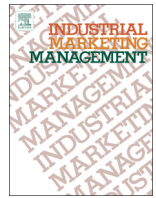




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Contagion and learning in business networks

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ABSTRACT

The purpose of this study is to examine network learning through the application of contagion theories. The transmission of knowledge, sharing of resources, and facilitation of learning through contagion has interested both business-to-business and economic geography researchers. This study responds to calls in both research traditions for research into knowledge and learning at the level of an interfirm network. More specifically, it focuses on developing an understanding of how the contagion of knowledge and ideas and the co-ordination of activities within a network takes place. We achieve this by drawing upon research in both network relationships dynamics and learning processes to investigate the causal mechanisms that drive contagion. We focus on two types of contagion: contagion by cohesion (i.e. the presences and closeness of direct contact with others in the network), and contagion by structural equivalence (i.e. where influence is related to the structural patterns of relationships in the network). We also identify two key mechanisms that act as a barrier to such contagion: isolation and immunity. We explore the implications of these findings for network learning opportunities, specifically learning-by-doing, learning-by-using, and learning-by-interacting.

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1. Introduction

Between the years 541–542 CE, a pandemic (which would again later contribute to the Black Death of the 14th century) swept across the Eastern Roman (Byzantine) Empire. It is estimated that 40% of the citizens of Constantinople were killed by the disease, which is thought to have been spread by rats and fleas hidden inside the grain distribution network. The rapid spread of disease experienced by the citizens of Constantinople owed its virulence to the highly centralized and controlled grain infrastructure that comprised of public granaries and grain ships; this ensured that the unfortunate populous were highly exposed to the virus.

Placed in a business context, the transmission of knowledge, sharing of resources, and facilitation of innovation through co-location and contagion has interested both business-to-business and economic geography researchers. In economic geography, the notion of learning in networks sees knowledge as a product of translation, in which the alignment of resources, such as bodies, machines, communication technologies, text (and so on), needs to be stabilized and made valid to achieve something and enable action (Muller, 2015). Innovativeness, or the openness of the firm to new ideas, relates learning and innovation processes beyond the level of the individual alone (Hurley & Hult, 1998). Both research traditions therefore have an intrinsic interest in the

creation and development of networks, defined as nodes (with their associated activities and functions), connections (i.e. communication channels, resource flows, infrastructure) and the intensity of the transfer of resources (e.g. goods, people, or ideas: Lambooy, 2004).

Research in business-to-business networks has highlighted issues such as continuity and the presence or absence of connections (Håkansson & Ford, 2002). In the economic geography literature, Bartsch, Ebers, and Maurer (2013) argue that the structure and quality of project team members' social ties with their intra-organisational colleagues (i.e. their social capital) affects their opportunities, motivation and ability to share knowledge across project boundaries. As Grabher and Ibert (2006) point out, for economic geography a relational understanding of embeddedness (associated mainly with the work of Granovetter) provided a popular metaphor around which the empirics of regional performance could be built. Contrary to much of the prevailing literature, Geldes, Felzensztein, Turkina, and Durand (2015) found that geographical proximity was less relevant to cooperation in networks than either cognitive and/or social proximity. They cite the need for more research in understanding which types of activity have a greater impact on the creation of active externalities and benefits for networks. In addition, and regardless of geographical proximity, Fitjar and Rodríguez-Pose (2015) highlight the importance of local context in understanding firm behaviour and networking activity.

Therefore the metaphor of the spread of a major epidemic seems appropriate, as it allows us to highlight both the structural and configuration aspects of contagion and social network analysis (as per Burt, 1987), with concepts such as structural equivalence and the notion of

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the individual as embedded within a wider network of institutions (as per [Granovetter, 1985](#)), and concepts such as cohesion. By drawing upon both of these research traditions, we address a concern in the field of economic geography that a focus on the network governance approach and notions of embeddedness alone bypasses alternative (and older) traditions such as the social network approach ([Grabher, 2006](#)). It also allows us to explore not just what [Grabher and Ibert \(2006\)](#) call communality (robust and thick ties that are firmly rooted in personal familiarity and social coherence) but also sociality (re-activating ties through ongoing face-to-face encounters) and connectivity (the task oriented subject matter of a project).

The use of metaphor (in this instance we use the metaphor of the spread of disease) has a long tradition in the study of organisations. [Morgan's \(1986\)](#) seminal work used several metaphors to develop an understanding of organisations related to philosophical and sociological theory ([Morgan, 2011](#)). [Morgan \(2011\)](#) maintains that in the use of metaphors, we generate partial truths that may nevertheless resonate and offer genuine understanding even if they are not strictly or literally true. We use "... *what we know* to negotiate and understand the unknown" ([Morgan, 2011: 463](#), emphasis in the original). In particular, he suggests that new metaphors are needed for understanding the shift in organisational forms from hierarchical structures to flat networks ([Oswick & Grant, 2015](#)). We see the metaphor of contagious disease as offering potentially useful and relevant insights into learning processes in such 'flat network' structures.

Research in economic geography has highlighted the role of networks in the co-ordination and transmission of knowledge and the diffusion of innovation ([Lambooy, 2004](#)). Knowledge is diffused through patterns that are either based on spatial contiguity or on a-spatial networks ([Maggioni, Nosvelli, & Uberti, 2007](#)), or what [Muller \(2015\)](#) terms topographical space (or metric distance) versus topological space (where distance and scale are functions of the relations in a network). However, "the economic geography literature [has been] mainly concerned with firm innovation" rather than individual knowledge and learning ([Rutten, 2016: 15](#)). [Lambooy \(2004\)](#) identifies contagion as a key approach in understanding diffusion in networks, and highlights the strengthening of already developed ties and structures (i.e. embedded relations) as necessary for the formation of a successful regional innovation system. They suggest examining diffusion and the distribution of information or knowledge as a field-process in which interpersonal contacts are viewed as part of a field of general forces, where such forces could include trust and embeddedness ([Lambooy, 2004](#)).

