**Entrepreneurial Attitudes as Drivers of Managers’ Boundary-Spanning Knowledge Ties in the Context of High-tech Clusters***[[1]](#footnote-1)\**

*by Irena Schierjott, Julia Brennecke and Olaf N. Rank*

*This study investigates the role of entrepreneurial attitudes for SME managers’ tendency to create knowledge acquisition ties with managers of other organizations in the context of an institutionalized high-tech cluster. We examine how innovation orientation, perceived personal control, need for achievement, and self-esteem influence boundary-spanning tie creation as a crucial facet of entrepreneurial behavior in the cluster context. Applying exponential random graph models (ERGMs) to survey data collected in a German biotech cluster, we find that innovation orientation and perceived personal control positively affect managers’ tendency to rely on interpersonal ties to gather knowledge. In contrast, need for achievement and self-esteem are negatively related to knowledge tie creation.*

**Entrepreneurial Attitudes as Drivers of Managers’ Boundary-Spanning Knowledge Ties in the Context of High-tech Clusters**

# *Introduction*

In high-tech industries such as biotech firms often co-locate in regional clusters in order to benefit from knowledge spillovers and thus innovation advantages typically associated with economies of agglomeration (e.g., [Marshall 1920](#_ENREF_70); [Porter 2000](#_ENREF_104); [Saxenian 1994](#_ENREF_119)). However, by now researchers largely agree that knowledge does not simply spill over from one organization to another located nearby. In other words, co-location is not a sufficient condition for knowledge transfer to occur (e.g., [Boschma 2005](#_ENREF_16); [Presutti, Boari, and Majocchi 2011](#_ENREF_108)). Network ties, such as firm-level alliances and interpersonal connections among managers, have been identified as a critical mechanism enabling the transfer of knowledge in the context of regional clusters (e.g., [Casper 2007](#_ENREF_26); [Li, Veliyath, and Tan 2013](#_ENREF_65); [Owen-Smith and Powell 2004](#_ENREF_97); [Saxenian 1994](#_ENREF_119)). Yet, firms and their managers vary greatly in their network embeddedness and thus in the benefits they can reap from the cluster membership (e.g., [BarNir and Smith 2002](#_ENREF_5); [Giuliani and Bell 2005](#_ENREF_45); [Owen-Smith and Powell 2004](#_ENREF_97)). The majority of prior research has sought to identify the reasons for this variation at the firm level, pointing to factors such as firm size and status ([Rosenkopf and Padula 2008](#_ENREF_116)), past collaborations ([Gulati and Gargiulo 1999](#_ENREF_50)), and network endogenous processes ([Giuliani 2013](#_ENREF_44); [Rosenkopf and Padula 2008](#_ENREF_116)) determining the differences in firms’ and their managers’ networks. By contrast, micro-level factors driving the creation of network ties among managers in regional clusters have attracted limited attention so far. This lack of attention seems surprising for several reasons: First, there is evidence that the acquisition of knowledge through boundary-spanning interpersonal ties may be more critical for success of biotech firms than contractual inter-organizational relations ([Liebeskind, Oliver, Zucker, and Brewer 1996](#_ENREF_66)). Second, interpersonal ties often precede more formal contractual relations between high-tech organizations in clusters ([Berends, van Burg, and van Raaij 2011](#_ENREF_11); [Brennecke, Schierjott, and Rank 2016](#_ENREF_18)). Third, particularly young small and medium-sized enterprises (SMEs) lack a track record of past collaboration and innovation helping them to attract contractual relations ([Stuart 1998](#_ENREF_125); [Stuart, Hoang, and Hybels 1999](#_ENREF_126)) and depend on their managers to create informal knowledge ties as a critical facet of entrepreneurial behavior ([Volery, Mueller, and von Siemens 2015](#_ENREF_129)). An understanding of how and why interpersonal ties form in the cluster context can thus benefit managers and their firms to strategically influence their networks and thereby potentially their firms’ performance ([Stuart and Sorenson 2007](#_ENREF_127)).

This study aims to enhance knowledge of the individual-level drivers of SME managers’ boundary-spanning networks in the context of high-tech clusters by integrating social-psychological research with literature on entrepreneurial behavior and social networks. We define the creation of interpersonal network ties to other managers within a cluster as entrepreneurial behavior aimed at the detection and exploitation of opportunities and the identification and acquisition of resources needed to pursue these opportunities ([Bird, Schjoedt, and Baum 2012](#_ENREF_13); [Kuratko, Ireland, Covin, and Hornsby 2005](#_ENREF_60)). Following an attitude approach to entrepreneurial behavior as suggested by [Robinson, Stimpson, Huefner, and Hunt (1991)](#_ENREF_113), we investigate the role of four dominant entrepreneurial attitudes, namely (a) innovation orientation, (b) perceived personal control, (c) need for achievement, and (d) self-esteem in business as drivers of managers’ varying propensity to engage in interpersonal networking. In line with prior research showing that entrepreneurial behavior depends on affective, cognitive, and conative reactions to business issues ([Becherer and Maurer 1999](#_ENREF_10); [Qiu 2008](#_ENREF_109)), we propose that these attitudes affect managers’ tendency to establish informal knowledge acquisition ties that span organizational boundaries within the cluster context.

To test our propositions empirically, we focus on managers and their informal knowledge network in an institutionalized, regional biotech cluster mainly consisting of biotech SMEs and research institutes. Behaving entrepreneurially is of foremost importance for managers in this context due to the high complexity and volatility of knowledge ([Baum, Calabrese, and Silverman 2000](#_ENREF_7); [Powell 1996](#_ENREF_105)). Moreover, the regional co-location facilitates and the institutionalized set-up actively fosters the purposeful creation of ties that span organizational boundaries ([McKelvey, Alm, and Riccaboni 2003](#_ENREF_80)). We take a full network approach and emphasize the association between the four entrepreneurial attitudes and the occurrence of knowledge acquisition ties within the informal, interpersonal knowledge network observed in the cluster. Analytically, we apply exponential random graph models ([ERGMs; Lusher, Koskinen, and Robins 2013](#_ENREF_69)) allowing us to account for endogenous dependencies, which influence tie creation and the structure of networks in clusters ([e.g., Giuliani 2013](#_ENREF_44)). Applying ERGMs, we are able to derive conclusions on SME managers’ attitudes as drivers of their tendency to create knowledge ties and simultaneously account for an accurate characterization of the overall network structure that single ties are embedded in.

Our study contributes to prior literature in several ways. We shed light on the role of individual- or micro-level factors driving the creation of knowledge networks in high-tech clusters. Identifying these factors is important because interpersonal ties trigger knowledge spillovers and can significantly enhance SME performance ([Casper 2007](#_ENREF_26); [Liebeskind, Oliver, Zucker, and Brewer 1996](#_ENREF_66)). Only by understanding what drives tie creation are we able to derive recommendations for practitioners on how to strategically influence network patterns ([Stuart and Sorenson 2007](#_ENREF_127)). In this connection, we seek to answer the question of why – despite a strong appeal to network within the context of the institutionalized cluster – some managers more heavily engage in the creation of knowledge ties as a critical facet of entrepreneurial behavior than others. While network research has shown that personality traits ([Landis 2016](#_ENREF_62)), political skills ([Fang, Chi, Chen, and Baron 2015](#_ENREF_38)), and rational-economic considerations ([Nebus 2006](#_ENREF_92)) impact on interpersonal tie creation, scholars have only recently drawn attention to the role of attitudes for individuals’ tendency to network ([Kuwabara, Hildebrand, and Zou 2016](#_ENREF_61)). In their conceptual paper, [Kuwabara, Hildebrand, and Zou (2016)](#_ENREF_61) highlight how domain-specific attitudes shape individuals’ affective, cognitive, and conative reactions to what is considered effective, appropriate, and necessary with respect to networking and thereby affect their actual tie-creation behavior. By linking entrepreneurial attitudes to the creation of knowledge ties as entrepreneurial behavior, our study translates the authors’ assertions to the cluster context and provides theoretical and empirical evidence for their arguments.

Our study also contributes to research on the role of managers in corporate entrepreneurship, that is, their role after the start-up phase of a firm has been overcome. While the majority of previous studies in corporate entrepreneurship has focused on organizational factors (e.g., a firm’s entrepreneurial orientation) determining the creation of contractual inter-organizational ties such as alliances (e.g., [Brouthers, Nakos, and Dimitratos 2015](#_ENREF_19); [McKelvey, Alm, and Riccaboni 2003](#_ENREF_80)), we investigate how managers’ individual characteristics influence their entrepreneurial behavior in established firms that face a complex and volatile environment. Doing so, we add to the longstanding debate on the relevance of interpersonal differences in entrepreneurship (e.g., [Aldrich and Martinez 2007](#_ENREF_3); [Gartner 1988](#_ENREF_43); [Wincent and Westerberg 2005](#_ENREF_131)). In addition, we add a social-psychological component to the explanation of corporate entrepreneurship by showing that not all entrepreneurial attitudes equally predict managers’ entrepreneurial behavior. Examining not only main but also interaction effects of entrepreneurial attitudes on managers’ tie-creation behavior, we also address a gap in the entrepreneurship literature recently identified by [Carsrud and Brännback (2011)](#_ENREF_22).

Finally, we contribute to the literature on (inter-)organizational networks by enhancing knowledge on the drivers of tie creation, specifically focusing on informal network ties that span organizational boundaries. To date, there are few full network studies that investigate managers’ boundary-spanning networks (for notable exceptions see [Brennecke, Schierjott, and Rank 2016](#_ENREF_18); [Pina-Stranger and Lazega 2010](#_ENREF_102)) and knowledge on the determinants of their creation is limited ([Shook, Priem, and McGee 2003](#_ENREF_121)). By exposing the individual-level drivers of boundary-spanning knowledge ties, our study confronts the common critique of structural determinism which argues that the study of networks “neglects altogether the potential causal role of actors' beliefs, values, and normative commitment […]” ([Emirbayer and Goodwin 1994: 1425](#_ENREF_37); also see Bensaou, Galunic, and Jonczyk-Sédès, 2014). In other words, it adds to research on the role of human agency for tie creation and for corporate entrepreneurship.

# *Theory and Hypotheses*

## The Creation of Knowledge Ties as Entrepreneurial Behavior in the Cluster Context

Knowledge networks emerging in the context of regional high-tech clusters have received high levels of attention as a critical mechanism driving knowledge spillovers among co-located organizations (e.g., [Giuliani and Bell 2005](#_ENREF_45); [Li, Veliyath, and Tan 2013](#_ENREF_65); [Owen-Smith and Powell 2004](#_ENREF_97)) – albeit by and large at the firm level (for notable exceptions see, [Brennecke and Rank 2016](#_ENREF_17); [Dahl and Pedersen 2004](#_ENREF_30); [Østergaard 2009](#_ENREF_96)). Not focusing specifically on clusters, [Phelps, Heidl, and Wadhwa (2012)](#_ENREF_101) have recently reviewed research on the importance of interpersonal knowledge networks for the creation, transfer, and adoption of knowledge. The authors summarize a plethora of studies that have linked the establishment of knowledge ties to individual creativity (e.g., [Burt 2004](#_ENREF_21); [Perry-Smith 2006](#_ENREF_98)), organizational learning ([e.g., Liebeskind, Oliver, Zucker, and Brewer 1996](#_ENREF_66)), information diffusion ([e.g., Singh 2005](#_ENREF_122)), or SME innovativeness ([e.g., Jørgensen and Ulhøi 2010](#_ENREF_58)). Most directly related to our study, managers’ number of knowledge acquisition ties (i.e., their network centrality) has been shown to determine their innovative performance ([Moran 2005](#_ENREF_87); [Rodan and Galunic 2004](#_ENREF_114)) and ties that span organizational boundaries have been demonstrated to be particularly valuable in this respect ([Perry-Smith 2006](#_ENREF_98)). In addition, interpersonal ties have been highlighted be more valuable than contractual inter-organizational relations to promote learning and foster flexibility in biotech organizations ([Liebeskind, Oliver, Zucker, and Brewer 1996](#_ENREF_66)).

