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Ignoring the Experts: Networks and Organizational Learning in the Public Sector

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Abstract

Although much of the research on learning in the public sector examines collaborative arrangements and interorganizational networks, it often stresses the importance of individual dialogue and social interaction as primary methods of learning. Given the collective focus, the current emphasis on organizational interaction has left the individual mechanisms by which learning occurs unspecified and understudied. This study takes as its unit of analysis the dyadic, advice seeking ties that operate as the pathways by which knowledge is transferred and developed among organizational members. Rather than exploring a single advice or knowledge sharing network, this study offers a novel approach for examining the social dynamics of organizational learning by linking two different types of task-relevant knowledge to the social networks that emerge when employees search for that knowledge. By measuring where expertise resides in each knowledge specific network and by modeling the processes and conditions affecting knowledge transfer, this study is able to analyze how efficiently organizations tap into the resources and skills that already exist among their members. The findings suggest that employees tend to ignore the experts when seeking tacit information, and instead rely on those they feel most comfortable with and with whom are most accessible. Several important distinctions to the patterns of network formation are noted between public and private organizations. Overall, the results suggest that public managers need to pay attention to the costs of knowledge sharing as much as its benefits in order to promote organizational learning.

Introduction

An organization's ability to learn has long been viewed as a key determinant of its success (Argote 2011; Argyris 1999; Drucker 1993). Learning at the organizational level occurs when individuals change their routines, procedures, and strategies in response to new knowledge and shared experiences (Mahler 1997). When organizations learn they become more efficient, reduce duplicative processes, avoid members making the same errors, and foster innovation (Argote 2013; Bresman 2010; Rashman, Withers, and Hartley 2009). Although the failure to learn remains a major criticism of the public sector (Moynihan and Landuyt 2009), the need for organizational learning is only likely to increase as public services continue to grow in their knowledge intensity (Brown and Brudney 2003; Richards and Duxbury 2015; Willem and Buelens 2007).

Scholarly work on organizational learning in the private and public sector has focused primarily on collective levels of analysis (Argote 2013; Rashman, Withers, and Hartley 2009). Public administration and management scholars have explored learning at the interorganizational, organizational, and group (team, department) levels. Research related to learning can be found in the areas of policy learning and evidence-based policy (Bennett and Howlett 1992; Lindblom and Cohen 1979; Nutley, Walter, and Davies 2007; Sabatier 1987; Sabatier and Jenkins-Smith 1988); policy networks (Considine, Lewis, and Alexander

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2009); collaborative governance and governance networks (Emerson, Nabatchi, and Balogh 2012; Gerlak and Heikkila 2011; Klijn and Koppenjan 2015); performance management and information use (Askim, Johnsen, and Christophersen 2008; Moynihan 2005); and team or group learning (Foldy and Buckley 2010; Richards and Duxbury 2015; Willem and Buelens 2007).

One limitation of the existing research on learning in the public sector has been the limited role of individual learning and individual agency (for exceptions, see Hatmaker and Park 2014; Hatmaker, Park, and Rethemeyer 2011; Siciliano 2015). As Simon (1991) and Argote (2013) contend, organizations and collectives learn via the learning of their individual members. Because current public sector research emphasizes interactions among organizations and groups the individual mechanisms by which learning occurs in the public sector remain understudied and unspecified. That is not to say that previous work ignores the role of the individual. On the contrary, work on the Advocacy Coalition Framework by Sabatier (Sabatier 1987, 1988; Sabatier and Jenkins-Smith 1993) has suggested that learning often occurs through professional forums that allow individuals to exchange and discuss information (Mahler 1997). Moynihan and Landuyt's (2009) examination of cultural and structural elements that facilitate organizational learning found that regular dialogue among key actors was the most influential variable. Recent work by Emerson and Nabatchi (2015) on collaborative governance regimes, stressed the importance of principled engagement and the establishment of formal venues where individuals can deliberate and share knowledge. Similarly, research on collaborative learning by Gerlak and Heikkila (2011) stress that learning is more likely to occur when the institutional and structural features of collaboratives facilitate the ability of leaders and individual members to interact.

Across these studies there is a consistent underlying belief—that organizational learning occurs through dialogue and interaction among individuals. This belief in the importance of individual interaction aligns with prior work on organizational learning (Senge 1990; Simon 1991), knowledge management (Argote, McEvily, and Reagans 2003; Argote and Miron-Spektor 2011), and social learning systems (Wenger 2000). Although research at the collective level acknowledges the role of interpersonal interaction and dialogue, such processes are assumed to exist. None of the aforementioned studies directly identify and model the social interactions posited to be drivers of collective learning. This is potentially problematic as, according to Bourdieu (1986), the presence of these interactions are neither a natural nor a social certainty. If organizational features such as learning forums are the structures through which learning occurs, they do so through the interaction and knowledge sharing ties among the individuals within the forum. Again, however, these micro-level actions are generally not directly explored in the current public sector learning literature, they are assumed. Consequently, our understanding of how interpersonal knowledge sharing ties form and of the mechanisms underlying individual and organizational learning is limited.

In this article, I directly examine the microprocesses of organizational learning by measuring and modeling the dyadic interpersonal advice seeking and knowledge sharing ties that exist in public organizations. These ties provide the opportunity for and operate as the conduit of knowledge transfer and knowledge development (Argote 2013; Reagans and McEvily 2003). Through the use of inferential network analysis techniques, I am able to assess the influence of a range of variables on tie formation. By identifying the antecedents of interpersonal knowledge sharing, this research can help public managers deal with the critical challenges of building learning organizations by ensuring that expertise and information travels from those within the organization who possess it to those who need it (Kim and Lee 2006).

This study takes places in an urban public school district. Public schools were chosen as an appropriate setting for several reasons. First, teachers operate in knowledge-intensive organizations where the tasks of teaching are complex and require constant learning to be successful (Coburn 2005; Rosenholtz 1991; Spillane, Kim, and Frank 2012). Second, teachers, which comprise the largest group of public sector employees (Watson 2014), are often seen as the "ultimate example" of street-level bureaucrats (Fowles et al. 2014) and thus representative of a broad class of public actors (Lipsky 1980; Weatherley and Lipsky 1977). Third, public education as a field setting offers a distinctive advantage over other fields as the areas of expertise relevant to teacher success have been widely studied and well documented (Danielson 2011). Therefore, it is possible to identify the critical knowledge domains around which advice and information seeking occur. Fourth, public schools and teachers are under heightened scrutiny to improve performance and face significant challenges due to high levels of teacher burnout (Alliance for Excellent Education 2014). Understanding the microprocesses of organizational learning in public schools offers both theoretical and practical relevance.

In the following section, I link organizational learning and learning mechanisms to advice networks. Next, I examine the three primary factors influencing learning and develop microlevel hypotheses regarding

advice tie formation. In the fourth section, I present the data and analytic results and conclude with further insight and discussion on the importance of the findings.

