Social Networks xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Social Networks

journal homepage: www.elsevier.com/locate/socnet

Network exploration and exploitation: Professional network churn and scientific production

Michael D. Siciliano[a,*], Eric W. Welch[b], Mary K. Feeney[b]

[a] Department of Public Administration, University of Illinois at Chicago, 400 S. Peoria Street, Suite 2100 (MC 278), Chicago, IL 60607, United States
[b] Center for Science, Technology, and Policy Studies, School of Public Affairs, Arizona State University, Phoenix, AZ 85004, United States

ARTICLE INFO

Article history:
Received 9 December 2016
Received in revised form 3 July 2017
Accepted 7 July 2017
Available online xxx

Keywords:
Networks
Churn
Scientific production
Exploration
Exploitation
Ego networks

ABSTRACT

The production of scientific knowledge is an inherently social process making professional networks important for producing science outcomes. Although prior work has demonstrated the connection between collaboration and productivity, most research that examines scientist networks begins from the perspective that structure predicts productivity. Institutional approaches to explaining productivity are useful, but generally ignore the role of individual agency or strategic network behavior. Our study utilizes the dynamic perspective of network churn to assess how professional network composition and structure change overtime via processes of network exploration and exploitation. Using two waves of survey data from a national sample of academic scientists and engineers across six disciplines in the United States, we investigate how network churn affects the quantity and quality of scientific production. Our results suggest that while network exploration generally improves production quality, it can hurt quantity. Network exploitation tends to have the opposite effect, resulting in short term gains but potentially limiting the innovativeness of future research. By recognizing the tradeoffs associated with alternative networking strategies, policy makers in universities and other research organizations can begin focusing on interventions that more effectively target scientists' strategic network behavior.
© 2017 Elsevier B.V. All rights reserved.

1. Introduction

Science outputs contribute to the foundation of knowledge, creation of technological innovation, and the economic advancement of societies (Partha and David, 1994; Mansfield, 1995; Narin et al., 1997). Nevertheless, the distribution of scientific production across fields of science is significantly skewed such that a small number of scientists produce a disproportionate quantity of publications (Lotka, 1926), patents (Stephan et al., 2007), and other scientific and technological outputs. While individual scientists are critical to the production of science, very little research has sought to understand the ways in which professional networks and choices to exploit network connections or explore new network ties might be influential in advancing science productivity. Given science's pivotal role in improving social and economic conditions, scientific production remains a central concern of science policy especially as the mechanisms by which scientists collaborate and produce outcomes evolve.

Prior research that aims to explain scientific production typically focuses on demographics, antecedent human capital, and organizational or institutional factors (Azoulay et al., 2007; Levin and Stephan, 1991; Merton, 1968; Williamson and Cable, 2003). Collaboration has long been linked to scientific productivity (Price and Beaver, 1966; Zuckerman, 1967). The burgeoning collaboration and team science literatures demonstrate how geographic proximity, team size, composition, geographic distribution, and connections among research organizations matter for productivity (Adams et al., 2005; Barnett et al., 1988; He et al., 2009; Katz, 1994; Lee and Bozeman, 2005; Melin, 1999; Melin and Persson, 1996; Stephan and Levin, 1997; Wang et al., 2005). Yet the relationship between collaboration and productivity at the individual level is complex and not well understood; simply increasing collaborative interaction does not always result in higher productivity (Hu et al., 2014). Advising junior scientists to 'Just collaborate more! Build your networks!' is likely not the best advice, for example.

Research has begun to examine how network structure and composition explain individual-level productivity. To date, this work demonstrates that factors such as network size and centrality help predict productivity (Balconi et al., 2004; Rotolo and Messeni Petruzzelli, 2013; Ynalvez and Shrum, 2011; Bellotti et al., 2015; Mali et al., 2016). Nevertheless, this research is relatively nascent.

* Corresponding author.
E-mail address: Sicilian@uic.edu (M.D. Siciliano).

http://dx.doi.org/10.1016/j.socnet.2017.07.003
0378-8733/© 2017 Elsevier B.V. All rights reserved.

Few studies have examined how structure and composition of a scientist's personal network simultaneously contribute to productivity over time (Gonzalez-Brambila et al., 2013, Lazega et al., 2008). Importantly, most prior research in this area relies heavily on bibliometric data that have limited ability to capture the relational character of social networks – friendship, resource exchange, etc. – and thus important actors and resources within a scientist's professional network may be missed.

This paper contributes to this line of research. Our primary question is how does change in network structure and composition over time explain differences in scientist productivity. We take a slightly different turn by incorporating the network churn literature, a relatively new trajectory that recognizes the role that individuals have in changing the micro-structure and composition of their networks to increase access to resources and productivity (Tasselli et al., 2015, Vissa, 2012; Vissa and Bhagavatula, 2012; Halgin and Borgatti, 2012). Network churn captures change in the composition and membership in professional networks over time (Sasovova et al., 2010; Feld et al., 2007).[1] To develop hypotheses linking change in networks to change in production, we draw on literature from organization theory predicting explorative versus exploitative strategic approaches to obtaining resources (March, 1991). By making use of data from a national survey of scientists in six fields conducted in 2007 and again in 2010, we link churn with productivity. We show that scientists' strategies to change professional network structure and composition over time have implications for different types of scientific outputs: publications, grant submissions, successful grant submissions, and grant dollar amount.

