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## **Looking back and ahead: A social network perspective on workplace learning and professional development**

### **Abstract**

In this chapter, we set forward a social network perspective on professional learning and development. The chapter stresses that how individuals learn and develop in and around the workplace is significantly affected by the way they are tied into a larger web of social connections. We reflect on the added value of a social network perspective to workplace learning research. Building on exemplary findings of recent studies, it shows that the pattern and quality of social relationships among professionals may significantly enhance our understanding of the ways in which interaction takes place and contributes to learning and development. We discuss how a social network approach allows to capture professional interactions in a more straightforward, visual and fine-grained way; and how it can simultaneously capture professional interactions at different levels of analysis (e.g., individuals, teams, units, organizations). We conclude by looking forward and setting up several avenues for future research.

### **Introduction**

Given the complexity and rapid change that characterizes work and working environments in our advanced knowledge society, personal capacities for professional growth and continuous learning are crucial for professionals. Yet, in many cases a traditional cognitive approach to professional learning does not suffice any more, that is, cumulative acquisition of knowledge and augmentation of expertise by an individual. In other words, professionals in and around the workplace can no longer solely rely on their individual competencies (Tynjälä, 2008). To cope with changing requirements and complicated professional problems, professionals must increasingly share their knowledge and engage in collaborative activities. As a response, both practice and research are paying increasing attention to the social and relational side of professional learning, reflecting the urge for professionals

to continually interact and connect (Boshuizen, Bromme, & Gruber, 2004; Hakkarainen, Palonen, Paavola, & Lehtinen, 2004). As such, professionals' learning is not only shaped by their know-what (i.e., declarative knowledge) and know-how (i.e., procedural knowledge), but also by their *know-who* (i.e., relational knowledge about who knows what) (Borgatti & Cross, 2003).

In this chapter, we set forward a social network perspective to demonstrate how this *know-who* or the relational side of professional learning can be unraveled further. Network research embraces a distinct perspective that focuses on relationships among actors, which can be individuals, work units or organizations (Brass, Galaskiewicz, Greve, & Tsai, 2004). According to a social network perspective, actors are embedded within networks of interconnected relationships that provide opportunities for and constraints on learning and development. A social network perspective attempts to capture interactions in a more straightforward, visual and fine-grained way (Borgatti, Everett, & Johnson, 2013). Namely, the key assumption underlying a network perspective is that the patterns and quality of social relationships (i.e. networks) offer a valuable framework to examine how, whether and to what degree interaction takes place. As such, taking a network perspective on professional learning entails that how individuals and organizations learn and develop is significantly affected by the way they are tied into a larger web of social connections (Wasserman & Faust, 1994). This perspective differs from traditional perspectives in that it focuses on the web of interactions that surrounds actors, rather than on individual actors in isolation.

In specific, the chapter is set up as follows: First, we demonstrate how a social network perspective offers a theoretical and methodological framework, and various tools for an in-depth examination of interactions. Second, we reflect on the added value a network perspective brings to the existing body of professional learning and development research. We hereby build on the cumulative body of research adopting a relational or social perspective on professional learning and development in and around the workplace. Then, we elaborate on social network theory and its most central ideas and approaches. Building on this framework, we look back at the existing body of studies relating networks and professional learning. We conclude by looking forward, and set up several avenues for future research taking a network perspective on professional learning.

### **The added value of a social network perspective on workplace learning and development**

Now, what does a social network perspective add? More specifically, what does a social network perspective have to offer to study professionals' learning and development in and around the workplace? We argue that a social network perspective may contribute at least in two important ways (Borgatti & Cross, 2003; Coburn & Russell, 2008; Daly, 2010; Moolenaar, 2012).

First, social network theory provides a powerful, analytical framework and mechanisms that allow for a detailed investigation of the nature, antecedents, and outcomes of interactions (for reviews see Borgatti & Foster, 2003; Brass, Labianca, Mehra, Halgin, & Borgatti, 2014). Through webs of relationships or ‘networks’, professionals and organizations can exchange knowledge, information, materials and other resources regarding their practice. A social network perspective foregrounds the importance of social interactions for achieving individual and collective learning. To date, a solid framework has developed, comprising theoretical concepts such as structural holes (Burt, 1992), closeness centrality (Freeman, 1979), structural equivalence (Lorrain & White, 1971), and the strength of ties (Granovetter, 1973). Using this framework, social network studies have related professionals’ relationships or network position to significant outcomes such as leadership (e.g., Carter, DeChurch, Braun, & Contractor, 2015), employability (e.g., Gerken, Beausaert, & Segers, 2016), development (e.g., Dobrow, Chandler, Murphy, & Kram, 2012), performance (e.g., Mehra, Kilduff, & Brass, 2001; Sparrowe, Liden, Wayne, & Kraimer, 2001), and innovation (e.g., Baer, Evans, Oldham, & Boasso, 2015).

Second, research on social networks builds on a long tradition of advanced and rigorous methodology and visualization to study interactions. Social network research is multilevel by nature as it allows simultaneous investigation of different levels of analysis (e.g., teachers in schools, or employees in teams). It thereby takes into account the nested structure of data, and includes a level of analysis that is often overlooked, namely the relational level. The levels of analysis can concern, for instance, interpersonal, team, interunit, and (inter)organization level interaction (Brass et al., 2004). In other words: “by embedding individual behaviors in the pattern of their interpersonal relationships, social network analysis can capture the multilevel nature of interaction to an extent that conventional methods and measures cannot” (Moolenaar, 2012, p. 9).

A major challenge for workplace research focusing on interaction and collaboration is that it has been interpreted in a very broad sense. We will now discuss how social network research attempts to capture interactions in a more straightforward and fine-grained way. And, as such, meets several conceptual and methodological challenges posed by the existing body research; such as studies on communities of practice, organizational (shared, collaborative) learning, and professional (learning) communities (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006; Wenger, McDermott, & Snyder, 2002).

First, the growing body of research focusing on the social aspect of workplace learning has mostly concentrated on interactions in general. However, a gap in the extant literature is that most studies fail to measure professional interactions with much precision (Coburn, Russell, Kaufman, & Stein,

2012). They describe interactions as a whole by providing descriptions, for example, using frequency indications of how often they reported a certain type of interaction. Yet, they do not actually report on differences and nuances of interactions in detail (e.g., the strength and quality of different relationships). Nor do they explore the nature and constellation of interactions (e.g., the diversity and spread of interactions). Adopting a social network perspective provides a more fine-grained exploration of professional interactions, yielding a better understanding of professional learning. This more fine-grained or in-depth insight into interactions is obtained by precisely measuring e.g. the strength, frequency or quality of each relationship in a network; instead of offering an overall description of ‘the relationship in general’. We will further illustrate our point by discussing and visualizing specific research examples in the next section.

Second, professional learning research typically assumes that the locus of professional communities is set by formal boundaries (Coburn & Russell, 2008), focusing on formal organizational boundaries such as teams, departments or workplaces. Yet, a professional is often embedded in a network of relationships that span subgroups and include individuals inside and outside organizational boundaries. Professionals increasingly face a need to engage in knowledge sharing and collaboration through multi-professional networks and teams. Consequently, scholars increasingly argue to not only pay attention to bounded communities but to also include professional interactions across boundaries of communities (Hodkinson, Biesta, & James, 2008; Wenger, Trayner, & de Laat, 2011). A social network perspective allows simultaneous examination of individuals and the (sub)units they are nested in (e.g., professionals in functional teams), within and across organizational boundaries.