Social Networks and Organizational Learning

Much of the learning that occurs in the modern workplace is driven by one's social interactions (Cross, Parker, and Sasson 2003; Myers 2015). Research on teachers and other street-level workers has found that individuals rely on peers to provide the resources and information needed to complete work tasks and implement policy (Coburn 2001; Daly 2010; Hill 2003; Maynard-Moody and Musheno 2003; Spillane, Kim, and Frank 2012). Faced with complex conditions and uncertainty regarding the most effective work procedures, employees engage with one another in a sensemaking process to develop shared understandings of their work and goals (Morrison 2002; Weick 1995; Weick, Sutcliffe, and Obstfeld 2005). Within public schools, Coburn (2001) suggests that teacher interactions are a primary mechanism by which teachers come to understand and implement policy. As employees seek information and resources from peers, discrete dyadic relations form across the organizational landscape and these dyadic ties scale up to form intraorganizational knowledge sharing and advice networks (Borgatti and Foster 2003; Brass 1995; Lazega et al. 2012; Raider and Krackhardt 2001).

The ties present in advice networks establish the actual opportunity and conduit for knowledge to be transferred and for learning to occur (Reagans and McEvily 2003). Although several scholars have noted that organizational learning in the public sector is understudied from a public management perspective (Moynihan and Landuyt 2009; Rashman, Withers, and Hartley 2009; Richards and Duxbury 2015), the interpersonal, microaspect of learning has been relatively ignored, at least from an empirical standpoint (Kapucu, Hu, and Khosa 2014). To address this gap, I focus on advice ties as the unit of analysis. I do so because the ties that emerge through advice seeking not only transfer knowledge (Reagans and McEvily 2003) but have been viewed as core elements in knowledge development (Bransford, Brown, and Cocking 1999; Spillane, Kim, and Frank 2012). Furthermore, information held by one individual in the network can be spread through the organization via the network and thus, tacit knowledge can be maintained within the organization even after the original owner of the information leaves. In this regard, advice networks function as a type of repository that embeds individual learning and allows higher level collective learning to occur (Argote 2013; Argote and Miron-Spektor 2011; Huber 1991).

While it is indeed the individual organizational member who learns (Senge 1990; Simon 1991), in knowledge intensive organizations that learning primarily occurs through dialogue and interaction with other organizational members rather than in isolation (Easterby-Smith, Crossan, and Nicolini 2000). Knowledge is developed via an interpersonal process that relies on the sharing of experiences rather than on individuals independently processing their own experiences. The learner (i.e., seeker of advice) gains knowledge of how to successfully complete work based on the experiences and knowledge of his or her peers. That information is then processed collaboratively and modified to match the context of the learner. This allows for successful practices to be replicated, adapted, tested and improved upon, and then shared with others to continue the processes of knowledge transfer and development.

Because aspects of both experiential (Kolb 2014) and vicarious learning (Bandura 1986) take place in advice networks, Myers (2015) recently referred to such learning as coactive learning or interpersonal vicarious learning to contrast it with the traditional notions of learning through observation and self-reflection. Overall, advice networks are the observable structure through which knowledge transfer and development transpire and interpersonal vicarious learning is the mechanism by which learning occurs within those structures. Given the importance of the dyadic, knowledge seeking tie, the next section identifies several theories and variables that may influence advice seeking and the formation of advice networks.

Factors Influencing Organizational Learning

Organizational learning is influenced by three sets of factors (Argote, McEvily, and Reagans 2003; Szulanski 1996): (a) the attributes of the individual actors, (b) the context in which knowledge sharing occurs, and (c) the characteristics of the knowledge itself. This study will directly assess the role of several variables from the first two factors and explore more qualitatively how knowledge type influences advice tie formation.

Individual and Dyadic Factors

The decision to seek help from one's local peers when facing a novel or difficult work situation, gives rise to advice-based social networks (Nebus 2006). On the surface it seems logical that when workers need assistance they turn to those in the organization with the most relevant experience and knowledge as those individuals are ones most likely to solve their problem

(Lazega et al. 2012; Nebus 2006). However, advice seeking may not solely be driven by a rational demand for information (Siciliano 2015). There are other factors which influence advice seeking decisions that need to be considered. Work by Casciaro and Lobo (2005), Nebus (2006), and Morrison and Vancouver (2000) suggests that individuals weigh the potential value of the information against the social and psychological costs associated with acquiring that information from a given individual. In this article, I will explore the role of peer expertise, accessibility, costs, and homophily as individual and dyadic factors that can influence advice tie formation.

Expertise

When trouble with student outbursts in the classroom or difficulty in designing a particular lesson plan arise, teachers may choose to turn to those peers most expert in that given area. The perceived value of the information obtained when seeking advice from a colleague increases as the colleague's expertise increases (Nebus 2006). Work by Borgatti and Cross (2003) has shown that the transfer of information in organizations is related to individual expertise. Seeking out the expert not only increases the potential accuracy and applicability of the information received, but also saves considerable time (Argote 2013). By going to an expert for help rather than unsuccessfully asking several less expert peers, the advice seeker's needs may be served much more quickly.

What about the expertise of the teacher who seeks advice? There are competing theories regarding how likely or unlikely experts are to seek information and knowledge from others. Research on the concept of absorptive capacity suggests that one's level of existing knowledge positively affects one's ability to acquire and integrate new knowledge (Cohen and Levinthal 1990). However, the work of Casciaro and Lobo (2005), Nebus (2006), and Morrison and Vancouver (2000) noted above, suggests that individuals are motivated to engage in knowledge seeking because the perceived benefits outweigh the perceived costs. For a given expert, the perceived value of information obtained from a potentially less expert peer may not outweigh the costs of acquiring it. Recent public sector work by Richards and Duxbury (2015) failed to find support for their hypothesized positive relationship between one's prior knowledge and one's level of knowledge acquisition. Although such relationships have been found in prior private sector studies, the authors reason that work in public sector organizations is more process focused rather than product focused. Given the difference in emphasis, there is less competition and perhaps less innovation and thus "once the process has been mastered (i.e., the current state of knowledge provides for adequate performance according to departmental or central-agency directives), the incentive for knowledge renewal might not be as pronounced" (Richards and Duxbury 2015, 1263). Therefore, I hypothesize that individual expertise will have a positive effect on being sought for advice but a negative effect on seeking advice.

H1: Teachers who require advice in a given content area are more likely to seek advice from teachers who have expertise in that area.

H2: Teachers who are themselves experts in a given content area are less likely to seek advice in that area.