Given these benefits, it is no surprise that interpersonal knowledge networks are of particular importance in the biotech industry – and thus in biotech clusters – where knowledge is typically viewed as the most critical resource ([DeCarolis and Deeds 1999](#_ENREF_34); [Liebeskind, Oliver, Zucker, and Brewer 1996](#_ENREF_66)) that brings about competitive advantages for an organization ([Grant 1996](#_ENREF_48)). Past research has provided evidence that SME managers create knowledge acquisition ties that span organizational boundaries as part of their day-to-day activities in order to obtain knowledge. They interact with colleagues in a variety of other organizations, such as biotech firms, government agencies, and consultancies ([McGee and Sawyerr 2003](#_ENREF_78)), universities ([Powell 1998](#_ENREF_106)), or venture capital providers ([Pina-Stranger and Lazega 2011](#_ENREF_103)). Doing so, they gain access to diverse, non-trivial knowledge, for instance on new technologies, strategic decision-making, and funding opportunities ([McDonald and Westphal 2003](#_ENREF_77); [Molina-Morales and Martínez-Fernández 2010](#_ENREF_86); [Østergaard 2009](#_ENREF_96)).

Because of its high significance for knowledge-intensive firms in the cluster context, the creation of boundary-spanning knowledge ties constitutes a crucial facet of SME managers’ entrepreneurial behavior ([Schoonjans, Van Cauwenberge, and Vander Bauwhede 2013](#_ENREF_120); [Volery, Mueller, and von Siemens 2015](#_ENREF_129)). While in other contexts these might be considered ancillary activities, the transfer of information as well as the establishment and maintenance of ties are core entrepreneurial activities of SME managers in the start-up as well as in the growth phase of their firm to which they devote a high proportion of their time (e.g., [Mueller, Volery, and von Siemens 2012](#_ENREF_89); [Volery, Mueller, and von Siemens 2015](#_ENREF_129)). This characterization of tie creation as entrepreneurial behavior applies even more to the purposefully created professional networks emerging in the context of an institutionalized cluster. The institutional framework implies that managers consciously decide for their firms to become cluster members in order to benefit from facilitation activities, many of which center around the provision of networking opportunities ([Mueller and Jungwirth 2016](#_ENREF_88)). In other words, the fact that they join the cluster suggests their interest to get in contact with the other cluster members.

Based on the above, it seems surprising that not all managers are equally engaged in creating boundary-spanning knowledge acquisition ties ([BarNir and Smith 2002](#_ENREF_5)). Even though there is a strong “primacy to network” (i.e., an expectation to actively create and maintain network ties) spurred by popular management literature and academic attention to the topic alike, recent research has pointed to a knowing-doing gap ([Kuwabara, Hildebrand, and Zou 2016](#_ENREF_61); [Pfeffer and Sutton 2013](#_ENREF_99)). Particularly, some individuals may feel conflicted or ambivalent about the idea to engage in instrumental networking and refrain from doing so despite having the opportunity ([Casciaro, Gino, and Kouchaki 2014](#_ENREF_25); [Kuwabara, Hildebrand, and Zou 2016](#_ENREF_61)). Building on prior research on the influence of individuals’ characteristics on their networking behavior (e.g., [Kuwabara, Hildebrand, and Zou 2016](#_ENREF_61); [Landis 2016](#_ENREF_62)), we argue that entrepreneurial attitudes are critical in this connection. They represent a domain-specific influence factor that will affect SME managers’ tendency to engage in the creation knowledge acquisition ties that span organizational boundaries within the cluster context.

## Entrepreneurial Attitudes

Attitudes are predispositions to respond to a stimulus such as a situation, a person, or an object in a specific way and entail cognitive, affective, and conative components. The cognitive component of an attitude reflects individuals’ beliefs and thoughts, the affective component consists of feelings, and the conative component comprises behavioral intentions and predispositions towards an attitude object ([Martin and Fellenz 2010](#_ENREF_71)). Most prominently put forward by the theory of planned behavior ([Ajzen 1991](#_ENREF_2)), attitudes have been consistently demonstrated to predict individual behavior ([Glasman and Albarracín 2006](#_ENREF_46)) and managers’ attitudes in particular have been linked to managerial behavior (e.g., [Cordano and Frieze 2000](#_ENREF_28); [Lin and Lee 2004](#_ENREF_67)).

Entrepreneurial attitudes can be defined as domain-specific attitudes towards practices and processes related to business opportunities and new ways of problem solving ([Qiu 2008](#_ENREF_109)). Among the most common entrepreneurial attitudes discussed in the literature are individuals’ (a) innovation orientation with respect to business questions (e.g., [Damanpour and Schneider 2009](#_ENREF_32); [Krauss, Frese, Friedrich, and Unger 2005](#_ENREF_59)), (b) perceived personal control in business (e.g., [Mueller and Thomas 2001](#_ENREF_90); [Ng, Sorensen, and Eby 2006](#_ENREF_93)), (c) need for achievement in business (e.g., [Collins, Hanges, and Locke 2004](#_ENREF_27); [Krauss, Frese, Friedrich, and Unger 2005](#_ENREF_59)), and (d) business-related self-esteem ([e.g., Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)). These attitudes have proved useful to distinguish entrepreneurs from non-entrepreneurs in studies investigating new venture creation (e.g., [McCline, Bhat, and Baj 2000](#_ENREF_76); [Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)). In addition, they have served to predict entrepreneurial behavior in the context of corporate entrepreneurship (e.g., [Damanpour and Schneider 2009](#_ENREF_32); [Qiu 2008](#_ENREF_109)). In the following, we discuss the four entrepreneurial attitudes as drivers of managers’ tendency to establish informal knowledge acquisition ties that span organizational boundaries as core entrepreneurial behavior. We derive hypotheses for our subsequent empirical analysis on how each attitude on its own as well as interactions between the different attitudes will influence the creation of knowledge ties in the cluster context.

## Entrepreneurial Attitudes as Drivers of Boundary-Spanning Tie Creation

*Innovation Orientation.*Innovation orientation as an entrepreneurial attitude can be defined as a “tendency to support and engage in creative ideas, process, and experimentation” ([Qiu 2008: 817](#_ENREF_109)) with respect to business activities. Managers exhibiting a strong orientation towards innovation in business encourage creative ideas and foster new processes far from established routines ([Krauss, Frese, Friedrich, and Unger 2005](#_ENREF_59); [Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)). They tend to deviate from existing practices, have a strong will to discover new and unique ways to deal with tasks and problems, and are more likely to adapt innovations within their organizations ([Damanpour and Schneider 2006](#_ENREF_31); [Damanpour and Schneider 2009](#_ENREF_32)). Moreover, they attach little value to performing routine tasks and are keen on grasping new opportunities ([Qiu 2008](#_ENREF_109)).

Since knowledge acquisition is crucial for continuous innovation ([Molina-Morales and Martínez-Fernández 2010](#_ENREF_86); [Yli‐Renko, Autio, and Sapienza 2001](#_ENREF_135)), managers with a strong innovation orientation are assumed be especially likely to engage in this facet of entrepreneurial behavior. Appealing most strongly to the cognitive component of the attitude, boundary-spanning ties with managers from other organization within the cluster bear the potential to discover ways of problem solving that differ from the old routines established over time in their own organization. In addition, they provide non-redundant information and new ideas on how to deal with tasks and challenges, and generally be innovative ([Alexiev, Jansen, van den Bosch, and Volberda 2010](#_ENREF_4); [Perry-Smith 2006](#_ENREF_98)). Finally, boundary-spanning knowledge networks help to avoid mostly intra-organizational phenomena such as collective blindness ([Nahapiet and Ghoshal 1998](#_ENREF_91)), groupthink ([Janis 1972](#_ENREF_57)), or inertia ([Hannan and Freeman 1984](#_ENREF_51)). As having external knowledge ties has repeatedly been shown to be highly favorable for SMEs (e.g., [Powell, Koput, and Smith-Doerr 1996](#_ENREF_107); [Yli‐Renko, Autio, and Sapienza 2001](#_ENREF_135)), and managers with a strong innovation orientation are known to invest considerable efforts in scanning their environment for competitive intelligence ([Qiu 2008](#_ENREF_109)), we propose:

*Hypothesis (H)1: There is a positive relationship between managers’ attitude towards innovation in business and their tendency to create informal knowledge acquisition ties that span organizational boundaries.*

*Perceived Personal Control.* Perceived personal control in business is an entrepreneurial attitude derived from Rotter’s ([1966](#_ENREF_117)) social learning theory. Following [Rotter (1966)](#_ENREF_117) a high level of perceived personal control is associated with the belief that reinforcements follow from one’s own behavior; it goes along with a learning orientation, and motivates and supports an active, striving behavior. In contrast, individuals with a low level of perceived personal control belief that reinforcements are controlled by forces independent of behavior such as chance, luck, fate, or powerful others.

As a domain-specific attitude, perceived personal control reflects managers’ perception of being able to influence business outcomes through personal efforts ([Ng, Sorensen, and Eby 2006](#_ENREF_93)). With respect to the creation of knowledge acquisition ties, individuals with a high level of perceived personal control are more likely to proactively scan the environment, and gather and use more information in decision making ([Phares 1976](#_ENREF_100)). While the latter appeals to the cognitive and conative components of this attitude, creating boundary-spanning knowledge ties also addresses the affective component of perceived personal control. Deriving satisfaction from taking responsibility for their own success, managers with a high level of perceived personal control have been shown to engage in instrumental networking behavior within their organization ([Ng and Feldman 2011](#_ENREF_94)). Based on these findings, we expect that managers’ level of perceived personal control will also influence their tendency to establish knowledge acquisition ties that span organizational boundaries. In order to feel satisfied and enhance their odds to thrive, managers with a high level of perceived personal control should be especially likely to take initiative and create external network ties that allow accessing intangible resources beneficial for performance. Moreover, by creating interpersonal ties, these managers might try to establish control over their environment. For instance, they might want to maintain possibilities to exert influence via their network connections ([Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)). Confirming this reasoning, prior research highlights that managers with a high level of perceived personal control show a more active attitude to the absorption of knowledge by using more scanning devices than their peers with a low level of perceived personal control ([Miller, De Vries, and Toulouse 1982](#_ENREF_83); [Qiu 2008](#_ENREF_109)). Based on these arguments, we suggest:

*H2: There is a positive relationship between managers’ personal control in business and their tendency to create informal knowledge acquisition ties that span organizational boundaries.*

*Need for Achievement.* The concept of need for achievement was formulated by McClelland and colleagues (e.g., [McClelland 1961](#_ENREF_73); [McClelland, Clark, Roby, and Atkinson 1949](#_ENREF_75)) and describes individuals’ desire to attain difficult goals and to master skills and problems through their own efforts. General need for achievement has repeatedly been shown to be a critical driver of individual behavior (e.g., [Baruch, O'Creevy, Hind, and Vigoda-Gadot 2004](#_ENREF_6); [Wofford, Goodwin, and Premack 1992](#_ENREF_132)), including different entrepreneurial actions ([Collins, Hanges, and Locke 2004](#_ENREF_27)), and has even been positively associated with entrepreneurial success ([McClelland 1987](#_ENREF_74); [Miner, Smith, and Bracker 1989](#_ENREF_85)). We investigate need for achievement not as a general but a domain-specific attitude towards results associated with business activities in an entrepreneurial context ([Qiu 2008](#_ENREF_109); [Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)), in this case a biotech cluster. Relating to the cognitive component of this domain-specific attitude, managers with a strong need for achievement believe in the added value of planning ahead, acting efficiently, and selecting business associates based on their competency. The affective component of a strong need for achievement is expressed by a sense of accomplishment resulting from the pursuit of business activities as well as from the independent mastery of challenges and tasks. Finally, its conative component becomes manifest by managers investing a lot of effort to take advantage of business opportunities and assuming responsibility for their decisions ([Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)).

