‘GUANXI’ AS A SHOCK ABSORBER: LESSENING THE DETRIMENTAL EFFECT OF STRUCTURAL HOLES ON THE ACQUISITION AND INTEGRATION OF KNOWLEDGE

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Research paper

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Abstract
China’s digital ventures are becoming increasingly popular on the global landscape, attracting significant attention on their digital innovation ecosystem; meanwhile, the reduction of communication cost and the convergence of digital technology are distributing the control over innovation activities and amplifying the knowledge heterogeneity, inducing a serious challenge. Facing this problem, collaborative knowledge activities could provide a solution, but in China, there is very limited understanding of this due to the existence of “guanxi”- influential relationships in Chinese culture. To address the gap, we adopt a mixed-methods research approach to explore how guanxi and structural holes affect knowledge acquisition and knowledge integration among Chinese digital ventures at different stages in doubly distributed innovation networks. Our findings indicate that guanxi fosters the acquisition and integration of knowledge by creating a buffer zone, around which knowledge resources flow in the form of favor exchange, ‘renqing’ (favor) accumulation, and ‘mianzi’ (face) preservation. Hence we make three contributions: 1) recognizing guanxi as a shock absorber to lessen the detrimental impacts induced by excessive structural holes situated in innovation networks; 2) identifying the significance of integrators in Chinese culture; 3) uncovering when and what type of guanxi is utilized the most for China’s digital ventures.

Keywords: Guanxi, Structural holes, Knowledge acquisition and integration, Digital innovation networks.

1 Introduction
China’s leading digital entrepreneurs are increasingly exerting their impact on the global landscape that attracts significant attention on their digital innovation ecosystem and calls for a ‘China for the World’ strategy for global business leaders (Leavy 2016). However, the radical reduction of communication and coordination cost as a result of digitization distributes the control over innovation activities widely; meanwhile, the convergence of digital technology is increasingly exacerbating the knowledge heterogeneity, both of which pose a particular challenge (Yoo et al. 2008; Yoo 2013). Facing this problem, we identify two interrelated activities- knowledge acquisition and knowledge integration- as a crucial solution, the implementation of which could be affected by social network structures (Uzzi 1997; Lyytinen et al. 2015). In general, a person holding more structural holes (i.e. the absence of a connection between two contacts) in his/her innovation network tends to take a more leading, crucial role in knowledge coordination (Burt 1992; Santos and Eisenhardt 2005). Nevertheless, most studies highlighting the benefits that accrue to structural holes have restricted their scope to western contexts (Burt 1992; 1997; 2000), when the Chinese culture has a unique influence towards structural holes. As China goes through an economic reform, its legal systems are still evolving, lead-
ing to the rise of informal relations that provide a comfortable zone for Chinese entrepreneurs, in which they ‘have no choice but to rely on guanxi’ (Fu et al. 2006: 4). Defined as ‘the exchange of favors; the cultivation of personal relationships; and the manufacturing of obligation’ (Yang 1994: 6), guanxi is highly particularistic but ubiquitous in China. Unlike traditional guanxi built for long-term cooperation (Ambler et al. 1999) or swift relationship stressing single-shot transaction in online marketplaces (Ou et al. 2014), developing guanxi among Chinese digital entrepreneurs in their innovation networks is a more dynamic process, through which a gradual transition occurs, from being treated as an outsider to becoming a part of an in-group. In this context, cognitive and social resources flow in the form of giving and receiving favors, and those who stand at the boundaries of different in-groups are very likely to be questioned (Lee et al. 2001). Existing research has studied the relation between guanxi and static organizational outcomes, but there is still a further need to understand the dynamics of guanxi on the behavior of Chinese digital entrepreneurs when conducting collaborative knowledge management activities, especially those who enjoy their centrality in their innovation networks. In order to help global business leaders and Chinese digital entrepreneurs better engage with China’s digital innovation ecosystem, within which guanxi is deeply embedded, we aim to explore how guanxi and structural holes affect knowledge acquisition and knowledge integration among Chinese digital ventures at different stages in doubly distributed innovation networks. Thus our core research question is: how does guanxi coordinate the disconnected and heterogeneous knowledge among Chinese digital ventures in their innovation networks? The rest of the paper is organized as follows. In the next section, we review the literature and develop a model; then we use interviews to build hypotheses and use surveys to test them. This is followed by discussion of our findings and implications, and conclusions.