Third, traditional professional learning research has few techniques or tools at its disposal to visualize interactions in detail. Social network analysis provides a variety of tools and techniques to reveal partially hidden or informal social structures and relationships (de Laat & Schreurs, 2013; Hakkarainen, Hytönen, Vekkaïla, & Palonen, 2017). Recent work has extensively demonstrated the use of straightforward network visuals to promote and support professional learning processes of individuals and organizations (Hogan, Carrasco, & Wellman, 2007; Van Waes & Van den Bossche, 2020). Visualization of interactions have not only proven useful for scientific purposes, but are also a valuable tool to translate findings to practice; for example, to design interventions or when giving feedback on interactional data to practitioners, policy makers or managers (Cross, Singer, Colella, Thomas, & Silverstone, 2010).

Fourth, a network perspective enables to examine interactions taking into account the multiple levels at stake. Network analysis may concurrently consider the individual level, the dyadic or relational level, and the (sub)group or organizational level. For example, research questions may simultaneously

address characteristics of an individual professional, the relationships s/he has with colleagues, within or between teams in the organization.

### **Social network research and approaches**

Now that we have argued why a social network perspective offers an added value to research on workplace learning and development, we move more deeply into social network research itself and the two major research approaches that can be adopted.

In recent years social network research has been firmly established as a major research area, and the number of publications referencing social network research is exploding (Borgatti, Brass, & Halgin, 2014). Networks consist of relationships, which are termed *ties* or *links*, between actors which are called *nodes*. Actors can be individuals or collectivities, such as teams, organizations or countries. The central focus of social network theory is on relationships and interactions as an explanation of actor and network outcomes. This in contrast to traditional or individualist explanations that focus on attributes of actors that are treated as a structural and independent cases. This reflects a shift from attributes to relations; or from monadic variables (attributes of individuals) to dyadic variables (attributes of pairs of individuals), which consist of social relations and recurring interactions. The fundamental unit of analysis is the pair of actors rather than the individual (Borgatti et al., 2014).

In social network research two fundamental kinds of network research approaches can be discerned, a whole network and a personal network approach (see Figure 1). Both approaches have their specific focus and merits (Borgatti et al., 2013), and offer different insights into professional learning processes. We illustrate this point with an example: Figure 1 illustrates Holly's personal network (encircled in red), extracted from the whole network. Holly will receive different information from her professional network, compared to Lee, as she occupies a bridging position between two groups. Her boundary-crossing interactions with two different groups may offer her more learning opportunities.

In *whole network* or socio-centric research, the ties among all pairs of nodes in a bounded group are studied (e.g., all teachers within a school). A whole network approach allows researchers to analyze patterns of connections, including structural features such as centrality, density, and betweenness (cf. infra). A *personal network* or ego-network approach involves systematically mapping social relationships of focal individuals, termed *ego's*; and determining the set of nodes that ego has ties with, 'alters' (Crossley et al., 2015) (e.g., a focal teacher and his/her contacts). A personal network approach allows participants to define their own network boundaries, as it intends to investigate the

ties of individuals across boundaries of communities, practices and locations (e.g., all ties of a focal teacher within or outside the classroom, grade, or school).

<Insert Figure 1 about here>

It is important to highlight that personal network studies answer different research questions compared to whole network studies, and as such may offer different insights into how professionals learn and develop. For example, Hytönen and colleagues (2014) used a whole network approach to examine the development of energy efficient experts' professional networks in the context of a continuing professional education in an emerging field. They aimed to understand networking processes and activities at different levels, that is, among all participants, at a small-group level and at an individual level. The results revealed differences in networking activity at the different levels. Their study showed that even though the intensity of professional knowledge exchange might be low among all professionals of a multi-professional network, intensive networking activities can take place among smaller groups and between individual actors and, thus, provide important resources for participants. Later, Hytönen and colleagues (2014) adopted a personal network approach to identify the key actors (or cognitively central actors) of the energy efficiency experts' professional networks to understand why certain people achieved essential roles in knowledge exchange in multi-professional networks (Hytönen, Palonen, & Hakkarainen, 2014). The study demonstrated that in multi-professional networks, the cognitive centrality of an actor is for the most part related to social context, that is, how the expert's profile fits into the wider professional context.

Van Waes (2017) adopted a personal network approach to study university teachers' networks. A personal network approach uncovered how features of a unique university teacher's network related to variables at the individual level of analysis, such as their professional development and expertise. For instance, their work showed how experienced experts developed larger and more diverse networks, compared to experienced non-expert colleagues whose small networks showed little diversity. This shows how a network perspective allows a deeper, more fine-grained exploration of interactions. The use of a personal network perspective sheds light on the fact that professional development is not a time-age effect as experienced experts seem to lapse into arrested development, linked to limited network input. This may in turn cause isolation (Bakkenes, De Brabander, & Imants, 1999; Ericsson, 2006), resorting to interactions that require low interdependence. This arrested or stagnated development is associated with automaticity, i.e., their behavior becomes routine and reaches a stable plateau without further improvement (Ericsson, 2006).

## **Looking back: extant research on networks and professional learning**

We further underpin our thinking by discussing exemplary research using a social network perspective to shed light on professional learning. We discuss how structural network features may affect the flow of resources between people, and how relational network features influence which resources are available from what kind of people.

### **Structural network features**

A basic structural concept used in social network studies is *density*. Density characterizes the general cohesion of the network, that is, the number of existing networking ties in relation to all possible ties. This implies that the greater the proportion of ties in the network, the more dense the network is. Studies show that density increases the rate, extent and fidelity of knowledge diffusion in networks (Singh, 2005). Therefore, people with denser networks might have more diverse access to resources as they have a higher number of connections. Density is often used to examine changes taking place in networks, such as increasing or decreasing number of ties in different contexts. For instance, it is often taken for granted that professional education and training supports the development of networking ties among participants. However, recent studies have shown that the emergence of professional learning networks is not always straightforward (Hytönen, Palonen, Lehtinen, & Hakkarainen, 2014; Rienties, Nanclares, Hommes, & Veermans, 2014). The development of professional learning ties does not take place automatically or without careful planning. Deliberate efforts as well as well-developed operating models are required to support tie development (Rienties et al., 2014). This specifically seems to be the case if participants come from different backgrounds and represent heterogeneous expertise (Hytönen, Palonen, Lehtinen, et al., 2014).

Another basic structural concept is centralization in social networks. Centralization can be studied by focusing on *centrality* that characterizes an individual actor's position in a network, or *centralization* of a network structure. Centrality values indicate the amount of information that a person provides to other network members. Therefore, it has been used as indicator for actors' importance or popularity in the network (Sparrowe et al., 2001). Degree centrality is probably the best known and straightforward form of centrality. It is measured by calculating 'in-degree' and 'out-degree'. In-degree captures the amount of people who seek an individual out for resources (by peer-evaluation). The more someone is nominated as a valuable resource in the network, the higher the in-degree. Out-degree stands for the number of times an individual reaches out for resources (by self-evaluation). In professional learning studies centrality measures have been used in searching for, for example, key persons in professional networks or identifying actors' different knowledge mediating roles

(Hytönen, Palonen, & Hakkarainen, 2014; Palonen, Hakkarainen, Talvitie, & Lehtinen, 2004). Network research on newcomers' networking roles has demonstrated that newcomers and young workers can very quickly achieve a central networking position in a professional community and become important knowledge-mediating actors (Hytönen, Hakkarainen, & Palonen, 2011).

The concept of *brokerage* refers to persons who are positioned in between people who themselves are not directly connected (Burt, Kilduff, & Tasselli, 2013). These **brokers** are considered valuable networking partners as they have access to versatile repositories of knowledge through their connections (Palonen et al., 2004). Studies have revealed that in professional communities these key persons are sought for professional help, advice and support more often than other professionals (Hytönen, Palonen, & Hakkarainen, 2014). Therefore, the key persons with strong brokerage roles or knowledge mediating roles are often described as 'stars', 'hubs', 'gatekeepers of knowledge' or 'cognitive central participants'. They bridge *structural holes*, i.e. holes in the social structure that result from absent or weaker connections, by building connections and mediating knowledge across different people and different knowledge cultures (Burt, 1992). In professional communities and networks, these persons are seen to connect people facing similar professional problems; to translate knowledge across different knowledge cultures and disciplines as well as facilitating innovations, new operational models and professional practices (Sverrisson, 2001). Consequently, they have influential roles in professional learning processes for individuals and organizations. Their role as knowledge mediators seems to be especially important in emerging and developing fields in which the knowledge base is not yet stable or consolidated (Hytönen, Palonen, & Hakkarainen, 2014).