Accessibility and Costs

Beyond the expertise of a potential advice provider, the costs of obtaining information from one's peers must also be considered (Nebus 2006). Borgatti and Cross (2003) developed a model of information seeking and learning in networks to better understand the relational characteristics that influence who seeks advice from whom. Their approach was an attempt to move beyond the examination of the implications of knowledge acquisition to study the factors associated with network formation. Conceptualizing information seeking as a dynamic choice process, Borgatti and Cross (2003) proposed that advice seeking is in part determined by the accessibility of one's peer and the perceived cost associated with seeking advice from that peer. Access relates to how available a member of the organization is to provide timely help and cost concerns the level of comfort one feels in going to that individual for assistance. Advice seeking costs, with regard to comfort, arise in the form of psychological costs (i.e., I don't want others to know my limitations or inability; Lee 1997; Morrison 2002; Nebus 2006).

Both access and costs (or comfort) are relational or dyadic attributes, as they vary from relation to relation. As Borgatti and Cross (2003) note, "a given contact can vary in their accessibility to others depending on who the seeker is to others. The classic example is the person who has time for high-status people, but not for others" (footnote, 435). Based on the work of Borgatti and Cross (2003), the following hypotheses are tested:

H3: Teachers are more likely to seek advice from peers who they perceive as more accessible.

H4: Teachers are more likely to seek advice from peers with whom they feel more comfortable (i.e., perceive lower psychological costs).

Homophily

In social and workplace settings, individuals are inclined to interact with others who share similar traits, a tendency known as homophily (Lazarsfeld and

Merton 1954). One reason for homophilious relations to occur in social networks is the natural tendency for people to be attracted to those with whom they share similar attributes (Byrne 1971). For more instrumental relationships, such as advice seeking, similarity can also reduce transaction costs by facilitating the establishment of trust and mutual expectations (Brass 1995; Feiock and Scholz 2010). Formal attributes, like sharing the same position within an organization, may also drive social ties as they operate as a signal of similarity with regard to job tasks and skill sets.

H5: Teachers are more likely to seek advice from peers who hold the same formal job title (e.g., both third grade teachers or both curriculum coaches).

Contextual Factors

The focal organizations of this study are all public schools from the same school district. Thus, many of the traditional contextual factors (e.g., industry, worker demographics) are controlled for. One critical area of context, not often considered, is the local network structure that surrounds an advice tie (Reagans and McEvily 2003). A social tie between two individuals is itself embedded in a broader social context (Agneessens and Wittek 2012; Reagans and McEvily 2003). Theoretical and empirical work on social networks suggests advice relations are self-organizing and thus there are endogenous processes at work that must be considered to avoid spurious conclusions about the individual and dyadic effects (Krackhardt 1987; Lusher, Koskinen, and Robins 2013). For example, as noted above, two teachers may interact because they have traits in common. This homophilious tendency can lead to areas of clustering in a network. However, clustering can also arise through triadic closure, whereby by individuals are more likely to form a tie if they share connections to a common third party. Because homophily and triadic closure co-occur and can lead to the same structural configurations, the size of the effect of either process must be assessed while controlling for the other (Lusher, Koskinen, and Robins 2013; Robins 2011; Robins et al. 2007).

Thus, beyond the traits of the individual advice seeker and advice provider, the broader context of the network in which those individuals are embedded affects the likelihood of tie formation. In this study, three network effects, often referred to as structural effects, are tested. The first, triadic closure, concerns the tendency for ties to form transitive relations. Specifically, in directed networks (i.e., networks with asymmetric, directional ties) involving advice seeking, transitive relations can be viewed as a type of hierarchal structure. Specifically, if i sends a tie to k and k sends a tie to j then i may be more likely to send a tie to j.

Second, across a range of settings and types of relational ties, social networks tend to exhibit a significant amount of reciprocity. Thus, a tie from i to j is more likely when there exists a tie from j to i. Though, there is often a hierarchal tendency associated with instrumental ties (experts generally don't seek out novices for help), tendencies to seek out high expert peers and reciprocity can co-exist as formation processes (Lazega et al. 2012).

Third, due to the uneven distribution of expertise among actors in an organization, certain individuals may become more highly centralized in the network. Teachers who are highly sought for advice may continue to attract more advice seekers over time resulting in nonuniform degree distributions (Rivera, Soderstrom, and Uzzi 2010). For example, teachers may witness one peer providing advice to several others and infer that the individual is the best source of information. Such processes are often referred to as preferential attachment or the Mathew effect, whereby popular individuals in a network continue to grow in popularity (Barabási and Albert 1999). Based on the preceding discussion, the following three hypotheses will be tested:

H6: Teachers are more likely to seek advice from peers with whom they share a common partner. In other words, advice seeking ties will tend to form transitive structures.

H7: Teachers are more likely to seek advice from a peer, if that peer seeks advice from them. In other words, advice seeking ties will tend to be reciprocated.

H8: Teachers are more likely to seek advice from a peer who is already highly sought for advice. In other words, teacher networks, with regard to in-degree, will tend to be centralized around a few high popularity nodes.

Knowledge Type

The third factor influencing knowledge transfer and learning is the type of knowledge being exchanged. Prior research suggests that the characteristics of the knowledge being sought can influence transferability (Van Wijk, Jansen, and Lyles 2008), and thus patterns of network formation could vary based on knowledge type. However, almost all research, conducted in both the public and private sector, tends to examine only one advice or communication network. As noted by Phelps, Heidl, and Wadhwa (2012, 1150), with few exceptions, research on advice and knowledge networks has focused on a unitary conceptualization of the network despite the fact that individuals are embedded in multiple and overlapping relations. Simply measuring a single communication or advice network not only combines but potentially obscures the different types

of knowledge and resources that flow within organizations. For example, a study by Sykes, Venkatesh, and Johnson (2014, 53) on the implementation of an enterprise resource planning system found that a single conceptualization of the advice network may be insufficient for tracking information exchange.

A primary characteristic of knowledge affecting its transferability is its level of codification (Zander and Kogut 1995). Codification level depends on how easily or how fully the knowledge can be documented in a written form (Hansen 1999). This relates to the distinction between explicit and implicit (or tacit) knowledge, where implicit knowledge is inherently more difficult to codify and consequently, transfer (Hansen 1999). As knowledge increases in its explicitness, it is more easily passed through a physical medium.

In a school, such knowledge may be contained in a sample quiz or lesson plan, and thus easily shared among teachers. In comparison, more tacit knowledge may require the advice provider to offer detailed explanations of the techniques and strategies they employ and work with the advice seeker to adapt and apply the knowledge. For instance, knowledge regarding approaches to control particular student behavior in the classroom is much more difficult to codify as it varies by student and type of behavior. Therefore, going to a peer to obtain a lesson plan or an assessment tool requires much less time on part of the provider to share that information. This may lessen psychological costs of seeking advice and increase perceptions of peer accessibility when searching for more explicit knowledge.