Addressing the cognitive component of the attitude, we expect managers with a strong need for achievement in business to strive towards creating a high number of knowledge acquisition ties that span organizational boundaries. They attach importance to the means of accomplishing their goals, act strategically, and plan ahead ([Casciaro 1998](#_ENREF_23); [Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)). Knowing that external networks determine knowledge spillovers and thus have the potential to crucially increase their business’s innovative performance, they are likely to see added value in the creation of knowledge acquisition ties. For the same reason, managers with a strong need for achievement can be assumed to invest considerable time and energy in the creation of a high number of boundary-spanning knowledge acquisition ties, which relates to the conative component of the attitude. Finally, appealing to the affective component of a strong achievement need, gaining valuable insights via boundary-spanning ties can trigger feelings of accomplishment. Moreover, informal ties with other managers can provide a frame of reference they can draw upon for social comparisons ([Festinger 1954](#_ENREF_40)). Being highly competitive, managers with a strong need for achievement might utilize their network ties to evaluate their performance relative to their peers. Following this reasoning, we suggest:

*H3: There is a positive relationship between managers’ need for achievement in business and their tendency to create informal knowledge acquisition ties that span organizational boundaries.*

*Self-esteem.* Self-esteem relates to individuals’ self-evaluation of their competencies ([Rosenberg 1999](#_ENREF_115)). As a domain-specific entrepreneurial attitude, it refers to the perceived competency and self-confidence of managers with respect to their business dealings. High self-esteem managers typically attribute failure to external factors rather than themselves, believe that they can provide a wide expertise, and positively evaluate their own task solutions. Moreover, they do not scare away from confrontations ([Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)).

With respect to the influence of self-esteem on creating informal knowledge acquisition ties social psychological research shows, on the one hand, that individuals with high self-esteem generally have more interpersonal contacts than individuals with low self-esteem ([Buhrmester, Furman, Wittenberg, and Reis 1988](#_ENREF_20)). They are confident concerning their own ideas and are not scared to get confronted with different views ([Baumeister, Campbell, Krueger, and Vohs 2003](#_ENREF_8); [Baumeister, Campbell, Krueger, and Vohs 2005](#_ENREF_9)). On the other hand, managers with high self-esteem might have the conviction of being able to handle tasks on their own and not needing external knowledge. Thus, relating to the cognitive component of the attitude, they might see little value in creating boundary-spanning ties. Moreover, appealing to the affective component of the attitude, addressing colleagues from other organizations for knowledge could be dissonant with the managers’ positive self-image and pose a threat to their self-esteem ([Tessler and Schwartz 1972](#_ENREF_128)). The mangers would admit to themselves and to others that their expertise is insufficient for an adequate task fulfillment. In order to keep their attitude – in this case their self-esteem in business – in line with their behavior and prevent themselves from cognitive dissonance ([Festinger 1957](#_ENREF_41)), they might thus avoid creating external network ties. Following the latter stream of arguments that pertains more directly to managers’ entrepreneurial behavior as opposed to tie-creating behavior in general, we posit:

*H4: There is a negative relationship between managers’ self-esteem in business and their tendency to create informal knowledge acquisition ties that span organizational boundaries.*

*Interactions between the four attitudes.* As highlighted by [Robinson, Stimpson, Huefner, and Hunt (1991: 19)](#_ENREF_113), “[n]o attitude exists in isolation”. Thus, in addition to the main effects of the four entrepreneurial attitudes on the creation of knowledge acquisition ties, we conjecture that there are interaction effects between them. As hypothesized above, a strong innovation orientation, high levels of perceived personal control, and a strong need for achievement in business are assumed to be positively related to knowledge tie creation. Going above these main effects, the different combinations of the three entrepreneurial attitudes might have a synergistic impact on managers’ tendency to engage in boundary-spanning networking. First, a high level of perceived personal control might reinforce the positive influence of a strong innovation orientation on managers’ tie-creation behavior. Managers drawn towards creativity and experimentation might be particularly convinced by the added value offered by the cluster context with respect to innovation. Their proactivity resulting from high levels of perceived personal control, in turn, might increase their propensity to act upon this conviction by creating many knowledge ties to other cluster managers. In this connection, prior research has shown that SME managers’ perceived personal control is positively related to the selection and implementation of innovative firm strategies (e.g., [Boone, De Brabander, and Van Witteloostuijn 1996](#_ENREF_14); [Miller and Toulouse 1986](#_ENREF_84)) of which knowledge tie creation may be one. Second, a strong need for achievement might complement managers’ innovation orientation in a similar way. The tendency to act strategically and work hard to foster knowledge spillovers paired with the will to discover novelty might make managers possessing a strong need for achievement and at the same time a strong innovation orientation particularly active networkers.

Concerning the third combination of perceived personal control and need for achievement, it is surprising that while they are traditionally investigated together as important predictors of entrepreneurial behavior (e.g., [Borland 1975](#_ENREF_15); [Diaz and Rodrigues 2003](#_ENREF_35); [Hansemark 2003](#_ENREF_52)), no prior research has explicitly tested for an interaction effect between these two entrepreneurial attitudes. Sharing common ground by emphasizing personal effort and engagement, perceived personal control and need for achievement in business might complement or substitute each other. Building on early work by [Wolk and DuCette (1973)](#_ENREF_133) demonstrating by theory and empirics that perceived personal control moderates the influence of need for achievement on student performance, we suggest that the respective domain-specific attitudes equally reinforce each other in their effect on tie creation. Managers perceiving to have high levels of control over their business success might be better able to translate the attributes associated with a strong need for achievement such as mastery of challenges and strategic planning into action, in this case knowledge tie creation within the cluster context. Based on the above arguments, we suggest:

*H5a: There is a positive interaction effect between managers’ innovation orientation and their perceived personal control on the creation of informal knowledge acquisition ties that span organizational boundaries.*

*H5b: There is a positive interaction effect between managers’ innovation orientation and their need for achievement on the creation of informal knowledge acquisition ties that span organizational boundaries.*

*H5c: There is a positive interaction effect between managers’ perceived personal control and their need for achievement on the creation of informal knowledge acquisition ties that span organizational boundaries.*

For self-esteem in business as the fourth entrepreneurial attitude we have predicted a negative main effect on knowledge tie creation. We expect a strong innovation orientation, high levels of perceived personal control, and a strong need for achievement to counterbalance this effect. First, a strong orientation towards innovation in business might outweigh managers’ conviction of being able to solve tasks on their own and thus seeing little value in boundary-spanning ties. Understanding the critical value of network ties for being innovative, managers combining a strong innovation orientation and high self-esteem might be more inclined to reach out to colleagues within the cluster context to foster knowledge spillovers. Second, the proactivity and inclination to take responsibility for one’s own success associated with a high level of perceived personal control might counterbalance the inhibiting effects of self-esteem on managers’ tie creation behavior, particularly it might counteract the desire to protect a positive self-image. In this connection, social-psychological research has shown that individuals with a high level of perceived personal control are less susceptible to external influence attempts ([Biondo and MacDonald 1971](#_ENREF_12)). Thus, managers combining this attitude with high self-esteem might be less prone to perceive acquiring external knowledge as dissonant with their positive self-image. Finally, a strong need for achievement might compensate for the negative effect of high self-esteem on tie creation in a similar way. The tendency to derive a sense of accomplishment from mastering challenges in an efficient way might lead high self-esteem managers to consider external knowledge acquisition as means to an end that benefits their success and is thus not necessarily dissonant with their positive self-image. Based on this reasoning, we hypothesize:

*H5d: There is a negative interaction effect between managers’ innovation orientation and their self-esteem on the creation of informal knowledge acquisition ties that span organizational boundaries.*

*H5e: There is a negative interaction effect between managers’ perceived personal control and their self-esteem on the creation of informal knowledge acquisition ties that span organizational boundaries.*

*H5f: There is a negative interaction effect between managers’ need for achievement and their self-esteem on the creation of informal knowledge acquisition ties that span organizational boundaries.*

# *Data and Method*

## Research Site and Respondents

We investigate managers’ entrepreneurial attitudes as drivers of knowledge network formation in a regional biotech cluster in Germany. In this institutionalized cluster set up as a registered association, regular social events organized by the cluster administration as well as regional co-location foster tie creation across organizational boundaries. The organizations’ formal cluster membership allows for a rigorous definition which organizations to include in the study ([Laumann, Marsden, and Prensky 1989](#_ENREF_63)). The cluster was founded in the year 2000. At the time of the investigation in 2011, it comprised 55 member organizations mainly consisting of biotech SMEs and co-located research institutes as well as some intermediates such as consultants, venture capital providers, and regional associations. Thus, it includes a variety of other organizations that SME managers acquire knowledge from, which was confirmed in discussions we had with managers of member organizations and the cluster administration. According to them, one of the major benefits of the cluster is the provision of an information and communication platform to the member organizations and their managers.

To collect data for our analysis, we asked firm managers and leaders of research institutes to participate in an online survey.[[2]](#footnote-2) Following [Pina-Stranger and Lazega (2010)](#_ENREF_102) we selected respondents that were either founders, chief executive officers (CEOs), chief financial officers, or chief operating officers within firms, or mangers of research institutes. In small biotech SMEs (the majority of organizations in the cluster), only the founder/CEO completed the survey. In larger organizations, other members of the top management team participated as well. After pilot-testing the questionnaire, we used a modified contact strategy ([Dillman 2000](#_ENREF_36)) to administer the survey. First, the administrative cluster manager announced the survey and its goals to all member organizations. Second, we send an e-mail invitation followed by up to three reminders. Finally, we called managers who had not completed the survey. Despite these efforts, some managers refused to participate or did not fully complete questionnaire. The final sample includes information on 48 managers from 36 organizations[[3]](#footnote-3) corresponding to a response rate of 65% which is similar to comparable network studies ([e.g., Ingram and Roberts 2000](#_ENREF_56)).[[4]](#footnote-4)

## Measures

*Dependent Variable.* Our dependent variable is the occurrence of knowledge acquisition ties in an interpersonal knowledge network among managers. We collected network data using a roster containing the names of all managers and asked the participants to indicate all persons from whom they regularly acquired knowledge and information concerning work-related matters ([Lazega and Pattison 1999](#_ENREF_64)). Respondents were to mark as many of the managers as contacts as they deemed appropriate. We recorded all network data dichotomously, hence we only distinguish between the presence and the absence of ties. For our analysis, we arranged the data in a 48 x 48 binary adjacency matrix, in which cell *xij* corresponds to *i*’s relation to manager *j*. If *i* indicated to acquire knowledge from *j*, cell *xij* was coded as 1, and 0 otherwise. Because of the relational nature of network data, we effectively work with more than 2,200 observations giving our models high predictive power. Since we are interested in knowledge acquisition across organizational boundaries, we did not include relationships between managers belonging to the same organization.

*Independent Variables.* To collect information on the respondents’ entrepreneurial attitudes, we used the entrepreneurial attitude orientation questionnaire developed by [Robinson, Stimpson, Huefner, and Hunt (1991)](#_ENREF_113) and subsequently used for instance by [McCline, Bhat, and Baj (2000)](#_ENREF_76). The questionnaire is designed to capture individuals’ innovation orientation, perceived personal control, need for achievement, and self-esteem in a business context. Following [Robinson, Stimpson, Huefner, and Hunt (1991)](#_ENREF_113) we used 26 items for measuring innovation in business, 10 for personal control of business outcomes, 22 for achievement in business, and 14 for perceived self-esteem in business. Respondents indicated the extent of agreement with each statement on a seven-point Likert-scale ranging from “strongly disagree to “strongly agree”. For each respondent, we calculated the average level of agreement on each of the subscales. The internal consistency reliability coefficients (Cronbach’s α) were 0.87 for innovation orientation, 0.71 for perceived personal control, 0.82 for need for achievement, and 0.73 for self-esteem suggesting that all four entrepreneurial attitudes are measured reliably ([Nunnally 1978](#_ENREF_95)).

*Control Variables.* We included the managers’ age measured in years, level of education, prior work experience, affiliation to a certain organizational type as well as their organizations’ size as control variables that might influence tie creation. With respect to the level of education, we differentiated between managers with a doctoral degree and those without because in Germany, holding a doctoral degree typically has important career implications not only in academia but also for working in industry. Concerning prior work experience we build on [Corolleur, Carrere, and Mangematin (2004)](#_ENREF_29) and distinguished between scientific experience in academia or industry, managerial experience in a private firm and experience as founder of a bio start-up. As the discussions we had with managers prior to the survey revealed that some of the managers joined or founded their organization directly after graduating from university we also included the category of not having any work experience. Concerning the type of organizations, we distinguished between managers belonging to biotech firms, research institutes, consultants, venture capital providers, and regional associations. Organizational size was captured by number of employees.