### **Relational network features**

Most extant network research focuses on the patterns or structure of networks (e.g., density, centrality). While that is important, often questions about the content, meaning and significance of relationships are less examined (Bellotti, 2014; Borgatti et al., 2014). Consequently, studies increasingly focus on examining what kinds of relational features are related to structural network qualities (Froehlich, Van Waes, & Schäfer, accepted). Many network studies have analyzed how professional connections with different qualities assist in sharing knowledge and competence.

A central concept used in examining the exchange of resources is *tie strength*. Tie strength indicates the closeness or strength of relationships by measuring for instance the frequency, intensity, reciprocity, depth, or time spent in a relationship (Marsden & Campbell, 1984). Strong ties connect to people that are close, whereas weak ties are looser contacts. Both weak and strong ties provide access to different kinds of resources and, thus, have different roles in professional conduct and

learning. For example, strong ties are instrumental in the diffusion of innovation, the transfer of tacit or complex information, as well as solving complicated problems and transferring knowledge between organizational units (Reagans & McEvily, 2003; Uzzi, 1996). Palonen et al. (2004) demonstrated that novel and complex knowledge is not easily transmitted without strong reciprocal ties. Strong social networks are also associated with increased individual and organizational performance (Burt, 1992; Hansen, 1999). In contrast, weak ties are more likely to bridge socially distant parts of a network, and thus more likely to gain access to new resources (Granovetter, 1973). They play an important role in the formation of novel ideas and non-redundant information (Levin & Cross, 2004)

An important principle guiding network formation is *homophily*. Social networks are often homogeneous in nature meaning that people tend to interact and create strong connections with people who have characteristics similar to their own, such as age, gender, educational background, equal work status or occupational group (McPherson, Smith-Lovin, & Cook, 2001). Homophily influences the information people receive, the attitudes they form, and the interactions they experience. For example, people with more diverse networks demonstrate more innovation (Kilduff & Krackhardt, 2008). Whereas homophily or similarity between people may enhance the decay of their networks, as information or knowledge may become redundant (Burt, 2000). Networks including a rich variety of people and reaching over the borders of professionals' immediate working environments and communities are especially important for coping in changing working life. *Diversity* in professional networks has been associated with expertise development with experienced professionals, whereas experienced non-experts display more relationships with people with similar characteristics (Van Waes, Van den Bossche, Moolenaar, De Maeyer, & Van Petegem, 2015).

Scholars increasingly emphasize the *quality* of the content that flows through network ties, or the 'stories' behind networks (Baker-Doyle, 2015). Researchers have adopted qualitative network techniques as they offer extensive explorative powers to examine the nature, the meaning, intensity, and depth of interactions (Fuhse & Mützel, 2011; Hollstein, 2011). Qualitative network data enable us to examine whether interactions between people involve, for example, swapping entertaining stories, exchanging basic information, or collaborating intensively on shared products. They also allow us to investigate the in- or interdependency between people, the depth of their exchanges, and the impact of their interactions on professional learning. Work by Coburn (Coburn & Russell, 2008; Coburn et al., 2012) demonstrated how the depth of interactions in networks determined the extent to which innovative learning processes succeeded. Recent research by Van Waes and colleagues (2016) showed that experienced experts had more high interdependent interactions (joint work, sharing),

compared to experienced non-experts, who described more independent (practical, organizing) talk (see Figures 2 and 3<sup>1</sup>). The quality of ties also differed in that the experienced experts had more high interdependent relationships in their networks and created more value, in comparison to their experienced colleagues with lower expertise. This shows how a network perspective allows a deeper, more fine-grained exploration of interactions. A promising venue to further uncover the social side of professional learning in its totality, is a mixed method network approach, using visuals such as the concentric circle method (Van Waes & Van den Bossche, 2020). Mixed method network research is gaining increasing terrain (Domínguez & Hollstein, 2014; Froehlich et al., accepted), and allows to address research questions that interact both structural and relational network features.

<Insert Figures 2 and 3 about here>

## **Looking forward: future research on networks and professional learning**

The existing body of network studies examining professional learning opens up new avenues for research. In this section we identify several areas ripe for further exploration.

### **Further uncovering relations between professional learning and network development**

Network ties are often implicitly regarded as ‘learning ties’. Yet, installing networks or communities does not necessarily mean that the professionals within are actually learning. Although it is often assumed indirectly, an increasing number of ties in the network does not automatically imply that new knowledge is created, that learning has taken place, or that professionals’ development is impacted. A dropped tie does not always imply that knowledge is lost, and a kept tie may not add anything or become redundant. The research designs of most studies are not designed to examine this causality between network development (social capital) and professionals’ learning (human capital) directly. Causality between the relationships under study is often funded indirectly by suggestions from the reviewed organizational literature on network development and professional learning. As such, future studies designed to examine directional links between network development and professional learning will be important. Future studies should aim to understand the nature of a learning tie, that is, when and how learning occurs in a network or a network connection. Moreover, setting up lines of longitudinal research would allow to study patterns of development of learning ties

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<sup>1</sup> The nodes in the network maps stand for the people, and the lines represent the ties or relationships between the instructor and the people in his or her personal teaching network. The length and thickness of the lines in the network maps display the interdependence, where thick and short lines stand for ties in which highly interdependent interactions were reported (i.e., sharing, joint work), whereas thin and long lines indicate ties with low interdependence (i.e., storytelling, aid and assistance). The size of the nodes represents the created value, where small nodes represent immediate and potential value, whereas large nodes stand for applied, realized or reframing value.

in professional networks. For instance, tracking networks over multiple measurement moments may help to discern profiles or patterns in the development of human and social capital. Longitudinal network data and performance measures could be collected at several time points to shed further light on, for example, how professional networks of experts unfold, and which the crucial elements are in this development over time.

### **Paying attention to the interface of education and workplaces**

Professional learning research has often focused on studying social structures, communication and knowledge flows within a single unit, such as an organization or team (Phelps, Heidl, & Wadhwa, 2012). Even though workplaces are important places for facilitating professional learning, many professionals -acting in rapidly changing working environments and dealing with complex multifaceted professional problems- need to rely on their networks reaching beyond the boundaries of their immediate workplace organizations and traditional institutional resources in order to support the development of skills and competencies (Nardi, Whittaker, & Schwartz, 2000). In this regard, recent studies emphasize the importance of deeper interactions and more strategic cooperation between educational institutions and workplaces that are often seen as separate and distant from each other (Harteis, Rausch, & Seifried, 2014; Hytönen, 2016; Hytönen & Kovalainen, 2020). New kinds of efforts to bridge and combine expertise of and stronger professional connections between educational institutions are needed to meet future educational challenges and to provide flexible possibilities for professionals to update and expand their expertise. These could generate new environments, to cultivate skills, and to share and receive critical knowledge between people with different types of expertise and professional competencies (Roxå, Mårtensson, & Alveteg, 2011).

As earlier network studies have shown, the development of comprehensive professional social networks and occupational knowledge exchange forums do not take place automatically at the learning environments organized by educational institutions and workplaces (Hytönen et al., 2014). Future network studies could help to understand better the interfaces of education and working life by providing knowledge on whether and how professional learning networks and connections are constructed and how their development could be supported in sustainable and productive way. Furthermore, future network studies should focus on examining how can learning in educational institutions and workplaces be better integrated and communication across organizational boundaries, different professional cultures and multi-professional networks facilitated. Future research could also help to overcome the question of how are individuals able to connect expertise from one specific field with the diverse expertise of their multi-professional networks. Future network studies should focus on examining the interface of education and workplaces, and more broadly multi-professional

networks crossing the boundaries of workplace communities and organizations. Potential questions to be addressed in future research are: How can learning in educational institutions and workplaces be better integrated, and the development of effective learning networks more supported? How are individuals able to connect expertise from one specific field with the diverse expertise of their multi-professional networks? Future research could also help to overcome the obstacles that are related to developing actual interconnections and relations between theoretical and practical knowledge cultures.