Differences in perceptions of cost and access may lead to differences in their effect on tie formation and the overall density of advice networks. Specifically, we may find that the coefficient size for costs and access are lower when advice seeking is for more explicit knowledge and subsequently, the density of those networks may be higher. Network density is ratio of the actual number of ties that exist to the number of ties possible. Unlike the prior hypotheses, the influence of knowledge type on access, costs, and density will be assessed qualitatively by examining descriptive aspects of the networks and their formation processes.

Data, Methods, and Measurement

The data for this study come from a large urban district in the Midwestern United States. The district, one of the largest in the state, was engaged in an ongoing reform movement to improve the norms of collaboration and overall collective support among its instructional staff. The district expressed interest in understanding the underlying processes influencing the dissemination of information and advice seeking behavior within its schools. As part of my research, I met with the superintendent, research director, members of the leadership team, and the teacher's union on several occasions. These meetings were designed to not only get buy-in for the research itself but to have members of the district participate in the development of the survey instrument. This included granting some control to the district as to which questions would be asked as well as to obtain help from relevant representatives in crafting the wording of certain questions to provide the most accessible language to the respondents.

After piloting, the survey was sent via email to all members of the instructional team (i.e., teachers, coaches, and principles)[1] in each of the district's 18 elementary schools in October of 2013. Three follow-up email reminders were sent in November and December of that year. The overall, district-wide response rate to the survey was 52%. However, given that high response rates are needed for network analysis, this study provides an in-depth analysis of five elementary schools which had response rates at or above 70%. No differences in school characteristics were found between the study schools and the rest of the district. Descriptive statistics on the schools are available in table 1.

In addition to the survey data, the district provided administrative data on its teachers and staff. This data included information on gender, ethnicity, years served in the district, education, and formal position. A third source of information, peer assessments, was also used to measure the expertise of each teacher. Three distinct sources of data—self reports, administrative data, and peer assessments—were used in the final dataset in order to reduce the potential for single-source bias (Podsakoff and Organ 1986).

Dependent Variables—Advice Networks

The dependent variables in the analyses are the advice seeking ties that exist in two different areas of expertise or knowledge domains in each of the five schools. As indicated above, prior research has tended to rely on a single measure of the advice network in organizations. One of the values of using public schools as the research context is the existence of a refined set of instructional content areas known as the Danielson Framework (Danielson 2011). This framework indicates the specific areas of expertise in which teachers need to be proficient in order to be effective educators. These content areas are grouped into domains that outline a specific type of skill or expertise. As noted by

1 Although data was collected from the core instructional team of each school, the term teacher is used throughout the article to simplify the discussion. In most schools, only two members of the instructional team were not formally designated as teachers: a curriculum specialist or coach and a principal.

Table 1. Descriptive Statistics for School Sites 1 Through 5

School Site	Number of Instructional Staff	Response Rate	Percent with Master's degree or higher	Average Experience (Years in District)	Percent Female	Percent White
1	36	94.4	52.8	12.4	94.4	94.4
2	30	71.9	56.3	14.5	96.9	93.8
3	28	78.6	78.6	19.3	82.1	96.4
4	20	70.0	60.0	9.5	100	85.0
5	25	76.0	84.0	18.4	92.0	100

the Danielson Framework's website, "The Framework may be used for many purposes, but its full value is realized as the foundation for professional conversations among practitioners as they seek to enhance their skill in the complex task of teaching" (The Danielson Group 2015). Thus, there is an explicit link between the Danielson Framework and the concept of interpersonal interaction and networks.

It is this purpose, as the basis for information needs and advice seeking, that I utilize the Danielson Framework. I explore a subset of two of the framework's knowledge domains that vary with their level of explicitness: (a) student behavior and classroom management (less explicit/more tacit) and (b) instructional material design and student assessment (more explicit/less tacit). The instructional material design and student assessment knowledge domain is more explicit, as the knowledge associated with that domain can be captured and transferred in written documents such as tests, quizzes, and lesson plans. The structure of the advice networks for each knowledge area was measured using the roster method of social network data collection. With the roster method, each respondent is given a list of the other teachers in the school and asked to indicate which of those individuals they sought out to (a) discuss ways to improve and manage student behavior and (b) exchange teaching material, lesson plans, and student assessments. Therefore, for each school, two distinct advice networks were measured. As will be discussed below, it was for these same two knowledge domains that teachers were also asked to identify the peers they deemed as experts.

Exponential Random Graph Models

Network data, such as the advice networks collected in this study, is difficult to model because the ties that form within the network are not independent of one another. The dependence among the observations causes problems when attempting to estimate tie formation using standard linear models (Butts 2008; Snijders 2011). In particular, the use of traditional statistical methods often underestimates standard errors leading to heightened type 1 error rates and spurious findings (Monge and Contractor 2003). Exponential random graph models (ERGMs) are a family of statistical models which allow researchers to account for the structural dependencies in a network while also examining the influence of actor characteristics on tie formation. ERGMs predict the conditional probability of a tie forming in the network. Unlike standard logistic regression models for binary outcomes that assume each outcome is independent, ERGMs require the tie probability to be conditional on the rest of the network. The logit formula of an ERGM is therefore (Koskinen and Daraganova 2013):

$$\log\frac{\Pr\left(X_{ij}=1|X_{-ij}=x_{-ij},\theta\right)}{\Pr\left(X_{ij}=0|X_{-ij}=x_{-ij},\theta\right)} = \theta_1\delta^{+}_{ij,1}(x)+\theta_2\delta^{+}_{ij,2}(x)+\ldots+\theta_p\delta^{+}_{ij,p}(x)$$

where $X_{-ij} = x_{-ij}$ indicates all of the other ties in the network except for the *ij* tie are held at their observed value and $\delta^{+}_{ij,p}(x)$ are the "change statistics" for the *p*th configuration. These change statistics indicate how the variables in the model change due to the addition of the *ij* link. For example, if the configuration of interest is a triangle, the addition of a single link could close any number of triangles and thus, the structure of the network beyond the dyad of interest must be known in order to calculate the change statistics. An equivalent version of the above formula for modeling all tie variables at the same time is (Koskinen and Daraganova 2013):

$$\Pr\left(X=x|\theta\right)=\frac{1}{k}\exp\left\{\theta_1 z_1(x)+\theta_2 z_2(x)+\cdots+\theta_p z_p(x)\right\}$$

The parameters, θ, weight the relative importance of their respective configurations $z_p(x)$, and the normalizing term $k(\theta)$ ensures that the sum of the probability mass function over all graphs is one. ERGMs approximate a maximum likelihood estimate of the theta coefficients through a Markov Chain Monte Carlo (MCMC) simulation process. The *ergm* package of the statnet suite (Handcock et al. 2008) in the R programming environment was used to estimate the models. For more information on the simulation procedures and algorithms, see Morris, Handcock, and Hunter (2008).