## Analytical Approach: Exponential Random Graph Models

We analyzed our data using exponential random graph models (ERGMs) that account for tie interdependence in networks ([for an introduction see Lusher, Koskinen, and Robins 2013](#_ENREF_69)). ERGMs are state-of-the-art for the analysis of interdependence structures such as knowledge networks and are increasingly applied in management research ([e.g., Lomi, Lusher, Pattison, and Robins 2014](#_ENREF_68)). In ERGMs, patterns of network ties are the dependent variables. Their goal is to investigate which patterns characterize the network and based on that to draw conclusions on processes that generate the specific network. In contrast to regression analysis, single (tie-)observations are not seen as independent of one another. As social ties imply dependence, we consider this as a major strength of our modeling approach. ERGMs model a stochastic process in which the presence of a particular tie is influenced by the presence or absence of other ties and, importantly, actor-level attributes such as in our case managers’ entrepreneurial attitudes. The models express the probability of the overall network structure in terms of parameters associated with specific patterns within the network. These patterns reflect the influence of the managers’ characteristics on their embeddedness in the interpersonal knowledge network. In addition, they are determined by interdependence assumptions regarding the network ties that serve to control for network endogenous processes. Formally, ERGMs can be expressed as:

(1)

where (i) *X* denotes the network variable for a network with n nodes, and *x* denotes the corresponding realizations.; (ii) *Y* is an array of actor attribute variables with realizations *y*; (iii) *ZQ(x, y)* is a network statistic counting the number of network patterns of type *Q* for a particular network realization *x* and given the vector of attributes *y*; (iv) *θQ* is the parameter corresponding to the statistic *ZQ(x, y)*; and (v) *κ* is a normalizing constant included to ensure that (1) is a proper probability distribution. The summation is taken over all network patterns (*Q*) included in a given model. The probability of observing any network *x* in this distribution (including the one that is actually observed) is dependent both on the statistics *ZQ(x, y)* and the corresponding parameter values *θQ* for all patterns in the model.

To capture the influence of managers’ entrepreneurial attitudes on the occurrence of ties we build on the *acquisition* pattern capturing the influence of an attitude on the managers’ tendency to create a tie with a colleague. We mean-centered the independent variables before creating the interaction terms in order to reduce potential problems of multicollinearity ([Aiken and West 1991](#_ENREF_1)). We also include acquisition patterns to control for the influence of managers’ age and level of education, as well as organizational size on tie occurrence. The acquisition pattern reflects the tendency of managers scoring higher on a continuous attribute *y* to express more knowledge acquisition ties. Similarly, in the case of binary attributes, the pattern captures the tendency of managers with the attribute to create ties versus those without. The network statistic for this pattern is defined as where *yi* is the attribute value and *xi+* is the number knowledge acquisition ties of manager *i*. To control for the influence of managers’ prior work experience and organizational affiliation, we include *matching* patterns in our models capturing the tendency of managers belonging to the same category to be connected by a tie. The matching pattern is defined as a count of the number of ties for which the sender and receiver have matching values on attribute *y*. A positive parameter value implies that ties are more likely to be created between managers sharing membership in the same category. With respect to the selection of patterns reflecting network endogenous dependencies we followed previous studies ([e.g., Lomi, Lusher, Pattison, and Robins 2014](#_ENREF_68)). In its simplest form, dependence occurs at the dyadic level and is represented in the models by the *arc* pattern capturing managers’ tendency to create ties and the *reciprocity* pattern capturing the tendency to reciprocate ties. More complex dependencies relate to managers’ differential propensities to be the source or the target of ties. They are accounted for in the models by including the *popularity spread* and *activity spread* patterns mirroring the network analytical notions of in- and out-degree centrality ([Freeman 1979](#_ENREF_42)). Finally, we include the patterns capturing *transitive closure* and *cyclic closure* reflecting variations in network clustering ([Robins, Pattison, and Wang 2009](#_ENREF_112)). Table 1 visualizes and explains all patterns that we included in our models.

- Insert Table 1 about here -

Following established procedures ([e.g., Snijders, Pattison, Robins, and Handcock 2006](#_ENREF_124)), we employed Markov chain Monte Carlo maximum-likelihood implemented in the PNet software ([Wang, Robins, and Pattison 2006](#_ENREF_130)) to estimate our models.

# *Results*

Figure 1 visualizes the observed knowledge network. The network has a density of 7.8 percent, which means that on average every manager acquires knowledge from four other managers. Yet, the visualization clearly reveals that ties are unevenly distributed among the managers. While some managers are tightly embedded in the network holding a high number of knowledge ties, others are only sparsely connected, and six managers do not have any knowledge ties. Table 2 shows descriptive statistics and Table 3 provides correlations for the variables included in the models.

- Insert Figure 1 about here -

- Insert Table 2 about here -

- Insert Table 3 about here -

Table 4 displays the results of our model estimation. Model 1 comprises only the control variables, in Model 2 we added the main effects, and Model 3 is the full model including interaction effects between the four entrepreneurial attitudes. We tested the models for their goodness of fit (GOF) following the procedure suggested by [Hunter, Goodreau, and Handcock (2008)](#_ENREF_55). We simulated a high number of graphs from the fitted models and compared the characteristics of the simulated graphs to the characteristics of the observed network. Particularly, we built on a sample of 5,000 graphs out of 500 million simulated networks for each model. We found that all GOF-statistics are below the threshold criteria recommended by [Robins, Pattison, and Wang (2009)](#_ENREF_112). In other words, the models yield a good fit suggesting that the observed network can be reproduced adequately based on the model parameters.

- Insert Table 4 about here -

Concerning the interpretation of results, a positive (negative) parameter estimate indicates that the respective pattern is observed more (less) often in the network than would be expected if ties emerged randomly, conditional on all other patterns in the model. The empirical results are stable across the three models and support our theoretical reasoning regarding the effects of the different entrepreneurial attitudes on the creating of boundary-spanning ties. The parameter for the managers’ *innovation orientation* is positive indicating that a strong innovation orientation goes along with a strong tendency to create knowledge acquisition ties with other managers. This finding supports Hypothesis 1. In support of Hypothesis 2, the parameter for *perceived personal control* of business outcomes exhibits a positive value. The higher the managers’ perceived personal control the more they engage in boundary-spanning tie creation. Surprisingly, the parameter for *need for achievement* in business is negative, thus we have to reject Hypothesis 3. In opposition to our expectations, managers with a strong achievement attitude create fewer knowledge acquisition ties that span organizational boundaries than expected by chance. Finally, *self-esteem* in business has a negative influence on managers’ knowledge acquisition behavior. Supporting Hypothesis 4, the higher the managers’ professional self-esteem the less likely they are to create knowledge ties that span organizational boundaries.

Concerning the interaction effects among the four entrepreneurial attitudes, we find that only the interactions between managers’ innovation orientation and self-esteem and their perceived personal control and self-esteem are significant. The former effect is negative, indicating that a strong innovation orientation counterbalances the negative main effect. In support of Hypothesis 5d the negative influence of a high self-esteem on managers’ tendency to create knowledge ties becomes less strong if a managers is strongly innovation-oriented. By contrast, a high level of perceived personal control reinforces the negative main effect of self-esteem. Hence, we have to reject Hypothesis 5e. The remaining interaction effects are insignificant suggesting that while some attitudes have a combined effect the creation of boundary-spanning ties, there are no interactions between others. Hypothesis 5a, 5b, 5c, and 5f are not supported.

Following [Lomi, Lusher, Pattison, and Robins (2014)](#_ENREF_68) and [Robins and Daraganova (2013)](#_ENREF_111) we computed conditional odds based on the results of Model 2 to get additional insights into the strength of the impact of each main effect on managers’ tendency to establish informal knowledge acquisition ties. Conditional odds provide information on the effect size of each parameter and are calculated by taking the exponential of the parameters presented in Table 4 multiplied by the standard deviation of each attitude measure. We find that, ceteris paribus, a rise in managers’ innovation orientation by one standard deviation increases the odds of observing a knowledge tie by 49 percent[[5]](#footnote-5). With respect to perceived personal control in business the odds of observing a tie increase by 21 percent per standard deviation. In contrast, a rise of need for achievement or self-esteem in business by one standard deviation decreases the odds of observing a knowledge acquisition tie by 23 percent and 13 percent respectively.

Concerning the control variables included in the models, only one of the actor-attribute parameters is significant (*organizational affiliation-matching*) showing a tendency for managers belonging to the same type of organization to turn to each other for knowledge more often than expected by chance. This finding is largely in line with previous research demonstrating that similarity fosters connections ([McPherson, Smith-Lovin, and Cook 2001](#_ENREF_81)). Concerning the network endogenous patterns, the negative *arc* parameter indicates that managers infrequently create knowledge ties outside of the more complex structural patterns characterizing the network. The positive *reciprocity* parameter points towards a strong tendency towards the mutual exchange of knowledge. The positive *popularity spread* parameter shows that some managers receive more nominations as providers of knowledge than others. These managers’ might have a reputation for being particularly knowledgeable among their colleagues triggering a tendency for preferential attachment ([also known as the "Matthew effect", Merton 1968](#_ENREF_82)) within the network. Finally, tendencies for *transitive closure* and against *cyclic closure* characterize the network. In instrumental networks such as the one studied here, this result points towards hierarchical differences among managers. While positive cyclic closure would indicate that all managers are equally embedded in a triadic relation, positive transitive closure represents a form of informal hierarchy in the sense that there is only one manager in a triad that two others turn to for knowledge ([Rank, Robins, and Pattison 2010](#_ENREF_110)).

# *Discussion and Conclusion*

Given the importance of knowledge spillovers as well as the “primacy to network” prevailing in high-tech clusters, the aim of this study is to shed light on the question of why some SME managers are more active than others creating boundary-spanning knowledge ties. Building on theoretical and empirical findings from research in social psychology, entrepreneurship, and organizational networks, we investigate the relationship between four dominant entrepreneurial attitudes and managers’ boundary-spanning network ties in the context of a German biotech cluster. The results of our analysis show that having strong entrepreneurial attitudes per se does not necessarily foster managers’ tendency to engage in boundary-spanning activities as an important facet of entrepreneurial behavior. Instead, each of the four attitudes influences managers’ tendency to informally acquire knowledge from other managers in a unique way. A strong innovation orientation and a high level of perceived personal control in business increase managers’ tendency to create knowledge acquisition ties. In contrast, a strong need for achievement and high self-esteem in business lead managers to create fewer boundary-spanning ties within the interpersonal knowledge network. Moreover, there are interaction effects between some of the entrepreneurial attitudes suggesting that distinct attitudes have a combined effect on managers’ propensity to create and maintain knowledge ties across the boundaries of their organizations.

Our findings concerning innovation orientation as key entrepreneurial attitude driving interpersonal knowledge tie creation confirm that highly innovative managers are keen on gathering new information and put great emphasis on receiving intellectual input. To do so, they make an effort to connect with managers from other organizations within the cluster leading them to occupy a central position in the interpersonal knowledge network. Likewise, perceived personal control in business positively influences managers’ tendency to create interpersonal knowledge acquisition ties. In order to thrive and steer their success, managers’ with a high level of perceived personal control are not only more likely to engage in intra-organizational networking behaviors as has been shown by [Ng and Feldman (2011)](#_ENREF_94). They also create boundary-spanning ties and actively acquire external knowledge.