### **Not ‘just’ structure... Making room for network agency in professional learning**

Traditionally, network research considers changes in networks as resulting from an interplay between self-organizing properties of networks, that is, networks develop because of the properties they have and the way they are structurally embedded in the larger network (Agneessens & Wittek, 2012; Brennecke & Rank, 2016). For example, if someone offers you help, you are likely to reciprocate this tie to maintain the structural balance. Social theorists have long been discussing the relative contributions of structure and human agency to social interactions and network dynamics (Bourdieu, 1986; Giddens, 1984). Some scholars have recently questioned whether structure has overwhelmed agency in empirical network studies (Gulati & Srivastava, 2014). If actors can intentionally affect their network, one may wonder whether a causal focus on structure and self-organizing properties of networks can be justified.

Few studies have examined the relation between network agency and professional learning. Professional learning in changing working environments is to great degree embedded in deliberate creation and cultivation of network relations. Exemplary, is the increased value attributed to *networked expertise* or *relational expertise* in and around workplaces (Hakkarainen et al., 2017). Research by Van Waes and colleagues (2015; 2016) demonstrated how experts displayed higher agency, as they described to frequently re-evaluate their networks and to act intentionally on them. Apparently, they somehow ‘learned’ to manage their network. The underlying assumption in this type of studies is that individuals, who are aware of their networks and the resources and expertise residing in it, are more likely to reach out to the ‘right’ people at the ‘right’ time when presented with challenges or opportunities (Borgatti & Cross, 2003). Professionals who consciously act to strengthen their network, display what is recently coined as ‘network intentionality’ (Moolenaar et al., 2014), that is, agency in forming, maintaining, activating, and dissolving relations to gain access to resources for the mutual benefit of oneself and others, given their own cognitions of what makes for a ‘good’ network (Nardi, Whittaker, & Schwarz, 2002).

Future research should challenge traditional network research by further uncovering the role of network agency in professional learning processes. For instance, it would be valuable to link the existing body of research around information and feedback seeking at the workplace with the concept of network agency. Information and feedback seeking are often regarded as individual undertakings and the role of network or relational agency is often underexposed (Ashford & Cummings, 1983; Van den Bossche, Van Waes, & van der Rijt, 2014). This also holds for information seeking in newcomer socialization processes (Morrison, 2002; Saks, Gruman, & Cooper-Thomas, 2011). Setting up a line of research considering a network (agency) perspective would help us to answer questions like: Which are potential barriers to the development of network agency in professional contexts? Can we support feedback and information seeking by supporting professionals' network agency? What are good 'beginners' networks' for newcomers in workplaces in terms of the pre-existing properties of networks? This sheds light on another aspect of learning: How to learn to become a professional networker, and what does this entail? Which knowledge, skills or attitudes are necessary in enhancing network agency in professionals and companies?

### **Designing network interventions and using network visualizations as feedback tools**

In recent years, both practitioners and researchers have also started to consider the design of effective initiatives to enhance the value of collaboration (Cross et al., 2010; Cullen-Lester, Woehler, & Willburn, 2016). These 'network interventions' may include (research-based) coaching or consulting activities, or organizational development activities in general. Network interventions are purposeful efforts to use social network data to accelerate behavior change, to improve performance, or diffuse innovations (Valente, 2012). They are designed to support professionals and organizations to intentionally act on their networks (Cross & Thomas, 2009; Parise, 2007). In intervention research, social network methodology is used as a mapping tool to render professionals' networks visible (Jaspersen & Stein, 2019). Network visualizations can make the characteristics of professional networks available for assessment. For instance, scholars have provided evidence that professionals who learned the properties of an effective network ('teaching to see social capital'), achieved greater performance and career advancement (Burt & Ronchi, 2007).

However, the mere mapping of networks does not necessarily provide a clear path to intervention. More information is needed on how to encourage the development of strong networks when they do not exist or how to sustain them when they do (Coburn, Choi, & Mata, 2010). Preliminary research has shown that mapping informal networks using social network analysis can detect multiple (isolated) networks in organizations, connect ideas, and facilitate value creation (Cross et al., 2010; de Laat & Schreurs, 2013). Studies also showed how network agency may constitute a supporting

mechanism for network change. This work suggests that network agency can be fostered through intervention by raising network awareness (Van Waes, De Maeyer, Moolenaar, Van Petegem, & Van den Bossche, 2018; Van Waes, Moolenaar, De Maeyer, Van Petegem, & Van den Bossche, 2018). Future research into the design and timing of network interventions could yield further insight into how to foster learning through interventions in different workplaces.

### **Exploring ‘the dark side’ of professional networks**

Social network research strongly emphasizes its positive consequences. However, one should be careful to interpret all ties as prosocial and favorable (Portes, 1998). Several scholars have argued that negative or challenging relationships may be even more consequential for professional learning and may outweigh the effects of positive ties (Everett & Borgatti, 2014). Existing research sheds light on questions about how less favorable network constellations, and negative or so-called ‘difficult ties’ develop. These concern relationships in which you have to exert significant extra effort to communicate, share perspectives, or come to a common understanding about important topics (Daly, Moolenaar, Liou, Tuytens, & del Fresno, 2015), e.g. disliking ties, difficult collaboration ties, no-friend ties. These negative relationships would have greater power than positive relationships to explain workplace outcomes, which is termed ‘negative asymmetry’ (Labianca & Brass, 2006). Negative relationships are also related to organizationally relevant outcomes such as lower individual performance, decreased satisfaction with one’s group, and lower organizational attachment (Sparrowe et al., 2001; Venkataramani, Labianca, & Grosser, 2013). For instance, individuals who dislike someone are unlikely to seek advice from the person they dislike, even if that person is highly competent (Casciaro & Lobo, 2008). Evidence is mounting that negative relationship ties can create liabilities for individuals in organizations both because resources are sometimes withheld from them, but also because negative flows are directed toward them (Marineau, Labianca, & Kane, 2016). Researchers further suggests how professional culture may hinder interactions (Roxå et al., 2011), or how lack of physical proximity can make for very isolated professionals (Spillane, Shirrell, & Sweet, 2017). Studies have shown that small networks lacking diversity in composition relate to arrested development (Van Waes et al., 2015), and that perceiving little value in one’s personal network may be detrimental for expertise development (Van Waes et al., 2016).

To date, few studies have provided in-depth examinations of this less favorable sides of networks, as network surveys generally probe for positive relationships (such as friendship, trust, presence of professional ties). Future research increasing insight into the formation of negative or difficult ties may enhance our knowledge around less favorable constellations of networks for professional learning in workplaces and professional communities. For example, why some people are able to

sustain joint work interactions, and while others mostly resort to superficial interactions at the workplace and stagnate in their development. Such a line of research will also inform organizations on preventing isolation and development of negative silo's, and in supporting the development of favorable network configurations.