The variables included in network formation models can be separated into two broad classes: dyadic

independent (also known as actor attribute effects) and dyadic dependent (also known as structural effects). Dyadic independent terms are variables based only the traits of the dyad itself and thus are not influenced by the broader structure of the network. These variables align with the first factor influencing organizational learning—the attributes of the individual actors. Dyadic independent terms include sender and receiver effects, homophily effects, and edge covariates. Sender and receiver effects are based on individual attributes and measure the change in tie formation probability given the trait of the advice seeker (i.e., the sender of an advice tie) and advice provider (i.e., the receiver of an advice tie). Homophily effects consider both members of the dyad jointly and assess how similarity on a given trait influences tie formation. Edge covariates are directionally measured for each dyad and capture *i*'s perception of *j*. Dyadic dependent terms capture the self-organizing properties of networks, and therefore align with the second factor influencing organizational learning—the broader structural context in which knowledge sharing occurs.

Individual and Dyadic Variables

Hypothesis 1 concerns a receiver effect based on expertise. Using the Danielson Framework, respondents were asked to nominate up to five coworkers that they deemed as experts in each of the two knowledge domains: (a) student behavior and classroom management and (b) instructional material design and student assessment. These areas map directly onto the advice seeking ties in the knowledge networks descried earlier that serve as the dependent variables. Thus for each knowledge domain, the ties established when seeking knowledge and the experts in that domain were identified. Peer nominations of expertise in a given knowledge area were used to calculate a continuous measure of a teacher's expertise. Expertise is an attribute of the teacher, and thus a receiver effect is able to capture whether or not greater expertise is related to a greater likelihood of being sought for advice. In other words, do teachers recognized as experts in a given knowledge area receive more in-coming advice ties than those not recognized as experts? Similarly, hypothesis 2 concerns a sender effect based on expertise. The same measure of expertise was used to examine whether experts in a given knowledge area were less likely to send ties (i.e., seek advice).

Hypotheses 3 and 4 relate to how perceptions of accessibility and cost influence the likelihood of seeking advice from a given peer. Accessibility was measured using the wording from Borgatti and Cross (2003). The question on the school survey stated "One issue in getting information or advice from others is your ability to gain access to their thinking. The extent to which you can access another person's thinking and knowledge is a continuum. At one end of the spectrum are people who do not make themselves available to you quickly enough to help solve your problem. At the other end of the spectrum are those who are willing to engage actively in problem solving with you in a timely fashion. With this continuum in mind, how would rate your overall ability to access this person's thinking and knowledge?" Every teacher provided an assessment of every other teacher on a scale from 1 (not accessible) to 5 (always accessible). The access variable represents an edge covariate in that the formation of an *i*,*j* tie may be dependent on *i*'s perception of *j*'s accessibility.

In addition, each respondent was also asked to assess the costs associated with seeking advice. Although Borgatti and Cross (2003) referred to both psychological and social costs in the same question on their survey, I separated the two. Social costs are partly controlled for in the model by including a reciprocity effect (see below). Psychological costs were measured using the relevant language from Borgatti and Cross (2003). The question asked, "Another issue in getting information or advice from others is your level of comfort in approaching others for advice. For a variety of reasons, people simply feel more comfortable seeking help from certain individuals. Please indicate the extent to which you would feel personally comfortable if you needed to ask each of the following individuals for information or advice on work-related topics." Higher rankings indicated less psychological costs due to increased comfort with the provider. To avoid confusion about the direction of the relationship, the term is simply labeled as *comfort* in the models below. The edge covariate of comfort ranged from 1 (uncomfortable) to 5 (extremely comfortable).

At the dyadic level, hypothesis 5 posited a homophily effect. This effect was based on whether the job title, as maintained in the school's administrative records, was the same for two teachers. This variable was calculated by assessing for every given dyad whether teacher *i*'s formal position matched teacher *j*'s formal position.

Contextual Variables

Hypotheses 6, 7, and 8 concerned dyadic dependent terms, or structural effects related to the self-organization of the networks. The variables of transitivity, reciprocity, and popularity spread capture the broader social context in which a single tie forms. Transitivity was measured through the use of geometrically weighted edge-wise shared partner distribution (GWESP). GWESP is used rather than the simple count of the number of triangles to avoid degeneracy issues that are common with ERGMs (Hunter 2007). Reciprocity is captured through the use of a mutuality term. This term provides an estimate of the increased

likelihood of the *i,j* tie forming given that the *j,i* tie exists. Lastly, the centralization of advice networks is measured through the geometrically weighted in-degree distribution or popularity spread. When positive and significant, this term suggests that the network is centralized around a few high degree nodes.

Control Variables

Several additional control variables were entered into the model.[2] At the individual level, education, seniority, self-efficacy, and perception of psychological safety were entered as attribute effects. The sender and receiver effects of education were included to control for variation in advice seeking or providing based on one's level of education. Education is measured as a binary variable indicating whether the teacher holds a bachelor's degree or has obtained a masters/PhD degree. Similarly, the sender and receiver effects of seniority were included to capture the role of experience in shaping advice tie formation. Seniority is a continuous measure based on the number of years the teacher has served in the district. Self-efficacy and psychological safety were included as sender effects to control for changes in advice seeking behavior that may be due to one's perception of their own ability as well as his or her general perception of the school environment. Self-efficacy was measured using a nine item subset of the Tschannen-Moran and Woolfolk Hoy (2001) scale. Psychological safety was measured based on six items from Edmondson's (1999) original scale.

Structural effects for two-path and activity spread were also entered into the model as these are standard structural control variables that should be included in most ERGMs (Lusher, Koskinen, and Robins 2013). The two-path term is included to control for the correlation between in and out-degree. Activity spread, like popularity spread, controls for the out-degree distribution of the network. Table 2 provides a visualization and description of each of the variables.

Results

Table 3 provides the ERGM results for each of the five schools for the knowledge domains of classroom management and table 4 provides the results for instructional material and assessment. In total, across the five schools and the two knowledge networks within each school, 5,228 dyadic advice relations were analyzed. All models successfully converged. MCMC diagnostics indicated that sample statistics from simulated networks were not significantly different from the observed statistics. The models therefore successfully captured within model statistics and did not display any signs of degeneracy. Goodness-of-fit measures for each of the models are available in an Supplementary Appendix. Overall, all 10 models demonstrate a good fit with the observed data and suggest that the observed networks could have derived from the processes that were included in the model (Koskinen and Snijders 2013). See the Supplementary Appendix for additional discussion on goodness-of-fit.