2 Theoretical Background

Our literature review expands across three major themes: knowledge acquisition and knowledge integration in doubly distributed innovation networks, the importance of guanxi in Chinese culture, and the relevance of network theory and structural holes in digital innovation. The next section synthesizes these essential themes in order to respond to our research question.

2.1 Knowledge Acquisition and Integration in Digital Innovation Networks

As digital innovations are seen as inherently layered (Yoo et al. 2010), different actors seek to remix digital components across multiple layers to create new value-in-use (Lessig 2008). In this way, digital innovation springs up, and a doubly distributed innovation network emerges, where widely dispersed actors with heterogeneous cognitive and social resources across diverse design hierarchies compete or cooperate to innovate (Barrett et al. 2012). As the network edge generatively expands, the knowledge becomes increasingly heterogeneous and disconnected, intensifying the need for digital ventures to absorb and leverage various pools of knowledge to create novel associations (Yoo et al. 2008; Kale et al. 2000). Specifically, we identify two activities: knowledge acquisition and knowledge integration. Knowledge acquisition, concerning the ease with which knowledge is accepted within the network, is essential for digital start-ups, since when they are new with limited resources, they tend to seek and absorb external knowledge in order to move away from vulnerable positions and reduce their liability of newness (Colombo et al. 2006; Benkler 2006). With digital technology affording a separation of contents and network and serving as generative memory, digital knowledge resources can flow across various medium boundaries on a real-time basis (Gupta et al. 2007; Yoo et al. 2012). In this way, digital technology facilitates the progress of start-ups to access and absorb knowledge from their innovation networks and increases the depth and breadth of knowledge available to them (Spender 1992; 1996). Drawing on digital technology acting as radar to scan the innovation networks and detecting the knowledge with target precision, digital start-ups can identify and access useful knowledge quickly that reinforce their ability to achieve innovation (Bacheldor 2003; Tsai 2001). As digital ventures grow, knowledge integration is raised when the full potential of the innovation network can only be realized, if and when the heterogeneous knowledge of independent actors are combined and trans-
formed into an innovation (Gold et al. 2001; Kallinikos et al. 2013). As innovations are increasingly moving toward the periphery of doubly distributed innovation networks, the volume and diversity of knowledge have increased exponentially exacerbating the difficulty in integrating knowledge (Carlile 2002). With digital technology enabling a separation of service and device, actors can add novel functionalities to or upgrade existing features from a digital product without a total overhaul of the design (Henfridsson et al. 2014). Such flexibility allows actors to tinker with heterogeneous knowledge in parallel and engage in a reflective learning process where critical reflexivity is inspired, an ongoing modification is promoted and those taken for granted is questioned thereby reducing the marginal cost of integrating differentiated knowledge for innovation (Tilson et al. 2010).