In contrast, managers’ need for achievement and self-esteem in business negatively influence their tendency to engage in boundary-spanning tie creation. The negative effect of managers’ self-esteem in business is in line with our expectations. High self-esteem managers most likely have the impression of not needing external knowledge because they are able to come up with suitable task solutions on their own. Alternatively, they might avoid asking for help to protect their positive self-image ([Tessler and Schwartz 1972](#_ENREF_128)). The finding regarding managers with a strong need for achievement in business at first sight seems surprising. Based on their characterization as hard-working, strategic, and in search of mastery ([Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)), we expected them to create a high number of knowledge acquisition ties. However, their tendency to prefer solving problems through their own efforts ([McClelland 1961](#_ENREF_73)) seems to lead managers with a strong need for achievement to avoid creating knowledge acquisition ties. Asking for “help” by turning to peers for knowledge might deprive them from the achievement gratification derived from solving problems by means of their own competence ([Tessler and Schwartz 1972](#_ENREF_128)). Moreover, their competitiveness might induce lower networking activities. Addressing colleagues from other organizations for knowledge, and thereby revealing knowledge gaps, puts them at risk of losing status ([Pina-Stranger and Lazega 2010](#_ENREF_102)), which is incommensurate with their competitive nature. As [McGrath, Vance, and Gray (2003: 8)](#_ENREF_79) put forward: “[e]xposing ignorance may cause discomfort, or it may be as costly as harming one’s reputation within the […] community.” The strong norm towards reciprocation (i.e., the mutual exchange of knowledge) that according to our models characterizes knowledge transfer within the cluster might additionally prevent managers with a strong achievement attitude to establish knowledge ties. Due to their competitiveness, they may be reluctant to interact with managers from other organizations because acquiring knowledge would imply a need for reciprocation ([Pina-Stranger and Lazega 2010](#_ENREF_102)). Finally, it is possible that managers with a strong need for achievement in business do not strive to create as many knowledge ties as possible but instead strategically select few others to connect to. This would be in line with findings by [Casciaro (1998)](#_ENREF_23) who shows that a strong need for achievement leads managers to more attentively observe and consequently more accurately perceive the network that surrounds them to get cues about who are the right people to connect to.

Testing for the attitudes’ combined effects on the creation of boundary-spanning ties reveals further interesting insights into the functioning of entrepreneurial attitudes as drivers of knowledge tie creation. In line with our expectation, we find a negative interaction effect between managers’ innovation orientation and their self-esteem. It can be concluded that over and above the two main effects, a strong innovation orientation counterbalances the negative influence of a high self-esteem on managers’ tendency to create knowledge ties. Being innovation-oriented these managers understand the critical value of networking for continuous innovation, which outweighs the motives related to a high self-esteem that impede the creation of boundary-spanning ties. In other words, a strong innovation orientation weakens high self-esteem managers’ belief of being able to find solutions on their own and considering the acquisition of external knowledge as a threat to their positive self-image. As it seems, the cognitive attitudinal component of a strong innovation orientation prevails over the influence that the affective component of having a high self-esteem has on boundary-spanning tie creation.

Surprisingly and opposed to our expectation, perceived personal control and self-esteem interact positively. While we initially assumed that a high level of perceived personal control would outweigh high self-esteem managers’ negative view of creating boundary-spanning ties, it rather seems that this entrepreneurial attitude fortifies the negative influence of a high self-esteem on managers tendency to create knowledge ties. That is, high self-esteem managers’ belief in not needing external knowledge and their perception of tie-creation as being dissonant with their positive self-image becomes more pronounced if they also have a high level of perceived personal control in business. Building on [De Hoogh and Den Hartog (2009)](#_ENREF_33) who argue that individuals with a high level of perceived personal control need less support and perceive challenges as more manageable, an explanation may be that the combination of a high self-esteem and high level of perceived personal control brings out these managers’ conviction of being able to handle tasks on their own and not needing external help to a larger extent. However, given the lack of prior research on interactions between different attitudes and networking ([Carsrud and Brännback 2011](#_ENREF_22)), future research is needed to provide insights into the exact mechanisms determining this positive interaction effect and its relationship with different types of entrepreneurial behavior.

Finally, the remaining entrepreneurial attitudes did not interact with each other in their influence on tie creation. In other words, there are no synergies between innovation orientation, perceived personal control, and need for achievement in their influence on boundary-spanning tie creation. Instead, these entrepreneurial attitudes seem to be orthogonal and neither function as complements nor as substitutes. Provided that the respective other attitudes are controlled for, they can thus be seen as consistent predictors of managers’ tie creation behavior in the context of high-tech clusters.

In sum, our study provides empirical backup for the conceptual assertions of [Kuwabara, Hildebrand, and Zou (2016)](#_ENREF_61), namely that domain-specific attitudes shape individuals’ tendency to network. In other words, the opportunity to establish knowledge acquisition ties provided by the cluster context is only half of the story. Managers’ attitudes equally need to be considered as they determine the knowing-doing gap that we can observe with respect to tie creation as a critical facet of entrepreneurial behavior. In addition, the results of our study reveal that entrepreneurial attitudes are not only decisive in the context of new venture creation ([McCline, Bhat, and Baj 2000](#_ENREF_76); [Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)) but also critically affect managers’ behavior in the context of corporate entrepreneurship – particularly with respect to creating knowledge ties within an interpersonal network that spans organizational boundaries. Importantly, while all four attitudes have been shown to be positively related to the likelihood of new venture creation ([Robinson, Stimpson, Huefner, and Hunt 1991](#_ENREF_113)) we find a more nuanced picture with respect to managers’ entrepreneurial behavior in established firms. A strong innovation orientation and high level of perceived personal control in business are positively related to creating interpersonal knowledge ties, whereas a strong need for achievement and high self-esteem in business reduce managers’ likelihood to establish network ties that span organizational boundaries. It seems that particularly the affective components of the latter two attitudes prevent managers from engaging in boundary-spanning tie creation. These finding highlights the need to differentiate between the different entrepreneurial attitudes rather than integrating them into a single construct as previous studies have done ([e.g., Qiu 2008](#_ENREF_109)). Scholars cannot take for granted that each entrepreneurial attitude has a positive effect on each type of entrepreneurial behavior. Instead, there is a strong need to carefully examine the specific effects each attitude may have on different entrepreneurial outcomes. Taking into account differences between the cognitive, affective, and conative components of entrepreneurial attitudes on different types of entrepreneurial behavior might be a useful starting point to address this task.

Apart from adding a social psychological component to the study of knowledge networks in high-tech clusters as well as corporate entrepreneurship – both of which traditionally focus predominantly on firm-level characteristics driving the establishment of contractual inter-organizational ties –, our study also enhances our understanding of the determinants of tie creation in informal social networks. Investigating informal knowledge networks across organizational boundaries as an under-researched area in management and network studies, we offer an explanation to the question of why some managers are more active than others creating ties and thereby shed light on the role of human agency for network formation. By taking a full network approach, we are able to account for the endogenous effect of indirect knowledge ties (e.g., ties between a focal manager’s contacts) on the propensity to create a tie. As these endogenous effects have been shown to be crucial for network formation in clusters ([Giuliani 2013](#_ENREF_44); [Rosenkopf and Padula 2008](#_ENREF_116)), considering them enhances the validity of our findings – particularly in comparison to studies focusing on direct network ties only ([e.g., BarNir and Smith 2002](#_ENREF_5)). The downside of the full network approach is that we are not able to take into account ties to managers outside of the cluster.

As an additional contribution to organizational network research, we provide empirical evidence that malleable attitudes – just like personality traits ([Landis 2016](#_ENREF_62)) – function as important drivers of tie formation. Doing so, we respond to a recent call for integration of psychological and network perspectives ([Casciaro, Barsade, Edmondson, Gibson, Krackhardt, and Labianca 2015](#_ENREF_24)). Our finding implies that, just as individuals’ attitudes might change in the long run, so may as a consequence their networking behavior. As the relationship between attitudes and behavior is not strictly one-sided ([Festinger 1957](#_ENREF_41)), future research might extend our study and address how entrepreneurial attitudes and knowledge networks co-evolve.

Besides making an important contribution to the fields of corporate entrepreneurship and interpersonal networks in the cluster context our study is of practical relevance. Following [Stuart and Sorenson (2007)](#_ENREF_127), knowledge of the drivers of interpersonal tie creation can be seen as the first step to influence network patterns and foster knowledge spillovers, for instance by means of entrepreneurial education and management training. While attitudes are malleable and past research has shown that education and training are useful instruments to shape entrepreneurial attitudes ([e.g., Fayolle and Gailly 2015](#_ENREF_39)) we do not suggest that training should be used to stress some entrepreneurial attitudes over others to foster specific kinds of entrepreneurial behavior. After all, creating interpersonal knowledge ties is just one of many behaviors in the context of corporate entrepreneurship that might lead to success. This being said, management training could illustrate the relationship between the four entrepreneurial attitudes and boundary-spanning knowledge networks and thereby raise managers’ awareness of how their attitudes shape their behavior. For instance, training could challenge managers with a strong need for achievement and high self-esteem in their negative feelings towards establishing ties with other managers and get them to see the positive aspects of this behavior.

There are some inherent limitations in our analysis that should be addressed by future research. First, as indicated above, the relationship between attitudes and behavior is not strictly one-sided. Building on theory confirming the causal influence of attitudes on behavior ([Ajzen 1991](#_ENREF_2)), we argue that entrepreneurial attitudes lead managers to create knowledge acquisition ties. However, as reasoned by [Salancik and Pfeffer (1978)](#_ENREF_118) a salient and relevant social context in which individuals operate might equally influence their attitudes. In other words, managers’ network embeddedness might affect their entrepreneurial mindset. While it is ultimately an empirical task to solve this issue, we argue that the cluster context is less likely to be a salient driver of attitudes than prior entrepreneurial experience ([Harris and Gibson 2008](#_ENREF_53)), family business experience ([Harris and Gibson 2008](#_ENREF_53); [Matthews and Moser 1996](#_ENREF_72)), as well as entrepreneurial education programs ([Fayolle and Gailly 2015](#_ENREF_39)) which have all been shown to influence entrepreneurial attitudes. Lacking longitudinal data, we are however not able to statistically account for it. Second, future research is needed to examine not only the number of boundary-spanning ties that managers create but additionally account for the strength of these ties. While boundary-spanning knowledge ties among managers are certainly weaker than kinship ties that are often investigated in the entrepreneurship literature (e.g., [Greve and Salaff 2003](#_ENREF_49); [Hoang and Antoncic 2003](#_ENREF_54)), it is very likely that there are differences with respect to the strength of knowledge ties as well. Investigating the role of the frequency or the emotional closeness of a tie ([Granovetter 1973](#_ENREF_47)) could for instance provide insights into whether specific attitudes lead managers to prefer the strategic creation of fewer, albeit stronger ties as opposed to more but weaker ties as indicated above might be the case for a strong need for achievement. Third, we chose a case study design set in a cluster context for our empirical examination which brings about questions concerning the generalizability of results ([Yin 1989](#_ENREF_134)). When selecting our subject of investigation, we attached importance to the fact that it would display the characteristics typically associated with SMEs in the high-tech industry. For instance, mirroring the composition of overall biotech industry ([e.g., Smith-Doerr 2004](#_ENREF_123)), our sample includes predominantly male respondents. Due to these idiosyncrasies, our findings might not be generalizable to managers’ tie-creation behavior in gender-balanced or non-co-located contexts.

In conclusion, our study demonstrates that managers’ entrepreneurial attitudes are important drivers behind the creation of interpersonal knowledge acquisition ties that span organizational boundaries. However, we find that not all four attitudes typically associated with entrepreneurial success also go along with creating a high number of knowledge acquisition ties. Our results confirm the importance of accounting for interpersonal differences in the context of corporate entrepreneurship. In addition, they contribute to understanding the drivers of managerial tie creation across organizational boundaries.

# References

Aiken, L. S., and West, S. G. (1991). *Multiple Regression: Testing and Interpreting Interactions*. Newbury Park; Calif: Sage Publ.

Ajzen, I. (1991). "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* 50(2), 179-211.

Aldrich, H., and Martinez, M. (2007). "Many Are Called, but Few Are Chosen: An Evolutionary Perspective for the Study of Entrepreneurship," in *Entrepreneurship*. Eds. Á. Cuervo, D. Ribeiro and S. Roig. Berlin: Springer, 293-311.

Alexiev, A. S., Jansen, J. J. P., van den Bosch, F. A. J., and Volberda, H. W. (2010). "Top Management Team Advice Seeking and Exploratory Innovation: The Moderating Role of TMT Heterogeneity," *Journal of Management Studies* 47(7), 1343–1364.