Individual and Dyadic Effects

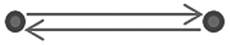
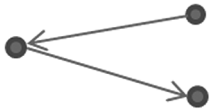
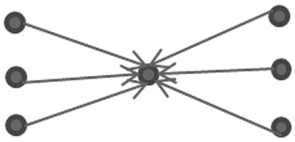
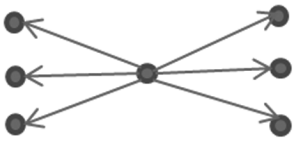
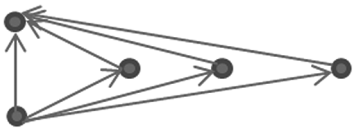
The first two hypotheses concerned the role of teacher expertise in seeking and being sought for advice. For the networks that formed around the less explicit and more tacit knowledge domain of classroom management, the expertise of the receiver of an advice tie (i.e., the advice provider) had no significant effect on tie formation. Opposite of hypothesis 1, one's level of expertise in classroom management had no significant influence on the likelihood of receiving ties from peers in need of classroom management advice. In other words, experts were not any more likely to be sought out for advice than non-experts. However, when the knowledge domain is more explicit, receiver expertise had a positive effect in all five schools and was significant in three of them. Thus, when the knowledge sought was more easily transferred and codified, teachers were more likely to go to the experts. Therefore, the role of expertise may be contingent upon the type of knowledge being sought.

The expertise of the advice seeker was hypothesized to have a negative effect on advice tie formation (Hypothesis 2). Support for this hypothesis was found in only one school for each of the knowledge domains. Thus, there is very limited evidence that a teacher's own expertise significantly influences the likelihood that she seeks advice from her peers. This finding aligns that of Richards and Duxbury (2015), which failed to find a positive association between prior knowledge and knowledge acquisition.

Hypotheses 3 and 4 predicted that the edge covariates of access and comfort would have a positive effect on advice tie formation. With regard to access, the coefficients in four out of the five schools in the classroom management domain and all five schools in the instructional material and assessment domain were positive and significant. Thus, there is strong evidence to suggest the when teachers perceive a peer as more accessible and more likely to provide information in a timely matter, the more likely they are to seek them out for advice. The size of the effect ranged from 0.117 to 1.033, with an average effect of around 0.5. This indicates that holding all else constant, for each unit increase on the access scale, the odds of seeking advice

2 While gender and ethnicity are common variables used in modeling social networks the lack of variability within the district prevents them from being used. As shown in table 1, nearly all teachers in the sample schools were white females.

Table 2. Summary and Visual Representation of Model Terms

Parameter/Variable	Structural Pattern	Definition
Edges		The overall tendency for advice ties to form in the network
Reciprocity		The tendency for advice ties to be reciprocated
Two-path		The tendency for teachers who send advice ties to also receive them
Popularity spread		The tendency for teachers to vary in the number of advice tie nominations
Activity spread		The tendency for teachers to vary in the number of advice ties sent
Transitivity (GWESP)		The tendency for groups of three teachers (or triads) to be closed or multiple clusters of triangles to form in the network
Edge covariate		The tendency for advice ties to form increases as the value of the edge covariate increases. The edge covariates in the model are for access and comfort.
Sender effects		The tendency for a teacher with a given attribute to seek advice. Sender effects include expertise, seniority, education, self-efficacy, and psychological safety.
Receiver effects		The tendency for a teacher with a given attribute to be the recipient of advice seeking. Receiver effects include expertise, seniority and education.
Homophily effects		The tendency for advice ties to form between two individuals with a similar attribute. The homophily effect in the model was for job description.

Note: Images and descriptions based on Wang, Robins, and Pattison (2009) and Lomi et al. (2014).

increase by 65% [exp (0.5) = 1.65]. For comfort, a positive and significant effect was found in three out of the five schools in the classroom management domain and three out of the five schools in the instructional material and assessment domain. The average effect was smaller, around 0.2, and thus a one unit increase on the comfort scale indicates a 22% increase in the odds of seeking a tie [exp (0.2) = 1.22].

The fifth and final individual/dyadic hypothesis focused on tendency for individuals to form homophilous ties. Strong support for this hypothesis was found in both knowledge domains. The coefficients on the homophily term for job title were positive and significant in four out of the five schools in the classroom management domain and all five schools in the instructional material and assessment domain. The average effect across the models was around 1.4, and thus two teachers with the same job title (e.g., both second grade teachers) were over four times more likely to form an advice tie [exp (1.4) = 4.05].

Table 3. Exponential Random Graph Results for the Classroom Management Networks

	Site 1	Site 2	Site 3	Site 4	Site 5
Contextual/structural effects					
Edges	−2.998 (0.320)***	−7.307 (0.836)***	−2.009 (0.640)***	−4.431 (1.287)***	−5.484 (1.432)***
Reciprocity	1.974 (0.255)***	1.573 (0.404)***	1.686 (0.398)***	2.678 (0.700)***	1.029 (0.435)**
Two-path	−0.162 (0.015)***	−0.049 (0.049)	−0.060 (0.050)	−0.365 (0.127)***	−0.057 (0.058)
Transitivity	0.595 (0.047)***	0.650 (0.257)**	0.399 (0.193)**	0.236 (0.183)	1.557 (0.615)**
Popularity spread	1.069 (1.589)	2.891 (5.507)	0.287 (1.812)	1.389 (3.512)	4.136 (9.650)
Activity spread	−0.808 (0.739)	2.336 (1.319)*	0.467 (1.341)	−2.475 (1.279)*	1.620 (1.872)
Individual and dyadic effects					
Receiver expertise	−0.027 (0.017)	−0.001 (0.031)	0.006 (0.037)	0.090 (0.105)	0.074 (0.060)
Sender expertise	−0.011 (0.015)	0.043 (0.028)	−0.122 (0.047)**	0.039 (0.087)	0.066 (0.064)
Edge covariate—access	0.277 (0.057)***	0.502 (0.129)***	0.117 (0.083)	1.033 (0.316)***	0.430 (0.146)***
Edge covariate—comfort	0.183 (0.057)***	0.229 (0.101)**	0.195 (0.098)**	0.112 (0.285)	0.006 (0.144)
Homophily—position	1.051 (0.215)***	1.360 (0.466)***	1.651 (0.490)***	1.497 (0.832)*	0.772 (0.580)
Seniority—receiver	0.006 (0.009)	−0.018 (0.024)	−0.053 (0.016)***	−0.006 (0.034)	0.020 (0.019)
Seniority—sender	−0.039 (0.010)***	0.109 (0.022)***	−0.023 (0.021)	−0.017 (0.031)	−0.059 (0.015)***
Education—receiver	0.036 (0.171)	−0.336 (0.308)	0.338 (0.379)	−0.187 (0.524)	0.234 (0.405)
Education—sender	0.282 (0.173)	0.996 (0.303)***	0.256 (0.457)	−0.352 (0.428)	0.071 (0.378)
Self-efficacy—sender	−0.163 (0.092)*	0.194 (0.153)	0.469 (0.224)**	0.685 (0.257)***	−0.313 (0.176)*
Psych safety—sender	−0.008 (0.087)	0.035 (0.158)	0.253 (0.187)	−0.533 (0.199)***	−0.242 (0.169)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Contextual and Structural Effects

The results across the two knowledge domains were quite similar in terms of the significant contextual and structural effects. The three hypothesized effects were for transitivity (hypothesis 6), reciprocity (hypothesis 7), and in-degree centralization (hypothesis 8). With regard to transitivity, the coefficient on the GWESP term was positive and significant in four of the five networks in each of the knowledge domains. The positive effect on transitivity coupled with the negative two-path effect indicates that two-paths tend to be closed. In other words, in support of hypothesis 6, transitive structures tend to emerge in the advice seeking networks.