## References

- Agneessens, F., & Wittek, R. (2012). Where do intra-organizational advice relations come from? The role of informal status and social capital in social exchange. *Social Networks*, 34(3), 333-345. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0378873311000189>
- Ashford, S. J., & Cummings, L. L. (1983). Feedback as an individual resource: Personal strategies of creating information. *Organizational Behavior and Human Performance*, 32(3), 370-398.
- Baer, M., Evans, K., Oldham, G. R., & Boasso, A. (2015). The social network side of individual innovation. *Organizational Psychology Review*, 5(3), 191-223. doi:doi:10.1177/2041386614564105
- Baker-Doyle, K. J. (2015). Stories in networks and networks in stories: A tri-modal model for mixed-methods social network research on teachers. *International Journal of Research & Method in Education*, 38(1), 72-82. doi:10.1080/1743727X.2014.911838
- Bakkenes, I., De Brabander, C., & Imants, J. (1999). Teacher isolation and communication network analysis in primary schools. *Educational Administration Quarterly*, 35(2), 166-202. doi:10.1177/00131619921968518
- Bellotti, E. (2014). *Qualitative networks: Mixed methods in sociological research*. London: Routledge.
- Borgatti, S. P., Brass, D. J., & Halgin, D. S. (2014). Social network research: Confusions, criticisms, and controversies. In *Contemporary perspectives on organizational social networks* (Vol. 40, pp. 1-29): Emerald Group Publishing Limited.
- Borgatti, S. P., & Cross, R. (2003). A relational view of information seeking and learning in social networks. *Management Science*, 49(4), 432-445.
- Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2013). *Analyzing social networks*. Los Angeles: Sage.
- Borgatti, S. P., & Foster, P. C. (2003). The network paradigm in organizational research: A review and typology. *Journal of Management*, 29(6), 991-1013.
- Boshuizen, H. P. A., Bromme, R., & Gruber, H. (2004). On the long way from novice to expert and how travelling changes the traveller. In H. P. A. Boshuizen, R. Bromme, & H. Gruber (Eds.), *Professional learning: Gaps and transitions on the way from novice to expert* (pp. 3-8). Dordrecht: Kluwer Academic Publishers.
- Bourdieu, P. (Ed.) (1986). *Distinction: A social critique of the judgment of taste*. Cambridge, MA: Harvard University Press.
- Brass, D. J., Galaskiewicz, J., Greve, H. R., & Tsai, W. (2004). Taking stock of networks and organizations: A multilevel perspective. *The Academy of Management Journal*, 47(6), 795-817. Retrieved from <http://www.jstor.org/stable/20159624>
- Brass, D. J., Labianca, G., Mehra, A., Halgin, D. S., & Borgatti, S. P. (Eds.). (2014). *Contemporary perspectives on organizational social networks* (Vol. 40). Bingley, UK: Emerald Group Publishing Limited.
- Brennecke, J., & Rank, O. N. (2016). The interplay between formal project memberships and informal advice seeking in knowledge-intensive firms: A multilevel network approach. *Social Networks*, 44, 307-318. doi:<http://dx.doi.org/10.1016/j.socnet.2015.02.004>
- Burt, R. S. (1992). *Structural holes: The social structure of competition*. Cambridge, MA: Harvard University Press.

- Burt, R. S. (2000). Decay functions. *Social Networks*, 22(1), 1-28.
- Burt, R. S., Kilduff, M., & Tasselli, S. (2013). Social network analysis: Foundations and frontiers on advantage. *Annual Review of Psychology*, 64(1), 527-547. doi:10.1146/annurev-psych-113011-143828
- Burt, R. S., & Ronchi, D. (2007). Teaching executives to see social capital: Results from a field experiment. *Social Science Research*, 36(3), 1156-1183. doi:<http://dx.doi.org/10.1016/j.ssresearch.2006.09.005>
- Carter, D. R., DeChurch, L. A., Braun, M. T., & Contractor, N. S. (2015). Social network approaches to leadership: An integrative conceptual review. *Journal of Applied Psychology*, 100(3), 597-622. doi:10.1037/a0038922
- Casciaro, T., & Lobo, M. S. (2008). When competence is irrelevant: The role of interpersonal affect in task-related ties. *Administrative Science Quarterly*, 53(4), 655-684. doi:10.2189/asqu.53.4.655
- Coburn, C., Choi, L., & Mata, W. (2010). "I would go to her because her mind is math". Network formation in the context of a district-based mathematics reform. In A. J. Daly (Ed.), *Social network theory and educational change* (pp. 33-50). Cambridge, MA: Harvard Education Press.
- Coburn, C., & Russell, J. L. (2008). District policy and teachers' social networks. *Education Evaluation and Policy Analysis*, 30(3), 203-235.
- Coburn, C., Russell, J. L., Kaufman, J. H., & Stein, M. K. (2012). Supporting sustainability: Teachers' advice networks and ambitious instructional reform. *American Journal of Education*, 119(1), 137-182.
- Cross, R., Singer, J., Colella, S., Thomas, R. J., & Silverstone, Y. (2010). *The organizational network fieldbook: Best practices, techniques, and exercises to drive organizational innovation and performance*. San Francisco: Jossey-Bass.
- Cross, R., & Thomas, R. J. (2009). *Driving results through social networks: How top organizations leverage networks for performance and growth*. San Francisco: Jossey-Bass.
- Crossley, N., Bellotti, E., Edwards, G., Everett, M. G., Koskinen, J., & Tranmer, M. (2015). *Social network analysis for ego-nets*. London: SAGE Publications Ltd.
- Cullen-Lester, K. L., Woehler, M. L., & Willburn, P. (2016). Network-based leadership development: A guiding framework and resources for management educators. *Journal of Management Education*. doi:10.1177/1052562915624124
- Daly, A. J. (Ed.) (2010). *Social network theory and educational change*. Cambridge, Massachusetts: Harvard Education Press.
- Daly, A. J., Moolenaar, N. M., Liou, Y.-H., Tuytens, M., & del Fresno, M. (2015). Why so difficult? Exploring negative relationships between educational leaders: The role of trust, climate, and efficacy. *American Journal of Education*, 122(1), 1-38. doi:10.1086/683288
- de Laat, M., & Schreurs, B. (2013). Visualizing informal professional development networks: Building a case for learning analytics in the workplace. *American Behavioral Scientist*, 57(10), 1421-1438. doi:10.1177/0002764213479364
- Dobrow, S. R., Chandler, D. E., Murphy, W. M., & Kram, K. E. (2012). A review of developmental networks. *Journal of Management*, 38(1), 210-242. doi:10.1177/0149206311415858
- Domínguez, S., & Hollstein, B. (2014). *Mixed methods social networks research: Design and applications*. Cambridge: Cambridge University Press.
- Ericsson, K. A. (2006). The influence of experience and deliberate practice on the development of superior expert performance. In K. A. Ericsson, N. Charness, R. R. Hoffman, & P. J. Feltovich (Eds.), *The Cambridge handbook of expertise and expert performance* (pp. 685-706). New York: Cambridge University Press.
- Everett, M., & Borgatti, S. P. (2014). Networks containing negative ties. *Social Networks*, 38, 111-120.