BarNir, A., and Smith, K. A. (2002). "Interfirm Alliances in the Small Business: The Role of Social Networks," *Journal of Small Business Management* 40(3), 219–232.

Baruch, Y., O'Creevy, M. F., Hind, P. and Vigoda-Gadot, E. (2004). "Prosocial Behavior and Job Performance: Does the Need for Control and the Need for Achievement Make a Difference?," *Social Behavior and Personality: An International Journal* 32(4), 399-411.

Baum, J. A. C., Calabrese, T., and Silverman, B. S. (2000). "Don't Go It Alone: Alliance Network Composition and Startups' Performance in Canadian Biotechnology," *Strategic Management Journal* 21(3), 267–294.

Baumeister, R. F., Campbell, J. D., Krueger, J. I., and Vohs, K. D. (2003). "Does High Self-Esteem Cause Better Performance, Interpersonal Success, Happiness, or Healthier Lifestyles?," *Psychological Science in the Public Interest* 4(1), 1-44.

--- (2005). "Exploding the Self-Esteem Myth," *Scientific American* 292(1), 84-91.

Becherer, R. C., and Maurer, J. G. (1999). "The Proactive Personality Disposition and Entrepreneurial Behavior among Small Company Presidents," *Journal of Small Business Management* 37(1), 28-36.

Bensaou, B. M., Galunic, C., and Jonczyk-Sédès, C. (2014). "Players and Purists: Networking Strategies and Agency of Service Professionals," *Organization Science* 25(1), 29-56.

Berends, H., van Burg, E. and van Raaij, E. M. (2011). "Contacts and Contracts: Cross-Level Network Dynamics in the Development of an Aircraft Material," *Organization Science* 22(4), 940–960.

Biondo, J. and MacDonald, A. (1971). "Internal‐External Locus of Control and Response to Influence Attempts1," *Journal of Personality* 39(3), 407-419.

Bird, B., Schjoedt, L., and Baum, J. R. (2012). "Entrepreneurs' Behavior: Elucidation and Measurement," *Entrepreneurship Theory and Practice* 36(5), 889-913.

Boone, C., De Brabander, B., and Van Witteloostuijn, A. (1996). "CEO Locus of Control and Small Firm Performance: An Integrative Framework and Empirical Test," *Journal of Management Studies* 33(5), 667-700.

Borland, C. M. (1975). "Locus of Control, Need for Achievement and Entrepreneurship," University of Austin, Texas.

Boschma, R. (2005). "Proximity and Innovation: A Critical Assessment," *Regional Studies* 39(1), 61-74.

Brennecke, J. and Rank, O. N. (2016). "Knowledge Networks in High-Tech Clusters: A Multilevel Perspective on Interpersonal and Inter-Organizational Collaboration," in *Multilevel Network Analysis for the Social Sciences*. Eds. E. Lazega and T. A. B. Snijders: Springer, 273-293.

Brennecke, J., Schierjott, I., and Rank, O. N. (2016). "Informal Managerial Networks and Formal Firm Alliances: A Multilevel Investigation in Biotech," *Schmalenbach Business Review (SBR)* 17(1), 103-125.

Brouthers, K. D., Nakos, G., and Dimitratos, P. (2015). "SME Entrepreneurial Orientation, International Performance, and the Moderating Role of Strategic Alliances," *Entrepreneurship Theory and Practice* 39(5), 1161-1187.

Buhrmester, D., Furman, W., Wittenberg, M. T., and Reis, H. T. (1988). "Five Domains of Interpersonal Competence in Peer Relationships," *Journal of Personality and Social Psychology* 55(6), 991-1008.

Burt, R. S. (2004). "Structural Holes and Good Ideas," *American Journal of Sociology* 110(2), 349–399.

Carsrud, A., and Brännback, M. (2011). "Entrepreneurial Motivations: What Do We Still Need to Know?," *Journal of Small Business Management* 49(1), 9-26.

Casciaro, T. (1998). "Seeing Things Clearly: Social Structure, Personality, and Accuracy in Social Network Perception," *Social Networks* 20(4), 331-351.

Casciaro, T., Barsade, S. G., Edmondson, A. C., Gibson, C. B., Krackhardt, D., and Labianca, G. (2015). "The Integration of Psychological and Network Perspectives in Organizational Scholarship," Organization Science 26(4), 1162-1176.

Casciaro, T., Gino, F., and Kouchaki, M. (2014). "The Contaminating Effects of Building Instrumental Ties How Networking Can Make Us Feel Dirty," *Administrative Science Quarterly* 59(4), 705–735.

Casper, S. (2007). "How Do Technology Clusters Emerge and Become Sustainable?: Social Network Formation and Inter-Firm Mobility within the San Diego Biotechnology Cluster," *Research Policy* 36(4), 438–455.

Collins, C. J., Hanges, P. J., and Locke, E. A. (2004). "The Relationship of Achievement Motivation to Entrepreneurial Behavior: A Meta-Analysis," *Human Performance* 17(1), 95-117.

Cordano, M., and Frieze, I. H. (2000). "Pollution Reduction Preferences of U.S. Environmental Managers: Applying Ajzen's Theory of Planned Behavior," *Academy of Management Journal* 43(4), 627-641.

Corolleur, C. D., Carrere, M., and Mangematin, V. (2004). "Turning Scientific and Technological Human Capital into Economic Capital: The Experience of Biotech Start-Ups in France," *Research Policy* 33(4), 631-642.

Dahl, M. S. and Pedersen, C. Ø. R. (2004). "Knowledge Flows through Informal Contacts in Industrial Clusters: Myth or Reality?," *Research Policy* 33(10), 1673–1686.

Damanpour, F., and Schneider, M. (2006). "Phases of the Adoption of Innovation in Organizations: Effects of Environment, Organization and Top Managers," *British Journal of Management* 17(3), 215-236.

--- (2009). "Characteristics of Innovation and Innovation Adoption in Public Organizations: Assessing the Role of Managers," *Journal of Public Administration Research and Theory* 19(3), 495-522.

DeCarolis, D. M., and Deeds, D. L. (1999). "The Impact of Stocks and Flows of Organizational Knowledge on Firm Performance: An Empirical Investigation of the Biotechnology Industry," *Strategic Management Journal* 20(10), 953–968.

De Hoogh, A. H. and Den Hartog, D. N. (2009). "Neuroticism and Locus of Control as Moderators of the Relationships of Charismatic and Autocratic Leadership with Burnout," *Journal of Applied Psychology* 94(4), 1058.

Diaz, F., and Rodrigues, A. (2003). "Locus of Control, Nach, and Values of Community Entrepreneurs," *Social Behavior & Personality* 31(8), 739-748.

Dillman, D. A. (2000). *Mail and Internet Surveys: The Tailored Design Method*. New York: Wiley.

Emirbayer, M., and Goodwin, J. (1994). "Network Analysis, Culture, and the Problem of Agency," *American Journal of Sociology* 99(6), 1411–1454.

Fang, R., Chi, L., Chen, M., and Baron, R. A. (2015). "Bringing Political Skill into Social Networks: Findings from a Field Study of Entrepreneurs," *Journal of Management Studies* 52(2), 175-212.

Fayolle, A., and Gailly, B. (2015). "The Impact of Entrepreneurship Education on Entrepreneurial Attitudes and Intention: Hysteresis and Persistence," *Journal of Small Business Management* 53(1), 75-93.

Festinger, L. (1954). "A Theory of Social Comparison Processes," *Human Relations* 7(2), 117–140.

--- (1957). *A Theory of Cognitive Dissonance*. Stanford: Stanford University Press.

Freeman, L. (1979). "Centrality in Social Networks - Conceptual Clarification," *Social Networks* 1, 215-239.

Gartner, W. B. (1988). "Who Is an Entrepreneur? Is the Wrong Question," *American Journal of Small Business* 12(4), 11-32.

Giuliani, E. (2013). "Network Dynamics in Regional Clusters: Evidence from Chile," *Research Policy* 42(8), 1406-1419.

Giuliani, E. and Bell, M. (2005). "The Micro-Determinants of Meso-Level Learning and Innovation: Evidence from a Chilean Wine Cluster," *Research Policy* 34(1), 47-68.

Glasman, L. R., and Albarracín, D. (2006). "Forming Attitudes That Predict Future Behavior: A Meta-Analysis of the Attitude-Behavior Relation," *Psychological Bulletin* 132(5), 778-822.

Granovetter, M. S. (1973). "The Strength of Weak Ties," *American Journal of Sociology* 78(6), 1360–1380.

Grant, R. M. (1996). "Toward a Knowledge-Based Theory of the Firm," *Strategic Management Journal* 17, 109–122.

Greve, A., and Salaff, J. W. (2003). "Social Networks and Entrepreneurship," *Entrepreneurship theory and practice* 28(1), 1-22.

Gulati, R. and Gargiulo, M. (1999). "Where Do Interorganizational Networks Come From?," *American Journal of Sociology* 104(5), 1439–1493.

Hannan, M. T., and Freeman, J. (1984). "Structural Inertia and Organizational Change," *American Sociological Review*, 149-164.

Hansemark, O. C. (2003). "Need for Achievement, Locus of Control and the Prediction of Business Start-Ups: A Longitudinal Study," *Journal of Economic Psychology* 24(3), 301-319.

Harris, M. L., and Gibson, S. G. (2008). "Examining the Entrepreneurial Attitudes of Us Business Students," *Education + Training* 50(7), 568-581.

Hoang, H., and Antoncic, B. (2003). "Network-Based Research in Entrepreneurship: A Critical Review," *Journal of Business Venturing* 18(2), 165-187.

Hunter, D. R., Goodreau, S. M., and Handcock, M. S. (2008). "Goodness of Fit of Social Network Models," *Journal of the American Statistical Association* 103(481), 248-258.

Ingram, P., and Roberts, P. W. (2000). "Friendships among Competitors in the Sydney Hotel Industry," *American Journal of Sociology* 106(2), 387–423.

Janis, I. L. (1972). *Victims of Groupthink: A Psychological Study of Foreign-Policy Decisions and Fiascoes*. Boston: Houghton Mifflin.

Jørgensen, F. and Ulhøi, J. P. (2010). "Enhancing Innovation Capacity in SMEs through Early Network Relationships," *Creativity and Innovation Management* 19(4), 397-404.

Kalish, Y., and Robins, G. L. (2006). "Psychological Predispositions and Network Structure: The Relationship between Individual Predispositions, Structural Holes and Network Closure," *Social Networks* 28(1), 56–84.

Krackhardt, D. (1987). "QAP Partialling as a Test of Spuriousness," *Social Networks* 9(2), 171-186.

--- (1988). "Predicting with Networks: Nonparametric Multiple Regression Analysis of Dyadic Data," *Social Networks* 10(4), 359-381.

Krauss, S. I., Frese, M., Friedrich, C., and Unger, J. M. (2005). "Entrepreneurial Orientation: A Psychological Model of Success among Southern African Small Business Owners," *European Journal of Work and Organizational Psychology* 14(3), 315-344.

Kuratko, D. F., Ireland, R. D., Covin, J. G., and Hornsby, J. S. (2005). "A Model of Middle‐Level Managers’ Entrepreneurial Behavior," *Entrepreneurship: Theory & Practice* 29(6), 699-716.

Kuwabara, K., Hildebrand, C., and Zou, X. (2016). "Implicit Theories of Networking: Effects of Lay Beliefs on Attitudes and Engagement toward Instrumental Networking," *Academy of Management Review*.

Landis, B. (2016). "Personality and Social Networks in Organizations: A Review and Future Directions," *Journal of Organizational Behavior* 37(S1), S107–S121.

Laumann, E. O., Marsden, P. V., and Prensky, D. (1989). "The Boundary Specification Problem in Network Analysis," in *Research Methods in Social Network Analysis*. Eds. L. C. Freeman, D. R. White and A. K. Romney. Fairfax; Va; Lanham, MD: George Mason University Press Distributed by arrangement with University Publishing Associates, 61–87.

Lazega, E., and Pattison, P. E. (1999). "Multiplexity, Generalized Exchange and Cooperation in Organizations: A Case Study," *Social Networks* 21(1), 67–90.