With regard to hypothesis 7, significant reciprocity effects were found in all five of the networks in each of the knowledge domains. Thus, advice seeking ties, whether in the classroom management domain or the instructional material and assessment domain, tended to be reciprocated.

Finally, hypothesis 8 proposed that advice tie formation would tend to be centralized around a few high popularity nodes. However, a tendency toward a centralized network was not supported. None of the coefficients in the five models for either of the knowledge domains were significant.

Knowledge Type

As highlighted by the results for expertise, knowledge type appears to influence the formation of advice networks; though not in the ways expected. I initially proposed that differences in network formation between the knowledge domains would be found with regard to the importance of psychological costs (i.e., comfort) and access. Given the potential reductions in psychological costs as well as the time costs to transfer more explicit knowledge, I posited that the density, or the average probability to seek advice, would be greater for the instructional material and assessment network. Both of those assumptions lacked empirical support.

First, very little difference in the size and direction of the coefficients on comfort or access were observed between the classroom management and instructional material and assessment domains. In fact, both variables were important factors in determining tie formation in each of the knowledge domains. Secondly, with regard to the overall likelihood of forming a tie, the density of the instructional material and assessment network was lower in all five schools compared to the classroom management network. The average density in the instructional material and assessment networks was 0.23 (meaning that 23% of possible ties were present) and the average density in the classroom management networks was 0.31.

There are at least two, nonmutually exclusive, reasons for observing a lower density in the more explicit knowledge domains. One, more explicit knowledge, given its reduced complexity, may simply be more

Table 4. Exponential Random Graph Results for the Instructional Material and Assessments Network

	Site 1	Site 2	Site 3	Site 4	Site 5
Contextual/structural effects					
Edges	−4.077 (0.442)***	−7.658 (0.871)***	−3.944 (0.810)***	−5.045 (1.374)***	−3.580 (0.964)***
Reciprocity	1.557 (0.330)***	0.995 (0.399)**	1.578 (0.442)***	1.240 (0.658)*	2.934 (0.537)***
Two-path	−0.189 (0.027)***	−0.033 (0.040)	−0.196 (0.059)***	0.086 (0.142)	−0.007 (0.068)
Transitivity	1.128 (0.129)***	1.408 (0.319)***	0.648 (0.181)***	0.108 (0.317)	0.444 (0.220)**
Popularity spread	5.673 (3.869)	4.454 (2.826)	2.289 (2.413)	2.197 (1.967)	3.079 (2.577)
Activity spread	−0.222 (0.733)	1.751 (1.328)	0.733 (1.186)	−0.000 (1.381)	−0.779 (1.185)
Individual and dyadic effects					
Receiver expertise	0.015 (0.024)	0.107 (0.042)**	0.029 (0.044)	0.328 (0.135)**	0.248 (0.114)**
Sender expertise	−0.019 (0.021)	−0.056 (0.040)	−0.071 (0.046)	−0.193 (0.161)	−0.350 (0.109)***
Edge covariate—access	0.277 (0.069)***	0.584 (0.131)***	0.310 (0.101)***	0.549 (0.285)*	0.498 (0.158)***
Edge covariate—comfort	0.192 (0.071)***	0.150 (0.091)*	0.306 (0.140)**	0.047 (0.267)	−0.191 (0.152)
Homophily—position	0.990 (0.234)***	1.237 (0.452)***	1.880 (0.613)***	1.555 (0.673)**	2.213 (0.608)***
Seniority—receiver	−0.025 (0.011)**	−0.027 (0.021)	0.015 (0.017)	0.011 (0.037)	−0.035 (0.022)
Seniority—sender	−0.004 (0.009)	0.052 (0.017)***	−0.029 (0.021)	0.012 (0.041)	0.009 (0.020)
Education—receiver	0.366 (0.224)	−0.417 (0.306)	−0.355 (0.470)	−0.331 (0.585)	0.062 (0.528)
Education—sender	0.386 (0.202)*	0.452 (0.258)*	1.077 (0.542)**	−1.131 (0.638)*	0.103 (0.455)
Self-efficacy—sender	−0.022 (0.097)	0.060 (0.121)	0.585 (0.244)**	−0.349 (0.357)	−0.221 (0.179)
Psych safety—sender	−0.261 (0.098)***	−0.254 (0.141)*	−0.388 (0.217)*	−0.029 (0.219)	−0.227 (0.175)

$^{***}P < 0.01$, $^{**}P < 0.05$, $^{*}P < 0.1$.

easily acquired and thus demand fewer interpersonal ties. Two, because teachers tend to rely on experts for more explicit information, they may obtain the necessary knowledge more quickly and thus may need fewer peers for help and assistance.

Discussion and Conclusions

Despite the importance of learning, public sector research on the topic remains sparse (Moynihan and Landuyt 2009; Rashman, Withers, and Hartley 2009; Richards and Duxbury 2015). Much of the existing work on learning occurs at the collective level of analysis. Few studies have empirically examined the interpersonal, knowledge seeking interactions through which learning occurs in knowledge-intensive settings. Prior research has tended to assume the presence of these social interactions rather than directly measure and model them. These advice ties however, and the social interactions that constitute them, are the means by which knowledge is transferred and developed (Bransford, Brown, and Cocking 1999; Reagans and McEvily 2003; Spillane, Kim, and Frank 2012). Unlike previous studies that have focused on collective levels of analysis, this study operated at the individual and dyadic level to explore the microprocesses that influence knowledge transfer and development in public organizations.[3]

The article makes several contributions to the study of public organizations and organizational learning. First, while previous work acknowledges that organizations, coalitions, and collaborative governance regimes learn and improve performance through individual learning and social interaction, that work has tended to either assume such processes exist or relied on proxy measures of networks (e.g., Emerson and Nabatchi 2015; Meier and O'Toole 2001, 2003; Moynihan and Pandey 2008; Sabatier 1987). Although these important studies indicate the value of networks and social interaction, the actual social structures that drive organizational and collective learning are treated as a black box. Thus, we remain uncertain about the form or structures of those networks and, more importantly, the processes by which they develop. This study

3 It is important to note that the distinction between the process and outcome of learning is often blurred. For instance, two of the three indicators of team learning used by Foldy and Buckley (2010) were the frequency of interaction (did the team meet regularly) and advice seeking behaviors (did the members ask for and provide help). Other scholars have noted that individual learning may not be observable and the definition of the outcomes, especially in the public sector, may depend on who defines success (Gerlak and Heikkila 2011).

opened the black box and used inferential network analysis techniques to shed light on the micro-processes that drive social interaction.

