Women in the Development, Process and Outcomes of Scientific Teams

Authors:
Hannah Love, Jennifer E. Cross, & Ellen Fisher (Colorado State University)

Woolley et al. (2010) made a groundbreaking declaration in Science that teams could be influenced by their membership as well as the team process. More specifically, scientific teams need three things to build collective intelligence: even turn taking, social sensitivity, and proportion female. Scientists often ask when they hear Woolley et al. (2010)'s conclusion that proportion female influences team performance, 'What proportion is enough?' To understand the significance of 'proportion female' on scientific teams, most research uses quantitative methods and/or studies collaboration patterns using publication metrics. Using this approach, however, neglects long-standing social science theories that women encounter discrimination throughout their scientific careers and the research process. Instead of measuring collaboration at the end of the scientific process (i.e. publications), gender needs to be measured during the process. Wooten et al. (2014), recommended using a development and process evaluation to study scientific teams. At Colorado State University, from 2015-2017, we conducted a mixed-methods development and process evaluation study of eight interdisciplinary research teams to examine the science of team science. We administered a social network survey at three time points to understand team development and dynamics. To support the social network data, we collected qualitative data including: participant observation and turn-taking data during meetings, and focus groups. Finally, we collected outcome metrics at nine time points to further distinguish between successful and non-successful teams. Analysis of the various sources of data (social networks, turn-taking data, and participant observation) revealed that gender played a significant role in team success. Social network analysis (SNA) revealed that teams with successful process evaluations had women as central mentors, leaders, and sources of advice. In addition, these teams had more even turn-taking and participant observation data revealed increased respect and fun during team meetings. This poster will provide a unique methodological perspective by providing mixed-methods data about the team process as it connects to team outcomes. Our data revealed that teams where women had more central roles in the networks also had more impressive outcomes metrics including those of grants submitted and awards received.

DEFINING AND REVIEWING FOR TEAM SCIENCE

Poster 15: Think About It: How Attitudes About Objectivity Influence Motivation

Author:
Rachel Nelson (Michigan State University)

The goal of this poster is to demonstrate a replicable and efficient model for investigators to collaborate with experienced editors in research proposal development, resulting in high-quality and competitive proposals. Mayo Clinic's Strategic Funding Office for Research will share a staffing case study for a program carried out since 2014. The result has been hundreds of investigator hours saved and consistent success rates that exceed institutional averages. A central problem at any academic medical center is the dearth of time physicians and scientists confront in proposal development, especially to achieve a well-edited, error-free document. Mayo has instituted a low-cost solution: a specialist pool of editorial staff. The design, applied to all narrative components, is flexible, time-efficient, and cost-effective. Key elements of the model are 1) outreach to initiate proposals early, encouraging adequate time for edit and review; 2) procedures to limit unnecessary rework; 3) priority mapping, focusing staff resources where time is most sensitive; 4) a team atmosphere, engendering a learning environment; 5) excellent collaboration to project manage the proposal development process. These pillars set a path for excellent response times and agility when juggling investigator timelines, complex guidelines, and sudden demands from administration. Particular to team science, success has been pronounced in large-scale, multidisciplinary team science proposals that are complex and prove challenging to project manage. Proposals submitted with editorial support were 15% more successful than those that did not receive support. The same is true for early investigator, mentored research programs (NIH K-award level). For example, in the past four years of effort at Mayo, every K23 applicant who was supported by this program obtained his/her award. Conversely, of all Mayo K23 applicants who did not participate, none were awarded. This collaboration, thus, demonstrates measureable improved outcomes, productive ROI, and is achievable at a cost-effective institutional investment. Moreover, this model is highly replicable and readily adaptable to varied allocation models. In an environment of scare institutional resources, this efficient and flexible design can yield impressive benefits, including increased funding.

DEFINING AND REVIEWING FOR TEAM SCIENCE

Poster 17: What Does Team Science Look Like?

Authors:
Deborah DiazGranados & Gerald F. Moeller (Virginia Commonwealth University)

Objective: The dilemma in understanding how to improve team science is having clear definitions and examples about what team science actually looks like in practice. The objective of this research is to better understand how laboratories, institutes, and centers in an academic institution represent team science, in an effort to provide recommendations for promoting and prescribing team science.

Research Methods: The current research uses qualitative methods to unpack how the term team science is practiced in laboratories, centers, and institutes of an academic institution. One-on-one interviews with center directors, faculty, graduate students and staff are in the process of being completed.

Summary of Findings: In the interviews that have been completed, interviewees have had a difficult time describing how they practice team science. With little knowledge of the field of team science, several interviewees have stated: "…I don't think I practice team science." However, after having focused discussions which draw from the interviewees' examples of how they accomplish their work, preliminary analyses have resulted in themes that describe collaborative science. The collaborative science described has highlighted the sharing of leadership, the need for diversity of skills and knowledge, and the importance of building trust within the teams.