We begin by integrating select literatures on science collaboration, network churn, and decision-making. Drawing from those literatures, we outline hypotheses about how network churn affects scientific productivity. Results suggest that the network-based decisions which scientists make have significant implications for their productivity. The findings provide important insight into understanding the dynamics of professional networks and the role of networks on career success among academic scientists. We close with a discussion of the implications of the findings for policy and management.

2. Network structure, churn, and scientific production

Scientists make decisions about the structure and composition of their professional networks. They choose to invest time and energy in one relationship over another, let network ties drop away, agree or not to joining new collaborations, and seek out new connections. In some ways the connections scientists make are the result of serendipity or their position in the network. However, in many, if not most, cases scientists consciously select their networks. Prior work confirms that scientists actively seek out collaborations for the purpose of accessing new resources, skills, or knowledge (Beaver, 2001; Heinze and Kuhlmann, 2008; Katz and Martin, 1997; Melin 2000; Thorsteinsdottir 2000; Wagner 2005). Bozeman and Corley (2004) show that scientists use collaboration strategies to enhance their ability to obtain resources and van Rijnsoever et al. (2008) find that scientists strategically attract others in exchange for access to knowledge, visibility, reputation, or other benefits that help them gain competitive advantage. Despite these findings, most research that examines scientists' networks begins from the perspective that structural embeddedness or network structure predicts productivity. While we do not disagree that these institutional approaches to explaining productivity are useful, prior work generally negates the role of individual agency or strategy; whether and how scientists' revitalization of their own networks affects their productivity.

Ego-centric professional networks comprise the relationships that an individual (i.e., an ego) forms with a set of peers (i.e., alters) and the interconnections among those peers (McCarty, 2002). Professional networks churn as egos form new connections and disengage from previous ones. Churn operates at both the dyadic level and the network level (Feld et al., 2007). At the dyadic level, network churn refers to the formation, persistence, and loss of ties over time and the changes in the composition of those ties (Halgin and Borgatti, 2012). At the network level, churn consists of change in the overall size of the network and change in the composition of the network members. In this research, we examine the changes in academic scientist networks at both levels and examine how churn affects scientific production. We ask two primary research questions: How do scientists' networks change over time? And, how does network churn affect science productivity?

To explain why scientists alter their networks and how that may matter for productivity, we distinguish between network exploitation and exploration strategies. Prior research shows that exploration strategies are related to the pursuit of new knowledge and innovation, while exploitation strategies tend to develop and use known factors (e.g. existing contacts, ideas, information or knowledge) (Lazer and Friedman, 2007; Levinthal and March, 1993). Scientists would employ exploitation strategies to maintain relationships that have known capacities, expecting that the resulting knowledge contributions from the research may have more marginal or incremental value. Exploiting existing relationships may result in greater output, given that one is capitalizing on known processes, but not necessarily greater output quality. By contrast, scientists would adopt exploration strategies to seek collaboration resources that have high promise for the formation of new ideas and approaches. An exploration strategy is likely to be more uncertain but may be more likely to produce new ideas and high impact outcomes (March, 1991). Fig. 1 illustrates the exploration and exploitation strategies, where an individual scientist (ego on the left) can take one of the two strategies in network building. In general, we expect that strategies based on exploration would be more likely to rely on the development of new ties and the severing of old ties while exploitation strategies would be more dependent on existing ties.

2.1. Dyadic churn

2.1.1. Adding ties and losing ties

Exploration and exploitation strategies are associated with two different production aims. Exploitation aims to refine existing knowledge, skill, and resource complementarities for production of new outputs. Exploration strategy includes searching and discovering new opportunities and resources often for purposes of innovation (March, 1991). While March's original work on exploitation and exploration focused on organizations, more recent research on entrepreneurs finds similar strategies related to churn: network broadening action and network-depending actions (Vissa and Bhagavatula, 2012).

Network churn comprises at least two strategies, exploitation and exploration, undertaken by individuals in an effort to gain resource advantages that enhance production quality and quantity. We assume that all scientists throughout their careers consistently employ both exploitation and exploration churn strategies, although some employ more of one than the other. Exploitation is a viable strategy for a scientist because she has already undertaken substantial learning about network members and members of the

[1] Note that the churn literature and topics discussed here are distinct from Bozeman and Rogers (2002) use of the term churn. Their "churn model" refers to the use and transformation of knowledge, where churn implies no particular direction or imputation, but rather a stirring, shaking, and agitation of scientific knowledge.

Please cite this article in press as: Siciliano, M.D., et al., Network exploration and exploitation: Professional network churn and scientific production. Soc. Netw. (2017), http://dx.doi.org/10.1016/j.socnet.2017.07.003

Download English Version:

https://daneshyari.com/en/article/7538355

Download Persian Version:

https://daneshyari.com/article/7538355

Daneshyari.com