Li, W., Veliyath, R. and Tan, J. (2013). "Network Characteristics and Firm Performance: An Examination of the Relationships in the Context of a Cluster," *Journal of Small Business Management* 51(1), 1-22.

Liebeskind, J. P., Oliver, A. L., Zucker, L., and Brewer, M. (1996). "Social Networks, Learning, and Flexibility: Sourcing Scientific Knowledge in New Biotechnology Firms," *Organization Science* 7(4), 428–443.

Lin, G. G., and Lee (2004). "Perceptions of Senior Managers toward Knowledge‐Sharing Behaviour," *Management Decision* 42(1), 108-125.

Lomi, A., Lusher, D., Pattison, P. E., and Robins, G. L. (2014). "The Focused Organization of Advice Relations: A Study in Boundary Crossing," *Organization Science* 25(2), 438–457.

Lusher, D., Koskinen, J., and Robins, G. L. (2013). "Exponential Random Graph Models for Social Networks: Theory, Methods, and Applications." New York: Cambridge University Press.

Marshall, A. (1920). *Principles of Economics*. London: Macmillan.

Martin, J., and Fellenz, M. R. (2010). *Organizational Behaviour and Management*. Andover: Cengage.

Matthews, C. H., and Moser, S. B. (1996). "A Longitudinal Investigation of the Impact of Family Background and Gender on Interest in Small Firm Ownership," *Journal of Small Business Management* 34(2), 29–43.

McClelland, D. C. (1961). *Achieving Society*. New York: The Free Press.

--- (1987). "Characteristics of Successful Entrepreneurs," *The Journal of Creative Behavior* 21(3), 219-233.

McClelland, D. C., Clark, R. A., Roby, T. B. and Atkinson, J. W. (1949). "The Projective Expression of Needs. Iv. The Effect of the Need for Achievement on Thematic Apperception," *Journal of Experimental Psychology* 39(2), 242.

McCline, R. L., Bhat, S., and Baj, P. (2000). "Opportunity Recognition: An Exploratory Investigation of a Component of the Entrepreneurial Process in the Context of the Health Care Industry," *Entrepreneurship: Theory & Practice* 25(2), 81–94.

McDonald, M. L., and Westphal, J. D. (2003). "Getting by with the Advice of Their Friends: CEOs' Advice Networks and Firms' Strategic Responses to Poor Performance," *Administrative Science Quarterly* 48(1), 1–32.

McGee, J. E., and Sawyerr, O. O. (2003). "Uncertainty and Information Search Activities: A Study of Owner–Managers of Small High-Technology Manufacturing Firms," *Journal of Small Business Management* 41(4), 385-401.

McGrath, C. A., Vance, C. M., and Gray, E. R. (2003). "With a Little Help from Their Friends: Exploring the Advice Networks of Software Entrepreneurs," *Creativity and Innovation Management* 12(1), 2–10.

McKelvey, M., Alm, H., and Riccaboni, M. (2003). "Does Co-Location Matter for Formal Knowledge Collaboration in the Swedish Biotechnology-Pharmaceutical Sector?," *Research Policy* 32(3), 483-501.

McPherson, M., Smith-Lovin, L., and Cook, J. M. (2001). "Birds of a Feather: Homophily in Social Networks," *Annual Review of Sociology* 27(1), 415–444.

Merton, R. K. (1968). "The Matthew Effect in Science: The Reward and Communication Systems of Science Are Considered," *Science* 159(3810), 56–63.

Miller, D., De Vries, M. F. K., and Toulouse, J.-M. (1982). "Top Executive Locus of Control and Its Relationship to Strategy-Making, Structure, and Environment," *Academy of Management Journal* 25(2), 237-253.

Miller, D., and Toulouse, J.-M. (1986). "Chief Executive Personality and Corporate Strategy and Structure in Small Firms," *Management Science* 32(11), 1389-1409.

Miner, J. B., Smith, N. R. and Bracker, J. S. (1989). "Role of Entrepreneurial Task Motivation in the Growth of Technologically Innovative Firms," *Journal of Applied Psychology* 74(4), 554.

Molina-Morales, F. X., and Martínez-Fernández, M. T. (2010). "Social Networks: Effects of Social Capital on Firm Innovation," *Journal of Small Business Management* 48(2), 258–279.

Moran, P. (2005). "Structural vs. Relational Embeddedness: Social Capital and Managerial Performance," *Strategic Management Journal* 26(12), 1129–1151.

Mueller, E. F. and Jungwirth, C. (2016). "What Drives the Effectiveness of Industrial Clusters? Exploring the Impact of Contextual, Structural and Functioning Determinants," *Entrepreneurship & Regional Development* 28(5-6), 424-447.

Mueller, S., Volery, T., and von Siemens, B. (2012). "What Do Entrepreneurs Actually Do? An Observational Study of Entrepreneurs' Everyday Behavior in the Start-up and Growth Stages," *Entrepreneurship Theory and Practice* 36(5), 995-1017.

Mueller, S. L., and Thomas, A. S. (2001). "Culture and Entrepreneurial Potential: A Nine Country Study of Locus of Control and Innovativeness," *Journal of Business Venturing* 16(1), 51-75.

Nahapiet, J., and Ghoshal, S. (1998). "Social Capital, Intellectual Capital, and the Organizational Advantage," *Academy of Management Review* 23(2), 242–266.

Nebus, J. (2006). "Building Collegial Information Networks: A Theory of Advice Network Generation," *Academy of Management Review* 31(3), 615–637.

Ng, T. W., Sorensen, K. L., and Eby, L. T. (2006). "Locus of Control at Work: A Meta‐Analysis," *Journal of Organizational Behavior* 27(8), 1057-1087.

Ng, T. W. H., and Feldman, D. C. (2011). "Locus of Control and Organizational Embeddedness," *Journal of Occupational and Organizational Psychology* 84(1), 173-190.

Nunnally, J. C. (1978). *Psychometric Theory*: New York: McGraw-Hill.

Østergaard, C. R. (2009). "Knowledge Flows through Social Networks in a Cluster: Comparing University and Industry Links," *Structural Change and Economic Dynamics* 20(3), 196-210.

Owen-Smith, J. and Powell, W. W. (2004). "Knowledge Networks as Channels and Conduits: The Effects of Spillovers in the Boston Biotechnology Community," *Organization Science* 15(1), 5–21.

Perry-Smith, J. E. (2006). "Social yet Creative: The Role of Social Relationships in Facilitating Individual Creativity," *Academy of Management Journal* 49(1), 85–101.

Pfeffer, J., and Sutton, R. I. (2013). *The Knowing-Doing Gap: How Smart Companies Turn Knowledge into Action*: Harvard Business Press.

Phares, E. J. (1976). *Locus of Control in Personality*. New York: General Learning Press.

Phelps, C., Heidl, R., and Wadhwa, A. (2012). "Knowledge, Networks, and Knowledge Networks: A Review and Research Agenda," *Journal of Management* 38(4), 1115–1166.

Pina-Stranger, A., and Lazega, E. (2010). "Inter-Organisational Collective Learning: The Case of Biotechnology in France," *European Journal of International Management* 4(6), 602–620.

--- (2011). "Bringing Personalized Ties Back In: Their Added Value for Biotech Entrepreneurs and Venture Capitalists Interorganizational Networks," *Sociological Quarterly* 52(2), 268–292.

Porter, M. E. (2000). "Location, Competition, and Economic Development: Local Clusters in a Global Economy," *Economic Development Quarterly* 14(1), 15–34.

Powell, W. W. (1996). "Inter-Organizational Collaboration in the Biotechnology Industry," *Journal of Institutional and Theoretical Economics* 152, 198-215.

--- (1998). "Learning from Collaboration: Knowledge and Networks in the Biotechnology and Pharmaceutical Industries," *California Management Review* 40(3), 228-240.

Powell, W. W., Koput, K. W., and Smith-Doerr, L. (1996). "Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology," *Administrative Science Quarterly* 41(1), 116–145.

Presutti, M., Boari, C. and Majocchi, A. (2011). "The Importance of Proximity for the Start‐Ups' Knowledge Acquisition and Exploitation," *Journal of Small Business Management* 49(3), 361-389.

Qiu, T. (2008). "Scanning for Competitive Intelligence: A Managerial Perspective," *European Journal of Marketing* 42(7/8), 814–835.

Rank, O. N., Robins, G. L., and Pattison, P. E. (2010). "Structural Logic of Intraorganizational Networks," *Organization Science* 21(3), 745–764.

Robins, G., and Daraganova, G. (2013). "Social Selection, Dyadic Covariates, and Geospatial Effects," in *Exponential Random Graph Models for Social Networks*. Eds. D. Lusher, J. Koskinen and G. L. Robins. New York; N.Y: Cambridge University Press, 91-101.

Robins, G. L., Pattison, P. E., and Wang, P. (2009). "Closure, Connectivity and Degree Distributions: Exponential Random Graph (p\*) Models for Directed Social Networks," *Social Networks* 31(2), 105–117.

Robinson, P. B., Stimpson, D. V., Huefner, J. C., and Hunt, H. K. (1991). "An Attitude Approach to the Prediction of Entrepreneurship," *Entrepreneurship: Theory & Practice* 15(4), 13-31.

Rodan, S., and Galunic, C. (2004). "More Than Network Structure: How Knowledge Heterogeneity Influences Managerial Performance and Innovativeness," *Strategic Management Journal* 25(6), 541–562.

Rosenberg, M. (1999). *Society and the Adolescent Self-Image*. Darby, PA: Diane Publishing Company.

Rosenkopf, L. and Padula, G. (2008). "Investigating the Microstructure of Network Evolution: Alliance Formation in the Mobile Communications Industry," *Organization Science* 19(5), 669–687.

Rotter, J. B. (1966). "Generalized Expectancies for Internal Versus External Control of Reinforcement," *Psychological Monographs: General and Applied* 80(1), 1-28.

Salancik, G. R., and Pfeffer, J. (1978). "A Social Information Processing Approach to Job Attitudes and Task Design," *Administrative Science Quarterly* 23(2), 224–253.

Saxenian, A. (1994). *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Harvard: Harvard University Press.

Schoonjans, B., Van Cauwenberge, P., and Vander Bauwhede, H. (2013). "Formal Business Networking and Sme Growth," *Small Business Economics* 41(1), 169-181.

Shook, C. L., Priem, R. L., and McGee, J. E. (2003). "Venture Creation and the Enterprising Individual: A Review and Synthesis," *Journal of Management* 29(3), 379-399.

Singh, J. (2005). "Collaborative Networks as Determinants of Knowledge Diffusion Patterns," *Management Science* 51(5), 756–770.

Smith-Doerr, L. (2004). *Women's Work: Gender Equality Vs. Hierarchy in the Life Sciences*. Boulder: Lynne Rienner Publishers.

Snijders, T. A. B., Pattison, P. E., Robins, G. L., and Handcock, M. S. (2006). "New Specifications for Exponential Random Graph Models," *Sociological Methodology* 36(1), 99–153.

Stuart, T. E. (1998). "Network Positions and Propensities to Collaborate: An Investigation of Strategic Alliance Formation in a High-Technology Industry," *Administrative Science Quarterly* 43(3), 668–698.

Stuart, T. E., Hoang, H. and Hybels, R. C. (1999). "Interorganizational Endorsements and the Performance of Entrepreneurial Ventures," *Administrative Science Quarterly* 44(2), 315–349.

Stuart, T. E. and Sorenson, O. (2007). "Strategic Networks and Entrepreneurial Ventures," *Strategic Entrepreneurship Journal* 1(3-4), 211-227.

Tessler, R. C., and Schwartz, S. H. (1972). "Help Seeking, Self-Esteem, and Achievement Motivation: An Attributional Analysis," *Journal of Personality and Social Psychology* 21(3), 318-326.

Volery, T., Mueller, S., and von Siemens, B. (2015). "Entrepreneur Ambidexterity: A Study of Entrepreneur Behaviours and Competencies in Growth-Oriented Small and Medium-Sized Enterprises," *International Small Business Journal* 33(2), 109-129.