- Freeman, L. C. (1979). Centrality in social networks conceptual clarification. *Social Networks*, 1(3), 215-239.
- Froehlich, D., Van Waes, S., & Schäfer, H. (accepted). Linking quantitative and qualitative network approaches: A review of mixed methods social network analysis in education research. *Review of Research in Education*(Special issue: Emergent Approaches for Education Research.).
- Fuhse, J., & Mützel, S. (2011). Tackling connections, structure, and meaning in networks: Quantitative and qualitative methods in sociological network research. *Quality & Quantity*, 45(5), 1067-1089. doi:10.1007/s11135-011-9492-3
- Gerken, M., Beausaert, S., & Segers, M. (2016). Working on professional development of faculty staff in higher education: Investigating the relationship between social informal learning activities and employability. *Human Resource Development International*, 19(2), 135-151. doi:10.1080/13678868.2015.1116241
- Giddens, A. (1984). *The constitution of society: Outline of the theory of structuration*. Berkeley and Los Angeles: University of California Press.
- Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360-1380.
- Gulati, R., & Srivastava, S. B. (2014). Bringing agency back into network research: Constrained agency and network action. In D. J. Brass, G. J. Labianca, A. Mehra, D. S. Halgin, & S. P. Borgatti (Eds.), *Contemporary perspectives on organizational social networks (Research in the sociology of organizations)* (Vol. 40, pp. 73-93). Bingley, UK: Emerald Group Publishing Limited.
- Hakkarainen, K., Hytönen, K., Vekkaila, J., & Palonen, T. (2017). Networked expertise, relational agency, and collective creativity. In A. Edwards (Ed.), *Working relationally in and across practices: A cultural-historical approach to collaboration* (pp. 133-152). Cambridge: Cambridge University Press.
- Hakkarainen, K., Palonen, T., Paavola, S., & Lehtinen, E. (2004). *Communities of networked expertise: Professional and educational perspectives*. Amsterdam: Elsevier.
- Halgin, D. S., & Borgatti, S. P. (2012). An introduction to personal network analysis and tie churn statistics using E-NET. *Connections*, 32(1), 37-48.
- Hansen, M. T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, 44(1), 82-111.
- Harteis, C., Rausch, A., & Seifried, J. (2014). Discourses on professional learning: On the boundary between learning and working. In C. Harteis, A. Rausch, & J. Seifried (Eds.), *Discourses on professional learning: Professional and practice-based learning* (pp. 1-7). Dordrecht: Springer Netherlands.
- Hodkinson, P., Biesta, G., & James, D. (2008). Understanding learning culturally: Overcoming the dualism between social and individual views of learning. *Vocations and Learning*, 1(1), 27-47. doi:10.1007/s12186-007-9001-y
- Hogan, B., Carrasco, J. A., & Wellman, B. (2007). Visualizing personal networks: Working with participant-aided sociograms. *Field Methods*, 19(2), 116-144.
- Hollstein, B. (2011). Qualitative approaches. In J. Scott & P. J. Carrington (Eds.), *The SAGE Handbook of Social Network Analysis* (pp. 404-416). London: Sage Publications Ltd.
- Hytönen, K. (2016). *Bridging academic and working life expertise in continuing professional education: A social network perspective*. University of Turku, Turku. (ser. B, tom. 424)
- Hytönen, K., Hakkarainen, K., & Palonen, T. (2011). Young diplomats' socialization to the networked professional cultures of their workplace communities. *Vocations and Learning*, 4(3), 253-273. doi:10.1007/s12186-011-9061-x
- Hytönen, K., & Kovalainen, A. (2020). Vocational education goes to industry: Future skills at work derive from novel models of cooperation. In S. Poutanen, P. Rouvinen, & A. Kovalainen (Eds.), *Digital work and the platform economy: Understanding tasks, skills and capabilities in the new era* (pp. 77-95). New York: Routledge.

- Hytönen, K., Palonen, T., & Hakkarainen, K. (2014). Cognitively central actors and their personal networks in an energy efficiency training program *Frontline Learning Research*, 2(2).
- Hytönen, K., Palonen, T., Lehtinen, E., & Hakkarainen, K. (2014). Does academic apprenticeship increase networking ties among participants? A case study of an energy efficiency training program. *Higher Education*, 1-18. doi:10.1007/s10734-014-9754-9
- Jaspersen, L. J., & Stein, C. (2019). Beyond the matrix: Visual methods for qualitative network research. *British Journal of Management*, 0(0). doi:10.1111/1467-8551.12339
- Kilduff, M., & Krackhardt, D. (2008). *Interpersonal networks in organizations: Cognition, personality, dynamics, and culture*. Cambridge Cambridge University Press.
- Labianca, G., & Brass, D. J. (2006). Exploring the social ledger: Negative relationships and negative asymmetry in social networks in organizations. *The Academy of Management Review*, 31(3), 596-614. doi:10.2307/20159231
- Levin, D. Z., & Cross, R. (2004). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. *Management Science*, 50(11), 1477-1490. Retrieved from <http://www.jstor.org/stable/30047959>
- Lorrain, F., & White, H. C. (1971). Structural equivalence of individuals in social networks. *The Journal of Mathematical Sociology*, 1(1), 49-80. doi:10.1080/0022250X.1971.9989788
- Marineau, J. E., Labianca, G., & Kane, G. C. (2016). Direct and indirect negative ties and individual performance. *Social Networks*, 44, 238-252. doi:<http://dx.doi.org/10.1016/j.socnet.2015.09.003>
- Marsden, P. V., & Campbell, K. E. (1984). Measuring tie strength. *Social Forces*, 63, 482-501. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=5285211&site=ehost-live>
- McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, 27, 415-444.
- Mehra, A., Kilduff, M., & Brass, D. J. (2001). The social networks of high and low self-monitors: Implications for workplace performance. *Administrative Science Quarterly*, 46(1), 121-146. doi:10.2307/2667127
- Moolenaar, N. M. (2012). A social network perspective on teacher collaboration in schools: Theory, methodology, and applications. *American Journal of Education*, 119(1), 7-39. doi:10.1086/667715
- Moolenaar, N. M., Daly, A., Cornelissen, F., Liou, Y.-H., Caillier, S., Riordan, R., . . . Cohen, N. A. (2014). Linked to innovation: Shaping an innovative climate through network intentionality and educators' social network position. *Journal of Educational Change*, 15(2), 99-123. doi:10.1007/s10833-014-9230-4
- Morrison, E. W. (2002). Newcomers' relationships: The role of social network ties during socialization. *Academy of Management Journal*, 45(6), 1149-1160. doi:10.2307/3069430
- Nardi, B. A., Whittaker, S., & Schwartz, H. (2000). It's not what you know, it's who you know: Work in the information age. *First Monday*, 5(5). Retrieved from <http://firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/viewArticle/741>
- Nardi, B. A., Whittaker, S., & Schwarz, H. (2002). NetWORKers and their activity in intensional networks. *Computer Supported Cooperative Work*, 11(1), 205-242. doi:10.1023/a:1015241914483
- Palonen, T., Hakkarainen, K., Talvitie, J., & Lehtinen, E. (2004). Network ties, cognitive centrality, and team interaction within a telecommunication company. In H. P. A. Boshuizen, R. Bromme, & H. Gruber (Eds.), *Professional learning: Gaps and transitions on the way from novice to expert* (pp. 271-294). Dordrecht: Kluwer Academic Publishers.