[Bartsch et al. \(2013\)](#) found that strong relational and cognitive ties among project teams and their colleagues outside the project can be an important source of continuity and organisational stability in the discontinuous setting of project-based organisations. [Walls and Paquin \(2015\)](#) call for more research on how shaping and sharing a vision takes place within a network. They recognise that intermediaries play an important role in this process, as they spur institutionalisation by helping to develop shared norms of action, reducing the cognitive barriers and the mental distance between those concerned. They go on to suggest that future research should explore the nature of relationships, rather than resources, in the network ([Walls & Paquin, 2015](#)). This paper responds to such calls for research that addresses the everyday relationships and social practices that facilitate learning, particularly in temporary sites of production and networks of actors ([Bathelt & Glückler, 2011](#); [Bathelt & Spiegel, 2012](#); [Certomà, 2011](#); [Ettlinger, 2003](#); [Faulconbridge, 2007](#); [Giuliani, 2007](#); [Jones, 2014](#); [Jones & Murphy, 2011](#); [Murphy, 2006](#); [Pain, 2008](#); [Rutten, 2016](#); [Watson, 2012](#); [Yeung, 2005](#)), as part of the broader relational turn in economic geography spanning the last two decades ([Amin, 2001](#); [Amin & Thrift, 2000](#); [Bathelt & Glückler, 2003](#); [Boggs & Rantisi, 2003](#); [Crang, 1997](#); [Jones & Murphy, 2011](#); [Yeung, 2005](#)).

[Iyengar, Van den Bulte, and Choi \(2011\)](#), discussing the mechanisms of social contagion, propose that contagion research is moving from investigating *whether* to *why* contagion is at work. They combined

network with co-location data to examine how different mechanisms may be operating over different kinds of ties and for different kinds of actors (nodes). Thus, it was not simply the presence or absence of contagion, but the way in which contagion operated that was of interest. They therefore advise researchers to investigate the causal mechanisms driving contagion, as understanding such mechanisms is important both theoretically and managerially. This gap is also highlighted by [Jones and Murphy \(2011:2\)](#) who maintain that "practice-oriented research represents an important basis from which to develop economic geographical theories". This is later re-emphasised by [Jones \(2014:11\)](#) who suggests that "learning within firms, clusters, and industries is driven by more than simply the aggregation of individual sources of human capital; it is instead the product of collectively legitimated (everyday) social practices wherein and through which knowledge is embedded". The advantage of such an approach, [Jones](#) maintains, is that it opens up fruitful new potential for theorising the nature of agency in the space economy.

We address the gap identified by [Iyengar et al. \(2011\)](#) by examining not just whether, but also *how* the transmission of knowledge, sharing of resources, and facilitation of innovation through co-location and contagion operated between members in two business network case studies. By focusing on the social practices of the network members, we embed knowledge development and dissemination within the legitimised social practices observed, as extolled by [Jones \(2014\)](#). This allows us to explore how contagion might help or hinder learning processes in newer organisational forms, such as flat networks ([Oswick & Grant, 2015](#)). Our contribution is to identify and explore several mechanisms that facilitate knowledge dissemination and learning processes in networks through behavioural and attitudinal changes in network members in order to understand how shaping and sharing a vision takes place ([Walls & Paquin, 2015](#)). We do this by using metaphor in identifying and exploring two types of contagion: contagion by cohesion (i.e. the presences and closeness of direct contact with others in the network) and contagion by structural equivalence (i.e. where influence is related to the structural patterns of relationships in the network). As suggested by [Iyengar et al. \(2011\)](#), we not only investigate the causal mechanisms driving these two types of contagion, but we also identify two key causal mechanisms that act as a barrier to such contagion: isolation and immunity. The paper is structured as follows. We begin with an overview of contagion theories, where we evaluate their usefulness in understanding learning in a network context, followed by a discussion of learning in networks. The remainder of the study empirically examines the application of contagion theories to network learning.

2. Contagion theories

A number of theories have attempted to explain the communication practices of networks (such as Cognitive Theories, Consistency Theories, Homophily, and Theories of Social Capital). We employ Contagion Theories as they are arguably the most developed and understood mechanism used to examine the emergence of communications networks ([Monge & Contractor, 2003](#)). Contagion theories are a family of related theories that examine how exposure or contact may lead to social influence (Social Information Processing), imitation and mimetic behaviour (Social Learning Theory and Institutional Theory), and similarity in positions and roles within the network structure (Structural Theory of Action: [Monge & Contractor, 2003](#)).

Contagion Theories are premised on a disease metaphor, where actors are *exposed* to attitudes, behaviour and information ([Burt, 1980](#)). They seek to explain network members' knowledge, attitudes and behaviour based on this exposure to the attitudes, information and behaviour of others ([Rogers & Kincaid, 1981](#)). The extent of this exposure will determine the alignment between actors' beliefs and attitudes ([Carley, 1991](#)), and is defined as a *convergence* model of communication ([Rogers & Kincaid, 1981](#)). Convergence of attitudes and understanding

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