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Featured Article

Network-based assessment of collaborative research in neuroscience

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Abstract

Introduction: The purpose of this study was to describe collaborative research in neuroscience within the context of the Center for Neurodegeneration and Translational Neuroscience (CNTN), a Center of Biomedical Research Excellence supported by the National Institute of General Medical Science. Drawing upon research on the science of team science, this study investigated the way that interactions around research emerged over the course of establishing a new research center. The objectives were to document changes in research activity and describe how human research support infrastructure functioned to support the production of science.

Methods: Social network analyses were used to model coauthorship relationships based on publication histories from baseline (2014) through the current grant year (2017) for key personnel (n = 12), as well as survey data on collaborative engagement among CNTN members (n = 59).

Results: Exponential random graph models indicated that over time, CNTN members were increasingly likely to form coauthorship relationships. Community detection algorithms and brokerage analyses suggested that the CNTN was functioning as intended to support scientific development.

Discussion: Assessment of team science efforts is critical to evaluating and developing appropriate support structures that facilitate successful team science efforts in translational neuroscience.

Keywords: Collaborative research; Neuroscience; Center for Neurodegeneration and Translational, Neuroscience (CNTN); Center of Biomedical Research Excellence (COBRE); National, Institute of General Medical Science (NIGMS)

1. Introduction

Effective assessment of multidisciplinary collaborative research efforts requires the use of assessment strategies that can determine how collaborative research teams are functioning to meet goals, document changes in scholarly productivity, evaluate mentorship relationships, provide early notification of ineffective research supports and structures, identify sources of bottlenecks in information flow, and outline the extent to which resources are being used appropriately [1,2]. In the context of the Center for Neurodegeneration and Translational Neuroscience (CNTN) funded through the National Institute of General Medical Sciences (NIGMS) Centers for Biomedical Research Excellence (COBRE) program, assessment acts to support the development of human capital and research infrastructure necessary for the success of neuroscience research and investigators. The CNTN is reflective of the emerging trend in collaborative, or team, science that has gained ground in biomedical research in part due to the growing evidence that impactful and innovative scientific advances are more likely to result from collaborative science efforts [3–5]. The science of team science, or documenting and evaluating the development and outcomes of collaborative research, has grown into its own robust field, catalyzed by evaluation and assessment policies and recommendations from extramural funding

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agencies and programs, such as the National Institutes of Health Clinical and Translational Science Awards (CTSA) [6,7]. Although work in this area has used network analytic techniques, for example, documenting the types of networks formed via collaboration [8,9] and productivity metrics of these networks [3,10,11], there remains much to learn from these techniques about how sustainable patterns of collaboration develop to support science.

Funders of biomedical research invest considerable resources into the preparation of emerging medical and academic researchers [12] and development of research infrastructure for neuroscience, which in this case, included human capital for research support. We refer to human capital for research support as teams of individuals who support the production of science. Critical individuals may include, but are not limited to, grant managers, clinical managers and staff, technicians, and students. Individuals such as grant managers and technicians rarely appear in assessments of team science [11] but are often critical to the production of research. Aims of the CNTN include supporting investigators working in human and animal models of neuroscience to produce initial data and assisting investigators in the development of advanced translational neuroscience skills, particularly in the areas of imaging and statistics. For many investigators, lack of research support, infrastructure, and the opportunity to develop advanced skills needed to conduct high-quality research are a detriment to producing scholarly products and grant proposals that are competitive for extramural funds [8,12]. The existence of a robust science infrastructure is critical to facilitating these interactions. This study reports on assessment results of the growth and development in shared authorships among key CNTN members, as well as the functioning of CNTN research support networks designed to support the production of neuroscience research.

1.1. Program evaluation and assessment in collaborative neuroscience research

Within the biomedical sciences, program evaluation research has focused largely on either the impact of scientific research in basic and applied settings, or the collaborative nature of scientific research teams, or the career advancement of investigators [2,13–15]. While no specific set of guiding principles exists solely for the purposes of evaluating scientific research, evaluation research to date has followed guidelines set by the American Evaluation Association broadly intended to cover all kinds of evaluation [16]. In recent years, assessment in government-funded research has grown to play an increasing role in evaluating research quality, reducing costs, and disseminating research credibility to the public [17]. Expenditures from the public purse must increasingly be justified by their measureable impact. Furthermore, a growing presence of translational science–specific evaluation literature [2,18,19] can be attributed to the requirement of a formal evaluation component for all National Institutes of Health CTSA [2].

The CTSA evaluation literature has produced a number of research articles supporting several evaluation designs appropriate for capturing and characterizing the nature of translational research programs [20–23]. Multidisciplinary teams working on biomedical science form and develop in a dynamic manner over time, self-organizing around research topics, specialized skills, and knowledge domains [24]. Studies have demonstrated innovation in describing the complexity of translational teams through various approaches including mixed methods, case study, and network analysis designs [1].

Evaluation may play a critical role in describing interactions within innovative scientific teams. The major challenge for evaluators is appropriately documenting the nature of these interactions to identify patterns that can be used in the service of promoting effective collaborative science. A limiting factor is that little is known about the predictors of successful collaboration, mechanisms that support collaborative researchers' development, or barriers to collaborative success [25,26]. While collaborative teams deliver greater levels of productivity over time and reap the benefits of increased visibility within the scientific community, there are few explanatory models to account for these outcomes [24,27].

1.2. Mapping neuroscience research collaborations

Publication tracking is a commonly accepted form of quantifying research production and has been used to link publishing trajectories with career development [22,26]. Quantity and quality of publications, often measured through journal impact factors and citation indices, are two normative indicators of impact in biomedical fields. Evidence also suggests a trend in high-impact coauthorship relationships in Alzheimer's disease research and related fields [5]. In Alzheimer's disease research, some of the most impactful work has emerged from long-standing collaborations. Collaborative research relationships foster opportunities to share ideas, generate intellectual stimulation, and cross-pollinate skill and knowledge development [28]. Scientific advancement may to some extent rest on scientists' abilities to functionally navigate the processes of forming research teams, effectively work to produce science, and efficiently distribute findings. From this perspective, a third metric of productivity and impact in biomedical research may be the extent to which scientists form and maintain publication and grant relationships.

Developing effective research teams that lead to these publication and grant relationships requires effort, negotiation, and time [8,18,29,30]. Academic faculty and clinical researchers are typically expected to publish research results to advance in their careers. Collaborative research centers and institutions are designed to facilitate