- Parise, S. (2007). Knowledge management and human resource development: An application in social network analysis methods. *Advances in Developing Human Resources*, 9(3), 359-383. doi:10.1177/1523422307304106
- Phelps, C., Heidl, R., & Wadhwa, A. (2012). Knowledge, networks, and knowledge networks. *Journal of Management*, 38(4), 1115-1166. doi:10.1177/0149206311432640
- Portes, A. (1998). Social capital: Its origins and applications in modern sociology. *Annual Review of Sociology*, 24(1), 1. Retrieved from <http://search.ebscohost.com/login.aspx?direct=true&db=afh&AN=1056932&site=ehost-live>
- Reagans, R., & McEvily, B. (2003). Network structure and knowledge transfer: The effects of cohesion and range. *Administrative Science Quarterly*, 48(2), 240-267. doi:10.2307/3556658
- Rienties, B., Nanclares, N. H., Hommes, J., & Veermans, K. (2014). Understanding emerging knowledge spillovers in small-group learning settings: a networked learning perspective. In V. Hodgson, D. McConnell, & M. De Laat (Eds.), *Exploring the theory, pedagogy and practice of networked learning* (pp. 127-147). The Netherlands: Springer.
- Roxå, T., Mårtensson, K., & Alveteg, M. (2011). Understanding and influencing teaching and learning cultures at university: A network approach. *Higher Education*, 62(1), 99-111. doi:10.1007/s10734-010-9368-9
- Saks, A. M., Gruman, J. A., & Cooper-Thomas, H. (2011). The neglected role of proactive behavior and outcomes in newcomer socialization. *Journal of Vocational Behavior*, 79(1), 36-46.
- Singh, J. (2005). Collaborative networks as determinants of knowledge diffusion patterns. *Management Science*, 51(5), 756-770.
- Sparrowe, R. T., Liden, R. C., Wayne, S. J., & Kraimer, M. L. (2001). Social networks and the performance of individuals and groups. *The Academy of Management Journal*, 44(2), 316-325. doi:10.2307/3069458
- Spillane, J. P., Shirrell, M., & Sweet, T. M. (2017). The elephant in the schoolhouse: The role of propinquity in school staff interactions about teaching. *Sociology of Education*, 0(0), 0038040717696151. doi:doi:10.1177/0038040717696151
- Stoll, L., Bolam, R., McMahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of Educational Change*, 7(4), 221-258. doi:10.1007/s10833-006-0001-8
- Sverrisson, Á. (2001). Translation networks, knowledge brokers and novelty construction: Pragmatic environmentalism in Sweden. *Acta Sociologica*, 44(4), 313-327. doi:10.1177/000169930104400403
- Tynjälä, P. (2008). Perspectives into learning at the workplace. *Educational Research Review*, 3, 130-154.
- Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: The network effect. *American Sociological Review*, 61(4), 674-698. doi:10.2307/2096399
- Valente, T. W. (2012). Network interventions. *Science*, 337(6090), 49-53. doi:10.1126/science.1217330
- Van den Bossche, P., Van Waes, S., & van der Rijt, J. (2014). Feedback, development, and social networks. In K. Kraiger, J. Passmore, N. R. dos Santos, & S. Malvezzi (Eds.), *The Wiley Blackwell handbook of the psychology of training, development, and performance improvement* (pp. 503-520). London: Wiley Blackwell.
- Van Waes, S. (2017). *The ties that teach: Teaching networks in higher education*. Doctoral dissertation, University of Antwerp, Belgium.
- Van Waes, S., De Maeyer, S., Moolenaar, N. M., Van Petegem, P., & Van den Bossche, P. (2018). Strengthening networks: A social network intervention among higher education teachers. *Learning and Instruction*, 53, 34-49. doi:<https://doi.org/10.1016/j.learninstruc.2017.07.005>

- Van Waes, S., Moolenaar, N., De Maeyer, S., Van Petegem, P., & Van den Bossche, P. (2018). Linked to professional development: Designing a network intervention to foster informal networks in a formal program. In K. J. Baker-Doyle & S. A. Yoon (Eds.), *Networked by design: Interventions for teachers to develop social capital* (pp. 44-64). New York: Routledge.
- Van Waes, S., Moolenaar, N. M., Daly, A. J., Heldens, H. H. P. F., Donche, V., Van Petegem, P., & Van den Bossche, P. (2016). The networked instructor: The quality of networks in different stages of professional development. *Teaching and Teacher Education, 59*, 295-308. doi:<http://dx.doi.org/10.1016/j.tate.2016.05.022>
- Van Waes, S., & Van den Bossche, P. (2020). Around and around: The concentric circles method as a powerful tool to collect mixed method network data. In D. Froehlich, M. Rehm, & B. Rienties (Eds.), *Mixed Methods Social Network Analysis* (pp. 159-174). London: Routledge.
- Van Waes, S., Van den Bossche, P., Moolenaar, N. M., De Maeyer, S., & Van Petegem, P. (2015). Know-who? Linking faculty's networks to stages of instructional development. *Higher Education, 70*(5), 807-826. doi:10.1007/s10734-015-9868-8
- Venkataramani, V., Labianca, G., & Grosser, T. (2013). Positive and negative workplace relationships, social satisfaction, and organizational attachment. *Journal of Applied Psychology, 98*(6), 1028-1039. doi:<https://doi.org/10.1037/a0034090>
- Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge: University Press.
- Wenger, E., McDermott, R., & Snyder, W. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Cambridge, USA: Harvard Business School Press.
- Wenger, E., Trayner, B., & de Laat, M. (2011). *Promoting and assessing value creation in communities and networks: A conceptual framework*. Heerlen: Open University.

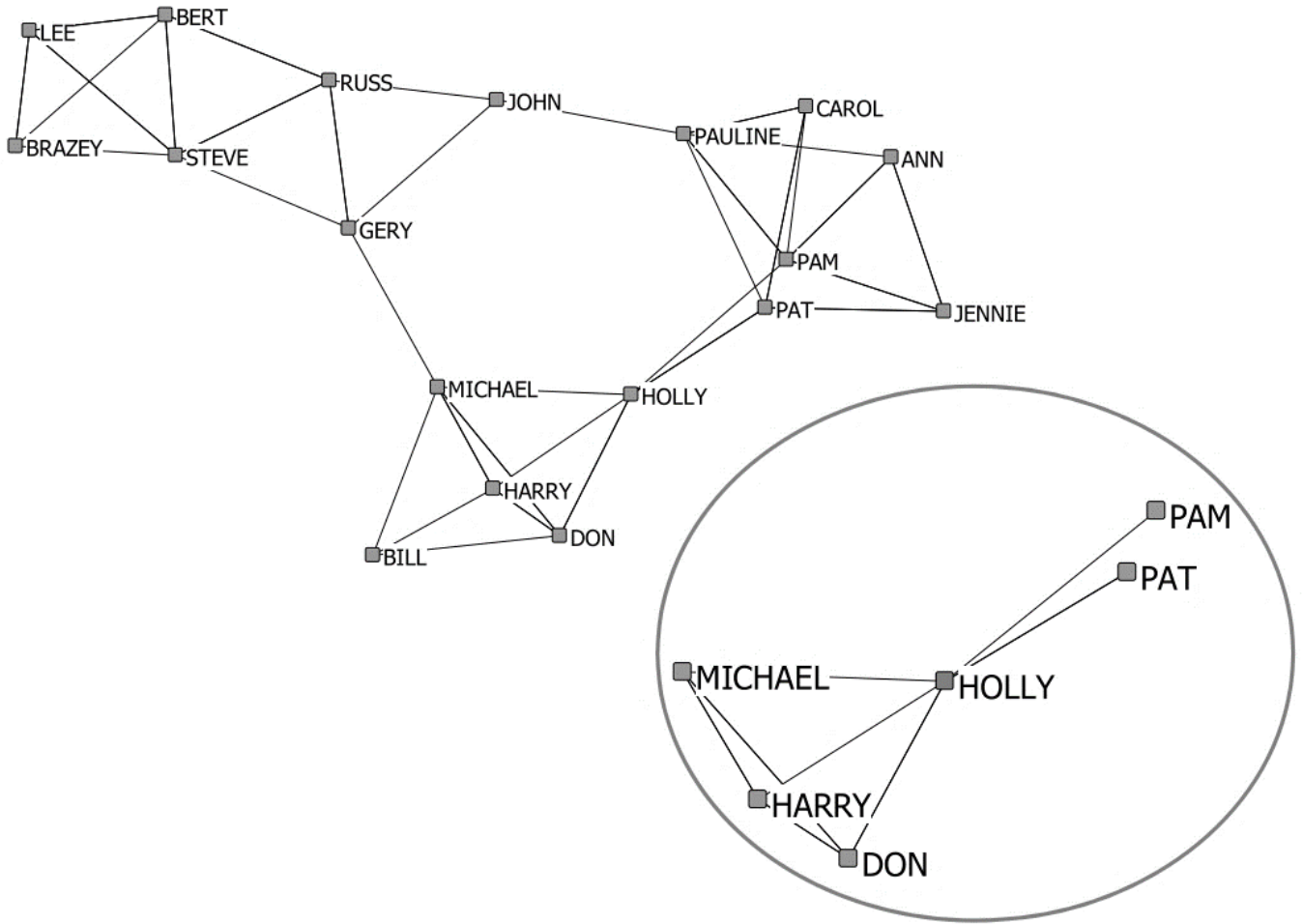


Figure 1: Example of a personal network (encircled) extracted from a whole network (Halgin & Borgatti, 2012, p. 38)