Wang, P., Robins, G. L., and Pattison, P. E. (2006). "Pnet: A Program for the Simulation and Estimation of Exponential Random Graph Models." Melbourne School of Psychological Sciences; The University of Melbourne; Australia.

Wincent, J., and Westerberg, M. (2005). "Personal Traits of CEOs, Inter-Firm Networking and Entrepreneurship in Their Firms: Investigating Strategic Sme Network Participants," *Journal of Developmental Entrepreneurship* 10(3), 271-284.

Wofford, J. C., Goodwin, V. L. and Premack, S. (1992). "Meta-Analysis of the Antecedents of Personal Goal Level and of the Antecedents and Consequences of Goal Commitment," *Journal of Management* 18(3), 595-615.

Wolk, S. and DuCette, J. (1973). "The Moderating Effect of Locus of Control in Relation to Achievement‐Motivation Variables1," *Journal of Personality* 41(1), 59-70.

Yin, R. K. (1989). *Case Study Research Design and Methods*. Newbury Park: Sage.

Yli‐Renko, H., Autio, E., and Sapienza, H. J. (2001). "Social Capital, Knowledge Acquisition, and Knowledge Exploitation in Young Technology‐Based Firms," *Strategic Management Journal* 22(6‐7), 587-613.

# Table 1

**Patterns Included in the Exponential Random Graph Models**

|  |  |  |
| --- | --- | --- |
| **Pattern** | **Visualization** | **Interpretation** |
| *Attribute-based patterns* | | |
| Acquisition (continuous or binary attribute) | D:\ERGM-Grafiken\Directed Parameters\[Attr]-Sender.bmp | Relationship between a continuous or binary attribute and the tendency to have knowledge acquisition ties with others |
| Matching (categorical attribute) | D:\ERGM-Grafiken\Directed Parameters\[Attr]-Interaction.bmp | Tendency of managers belonging to the same category to have knowledge acquisition ties with each other |
| *Network endogenous patterns* | | |
| Arc | D:\ERGM-Grafiken\Directed Parameters\Arc.bmp | Baseline tendency for a knowledge acquisition tie to occur |
| Reciprocity | D:\ERGM-Grafiken\Directed Parameters\Recipocity.bmp | Tendency towards reciprocation of knowledge acquisition ties |
| Popularity spread | D:\ERGM-Grafiken\Directed Parameters\Alt-in-star.bmp | Tendency for variation in the degree to which a manager receives multiple nominations as a provider of knowledge |
| Activity spread | D:\ERGM-Grafiken\Directed Parameters\Alt-out-star.bmp | Tendency for variation in the degree to which a manager expresses multiple knowledge acquisition ties |
| Transitive closure | D:\ERGM-Grafiken\Directed Parameters\AT-T.bmp | Tendency for transitive closure to occur |
| Cyclic closure | D:\ERGM-Grafiken\Directed Parameters\AT-C.bmp | Tendency for cyclic closure to occur |

= manager; = manager with binary or categorical attribute or high values on a continuous attribute.

# Table 2

**Descriptive Statistics**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Mean** | **S.D.** | **Min** | **Max** |
| *Continuous variables* | | | | |
| Knowledge acquisition ties | 3.90 | 3.87 | 0 | 15 |
| Innovation orientation in business | 4.94 | 0.71 | 2.76 | 6.08 |
| Perceived personal control in business | 5.49 | 0.63 | 3.00 | 6.70 |
| Need for achievement in business | 5.18 | 0.60 | 3.23 | 6.41 |
| Self-esteem in business | 5.88 | 0.51 | 4.00 | 6.86 |
| Age | 44.77 | 8.29 | 28 | 66 |
| Organizational size (no. of employees) | 48.21 | 54.75 | 1 | 199 |
| *Binary and categorical variables* | | | | |
| Level of education | (0) no doctoral degree: 37.5%  (1) doctoral degree: 62.5% | | | |
| Prior work experience | (1) scientific experience in academia: 39.6%  (2) scientific experience in industry: 16.7%  (3) managerial experience in a company: 25%  (4) experience as founder of a bio start up: 2.1%  (5) no work experience: 16.7% | | | |
| Organizational affiliation | (1) biotech firm: 47.9%  (2) research institute: 29.2%  (3) consultant: 8.3%  (4) venture capital provider: 6.3%  (5) regional association: 8.3% | | | |

*N* = 48.

# Table 3

**Correlations**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| 1. Knowledge acquisition ties |  |  |  |  |  |  |  |
| 1. Innovation orientation in business | 0.40\*\* |  |  |  |  |  |  |
| 1. Perceived personal control in business | 0.23 | 0.34\* |  |  |  |  |  |
| 1. Need for achievement in business | -0.09 | 0.38\*\* | 0.45\*\* |  |  |  |  |
| 1. Self-esteem in business | -0.07 | 0.28 | 0.26 | 0.26 |  |  |  |
| 1. Age | 0.07 | 0.24 | -0.02 | -0.03 | 0.33\* |  |  |
| 1. Level of education | 0.20 | 0.17 | 0.08 | -0.01 | 0.11 | 0.24 |  |
| 1. Organizational size (no. of employees) | 0.03 | 0.16 | -0.20 | 0.05 | -0.29\* | -0.18 | -0.22 |

*N* = 48 managers.

\**p* < .05

\*\**p* < .01

# Table 4

**Results of the Exponential Random Graph Models for Knowledge Ties**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Model 1** | **Model 2** | **Model 3** |
| *Control Variables: Network Endogenous Patterns* | | | |
| Arc | -5.051\*\* (0.407) | -5.619\*\* (0.949) | -4.933\*\* (1.183) |
| Reciprocity | 2.310\*\* (0.361) | 2.312\*\* (0.360) | 2.299\*\* (0.35) |
| Popularity spread | 0.296 (0.178) | 0.564\*\* (0.200) | 0.691\*\* (0.195) |
| Activity spread | 0.460\* (0.192) | 0.300 (0.190) | 0.236 (0.203) |
| Transitive closure | 0.856\*\* (0.131) | 0.739\*\* (0.138) | 0.673\*\* (0.137) |
| Cyclic closure | -0.463\*\* (0.101) | -0.417\*\* (0.107) | -0.389\*\* (0.099) |
| *Control Variables: Manager and Organization Characteristics* | | | |
| Organization size (acquisition) | 0.001 (0.001) | -0.001 (0.001) | -0.002 (0.002) |
| Manager age (acquisition) | 0.001 (0.006) | -0.003 (0.008) | -0.014 (0.011) |
| Level of education (acquisition) | 0.183 (0.116) | 0.099 (0.144) | 0.138 (0.156) |
| Prior work experience (matching) | 0.209 (0.132) | 0.070 (0.145) | 0.108 (0.145) |
| Organizational affiliation (matching) | 0.296\*\* (0.116) | 0.446\*\* (0.133) | 0.529\*\* (0.139) |
| *Main Effects: Entrepreneurial Attitudes* | | | |
| Innovation orientation in business (acquisition) |  | 0.563\*\* (0.139) | 0.936\*\* (0.214) |
| Perceived personal control in business (acquisition) |  | 0.296\* (0.15) | 0.369\* (0.163) |
| Need for achievement in business (acquisition) |  | -0.427\*\* (0.133) | -0.773\*\* (0.193) |
| Self-esteem in business (acquisition) |  | -0.264\* (0.126) | -0.380\* (0.191) |
| *Interaction Effects: Entrepreneurial Attitudes* | | | |
| Innovation orientation \* perceived personal control (acquisition) |  |  | 0.275 (0.353) |
| Innovation orientation \* need for achievement (acquisition) |  |  | -0.221 (0.337) |
| Perceived personal control \* need for achievement (acquisition) |  |  | -0.259 (0.280) |
| Innovation orientation \* self-esteem (acquisition) |  |  | -1.293\*\* (0.444) |
| Perceived personal control \* self-esteem (acquisition) |  |  | 1.051\* (0.453) |
| Need for achievement \* self-esteem (acquisition) |  |  | 0.269 (0.460) |

*N* = 2,224 tie observations.

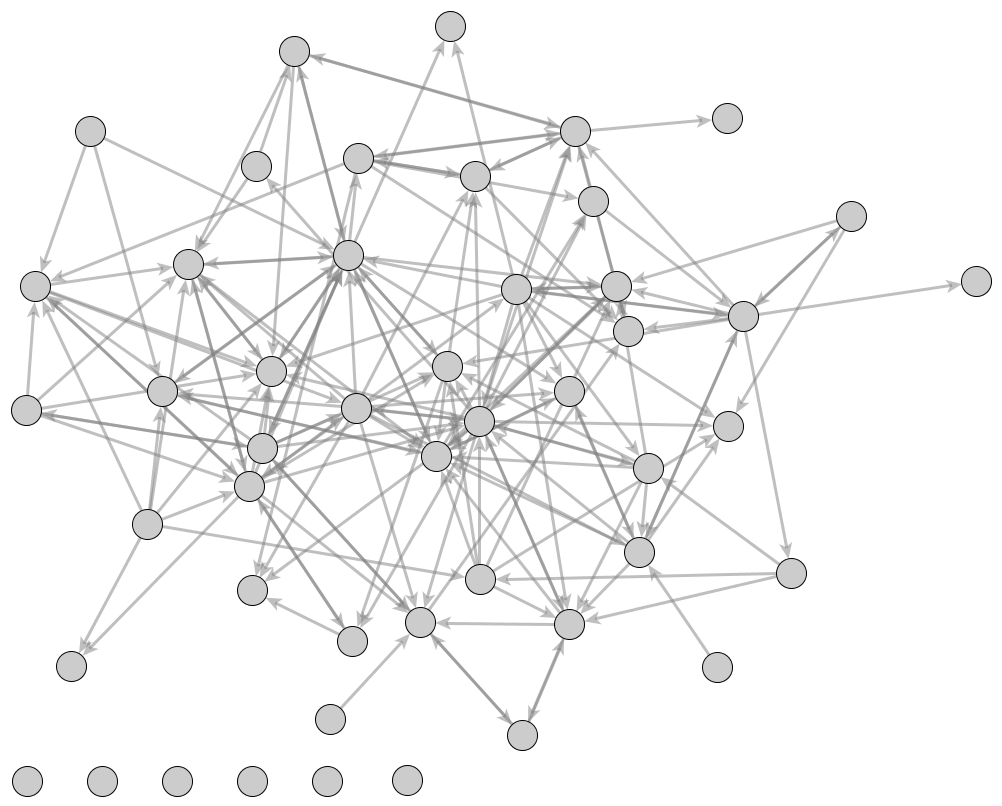
Unstandardized coefficients. Two-tailed tests reported. Standard errors in parentheses.

\**p* < .05;

\*\**p* < .01

# Figure 1

**The Interpersonal Knowledge Network**



1. \* All authors contributed equally. We thank the Editor and anonymous JSBM referees for their helpful suggestions.

   Irena Schierjott is a consultant at Mercuri Urval Management Consulting GmbH Hamburg, Germany.

   Julia Brennecke is Lecturer in Innovation and Knowledge Management at the University of Liverpool Management School, UK, and adjunct researcher at the Centre for Transformative Innovation at Swinburne University of Technology in Melbourne, Australia.

   Olaf N. Rank holds the Chair of Organization and Human Resource Management at the University of Freiburg, Germany.

   Address correspondence to: Julia Brennecke, Department of Organisation and Management, University of Liverpool Management School, Chatham Street, Liverpool L69 7ZH, UK, Email: Julia.Brennecke@liverpool.ac.uk. [↑](#footnote-ref-1)
2. Since all individuals included in our sample held managerial responsibilities within their organizations, we collectively refer to them as “managers”. [↑](#footnote-ref-2)
3. In four of the organizations, we surveyed two managers each, and in another four of the organizations, we surveyed three managers respectively. [↑](#footnote-ref-3)
4. To check for a potential nonresponse bias, we compared the (normalized) number of respondents’ knowledge acquisition ties to other respondents and to non-respondents. The result of a paired sample t-test revealed no significant differences, indicating that no respondent acquired proportionally more knowledge from non-respondents. [↑](#footnote-ref-4)
5. Calculated as exp(0.563\*0.71) = 1.49. [↑](#footnote-ref-5)