Second, this study demonstrated the potential value in disaggregating general conceptualizations of information and advice seeking into knowledge specific networks. Relying on the Danielson Framework, two specific knowledge domains relevant to teacher success were chosen based on their level of explicitness. Overall, the primary difference in network formation between the knowledge domains dealt with the expertise of the teacher being sought for advice. The results suggest that teachers do not engage in more advice seeking when the knowledge needed is explicit (and thus less costly to transfer), but rather teachers are more willing to seek out the experts for help. For tacit knowledge, experts tend to be ignored, as they are not sought for advice any more frequently than nonexperts. This finding will be discussed in more detail in the section on public–private distinctions below.

Three, the results of this study combined with previous work at the collective level of analysis, suggest that organizations need to work to not only establish the proper structures and forums that provide the opportunity for individuals to interact, but also need to develop the proper culture and incentives to promote knowledge sharing and trust. An organization or collaborative may formally mandate a learning forum, such as offering a common planning period to public schools teachers, but such structural changes do not directly lead to successful social interactions and collective learning (Hargreaves 1994; Moynihan and Landuyt 2009). It is likely that a sharing culture, without adequate time and space to share, or the presence of learning opportunities without a culture of sharing, will fail to deliver on organizational learning.

Public managers are faced with the considerable challenge of developing and implementing strategies that enable their employees to more effectively access task related knowledge. For collegial environments to turn into productive environments, employees need to be able to not only recognize where expertise resides among their coworkers (Coburn, Choi, and Mata 2010) but feel empowered enough and safe enough to seek advice from those experts. In organizations like public schools that develop specific positions, such as coaches, designed to function as expert resources for advice and informational needs, criteria for selecting individuals into those positions need to extend beyond expertise or willingness to serve in that role. As the results of this study suggest, expertise may not be playing a primary role in determining advice and help seeking behavior concerning more tacit types of knowledge. Based on the findings in table 3, the most relevant factors influencing tie formation are reciprocity, transitivity, job similarity, accessibility, and comfort. These findings contrast in important ways with work conducted in the private sector.

Public–Private Distinctions

Although there are clearly lessons that can be bridged between private and public organizations, the political environment in which public agencies operate and the tasks they perform make organizational learning in the public domain distinct (Dekker and Hansén 2004). This distinction is demonstrated in this study as three prior findings from private sector research were not confirmed. First, private sector studies found positive and significant sender and receiver effects with regard to prior knowledge and expertise (e.g., Borgatti and Cross 2003; Cross and Sproull 2004). In the current study, I find no effects for either the sender or receiver with regard to tacit knowledge and only a receiver effect (i.e., provider) with regard to more explicit knowledge.[4]

Second, with regard to psychological costs, as measured by the edge covariate comfort, this study found positive and significant effects in the majority of schools in both knowledge domains. Using a similar construct, Borgatti and Cross (2003) found no significant effect on advice tie formation. Borgatti and Cross (2003) reason that their unexpected null finding may be due to the fact that costs may operate at a group level or organizational level. They note that of all of the relational variables measured in their study, cost had the lowest variance. This may suggest that the costs of seeking advice can be influenced at the collective level to alter social interactions at the individual or dyadic level (Edmondson 1999).

Third, research by Su, Huang, and Contractor (2010) found strong support for in-degree centralization in the networks they modeled. Their findings show that a small subset of organizational members served as central sources of information. In contrast, no significant effects were found in any school for either knowledge domain. This indicates that within these public schools, no single individual or set of individuals emerged as the primary sources of knowledge.

One reason for the differences in the effects of expertise, comfort, and in-degree centralization between

4 Although sector differences may influence the role of expertise, it is also important to note that these prior studies relied on a single definition of the advice network. Such a general conceptualization of an information seeking tie may obscure distinctions in formation processes that exist for different types of knowledge (Phelps et al. 2012; Sykes et al. 2014).

public and private organizations may be related to the distinction between product versus process focus highlighted by Richards and Duxbury (2015). Because public sector work tends to be process focused, there may be no single solution for any dilemma or problem faced by employees. In this context, the advantages of seeking the expert may be reduced as no single best answer or strategy exists. In the private sector, with greater emphasis placed on products and innovation, obtaining expert advice might be of primary concern and thus the benefits of relying on the expert may outweigh the costs. In process focused settings, where the value of expertise may be diminished, costs of advice seeking become the dominate factor. Thus, employees may tend to rely on the peers who are most accessible or with whom they feel most comfortable or share a reciprocal tie, as these relations may absorb psychological and social costs.

Thus, we may find that networks in the private sector, as compared to the public sector, emphasize expertise, are centralized around a few key knowledge providers, and tend to be less influenced by psychological costs (i.e., comfort). In addition, the process–product distinction can also help to explain why we find different effects for expertise in the classroom management and instructional material and assessment domains, as the latter is more product focused. The differences between sectors, and across knowledge domains, point to the continuing need for context specific research on knowledge transfer and learning in the public sector.

Limitations and Future Research

Future research can build on these findings and the limitations inherent in this study in three important ways. First, research in contexts other than public schools is needed to examine generalizability. While teachers are often the subject of research on street-level behavior, variances in context may alter the findings. Second, future research could improve the capacity to make causal arguments by collecting longitudinal data and modeling network evolution. Longitudinal research may be especially powerful in newly formed organizations or to track the advice choices of new employees (Hatmaker, Park, and Rethemeyer 2011). Third, rich qualitative data can facilitate our understanding of how expertise is recognized and how more nuanced factors may influence specific advice seeking decisions. Qualitative work would be helpful in identifying how fundamental differences in knowledge types, such as the level of codification, shape tie formation and knowledge transfer.

As more and more organizations attempt to build robust knowledge sharing and collaboration networks, understanding how information is actually spread within the organization and the factors that influence advice seeking is extremely important for identifying effective strategies to promote organizational learning. These processes are equally relevant for interorganizational networks and collaborative arrangements, as the learning mechanisms within those structures also rely on individual interaction and discussion (Ulibarri and Scott 2016). Hopefully, the lessons and conclusions drawn from this study will spur additional research connecting individuals, networks, and organization learning in the public sector.

Supplementary material

Supplementary data is available at the *Journal of Public Administration Research and Theory* online.

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