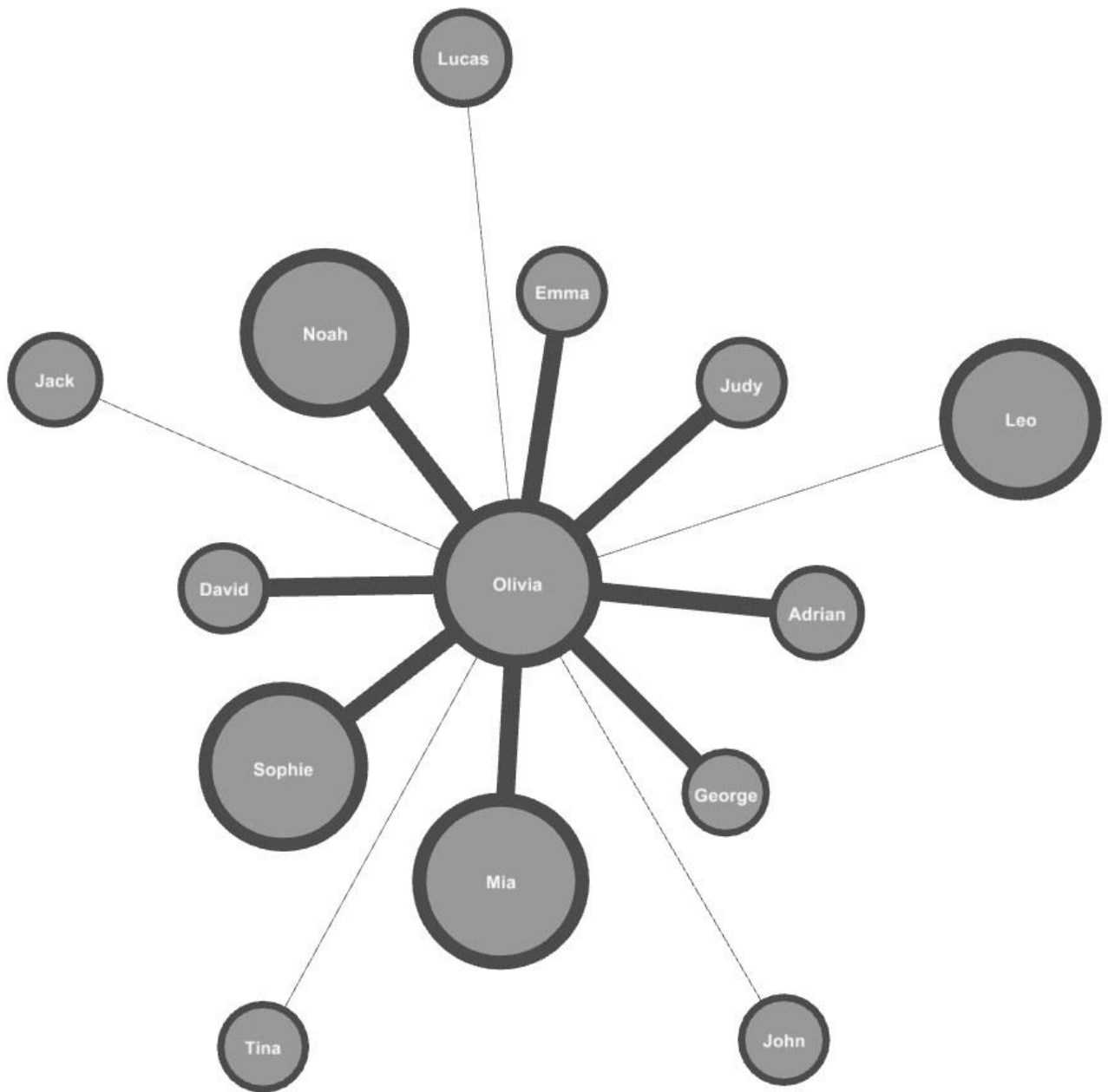


Figure 2: Personal network map of experienced expert teacher

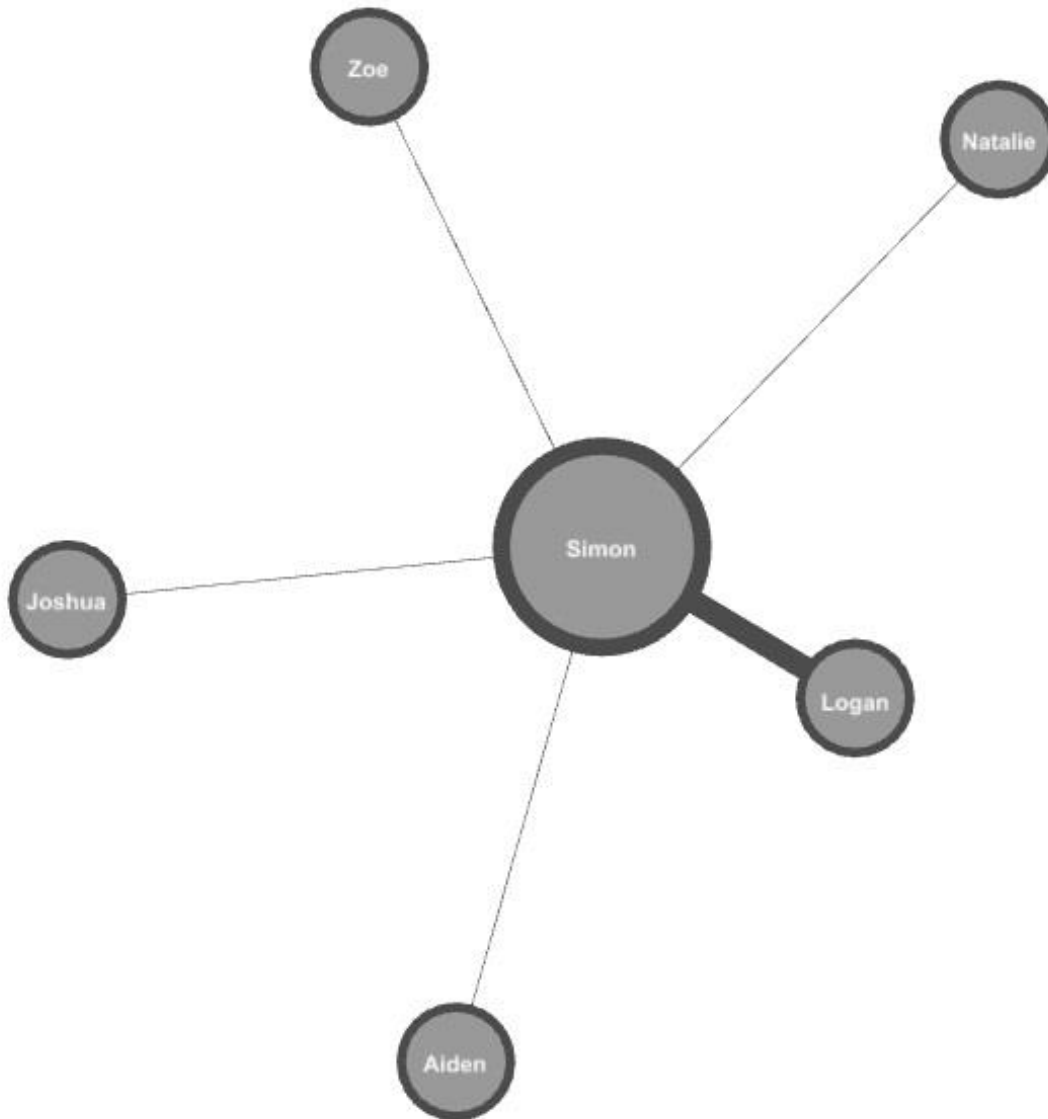


Figure 3: Personal network map of experienced non-expert teacher