2.2 Conceptualizing Guanxi and Structural Holes in Chinese digital ventures

As highly particularistic ties between people (King 1991), guanxi involves a mechanism governing different types of relationships with varying degrees of social norms. In this context, members of different guanxi clusters are expected to fulfill their varying role obligations (Lin 2001), as Bell (2000) viewed guanxi as a means by which people can accomplish their personal, family or business goal. In the context of digital innovation networks where distributed actors with diverse knowledge compete or cooperate to innovate, we examine two types of guanxi: family or friend guanxi and business guanxi. Specifically, guanxi with families or friends, related by blood or emotionally very close, has a high intimacy, obligation, and expectation due to the embedded degree of mutual trust and dependence as-sociated with each other (Fan 2002). Business guanxi, which is based on personal gain and loss, focuses on seeking business solutions via personal connections (Yang and Wang 2011). Unlike legal contracts, such guanxi is unstable due to the sparse interconnection and low levels of trust so that these transient ties enable people to treat each other as outsiders in one business deal (Yau et al. 2000). Unlike traditional guanxi built for long-term cooperation with high levels of commitment (Ambler et al. 1999), or swift relationship stressing one-time transaction in online marketplaces which is shallow (Ou et al. 2014), guanxi between digital ventures in doubly distributed innovation networks is more dynamic, highlighting ‘any given guanxi is not fixed in a given circle but can move outward to become more distant or inward to become closer’ (Chen and Chen 2004: 312), and thus developing guanxi is a gradual transition process from being treated as an outsider to becoming a part of an ingroup (Lee et al. 2001). Guanxi in digital innovation networks inherits the traditional guanxi in Confucian culture (Chen et al. 2004) to facilitate resource mobilization by exchanging favors, accumulating renqing and preserving mianzi (face) before, during or after the innovation. Specifically, among all the elements measuring guanxi, renqing stressing the social exchange nature of guanxi, is a lubricant for emotional and economic favor exchange in the pursuit of relational longevity, and values reciprocity reflected in highly symbolic interactions where many signals are silent embedded in mutual understanding, trust and expectation between two digital players (Wang 2007). As Yang (1994) noted, renqing once is developed, a person can ask a favor from someone with an obligation to repay this favor in the future. Hence such reciprocal favor returns are significant for maintaining guanxi in highly uncertain innovation networks (Luo 2005). Besides renqing, mianzi serving as a social currency has an absolute value in China: giving or saving mianzi symbolizes the Chinese social rituals while losing mianzi may degrade and dissolve the guanxi (Hwang 1987). From the view of hierarchical ties, the underlying social status of mianzi is a fundamental aspect of favor exchange; between two innovators with a dramatic difference in social power, saving the senior innovator’s face means a big favor giving that may lead to a greater favor in return for the junior innovator (Zhang and Zhang 2006). Shedding light on the dynamics of guanxi in digital innovation networks, another unique element is ingroup (Leung and Bond 1984): the Chinese tend to make a clear distinction between people belonging to in and out the group and impose clearly defined boundaries on network membership. Imagining two concentric circles (Tsui et al. 2000): in-group is the inner circle implying a small yet trusted network through which an abundance of resources flow in the form of favor exchange; out-group is the outside of the circles composed of outsiders. The middle between two concentric circles indicates guanxi with
a potential to become an insider, but time has not yet proven the relation strong enough nor has trust been sufficiently built (Tsui and Farh 1997). Thus the middle group within digital innovation networks needs investing efforts to accumulate enough renqing and to preserve enough mianzi so as to show the willingness and ability to become an insider (Wang 2007). However, actors who stay at the boundary of two in-groups may be severely disadvantaged as both in-groups may distrust them and treat them as outsiders whose behavior of standing on two boats is socially disparaging (Batjargal 2005).

Drawing on the theories such as the strength of weak ties (Granovetter 1973), betweenness centrality (Freeman 1977), and structural autonomy (Burt 1980) with their roots in western worlds, Burt (1992) defined a structural hole as the absence of a connection between two contacts both linked to an actor. In the context of digital innovation networks, structural holes may occur when information disseminates faster within a group than across groups (Batjargal 2010). In reality, actors can trace merely a few ties while losing track of many others due to conflicting beliefs and heterogeneous knowledge (Burt 2005). Also, brokers, intermediaries between otherwise disconnected contacts, may deliberately maintain structural holes to pursue monopolistic information and control advantages providing them enough space to spot and recombine digital components across multiple layers in a novel way (Burt 2002). Hargadon and Sutton (1997) originally recognized the value of bridging structural holes in technological innovation by finding how technology brokers enhance their innovation outcome from their in-between vantage points. Hargadon and Sutton (2000) further raised the concept of knowledge brokers and revealed how they take advantage of their central positions to access, transfer and recombine knowledge for spurring innovation. Built upon these concepts, we focus on how brokers leverage structural holes between distributed and various digital ventures to stimulate innovation within doubly distributed innovation networks. Echoing the traditional information advantage that accrues to structural holes (Burt 1992; 1997), the vantage points within a digital innovation system help brokers achieve a knowledge advantage (Verona et al. 2006). Specifically, standing at the hub makes brokers dialogue with a range of disconnected digital ventures, absorb and leverage dispersed knowledge, filter redundant knowledge out and then redistribute it for innovation (Regans et al. 2004; Ahuja 2000); due to the central positions at the crossroads of networks, they are early to touch the novel knowledge which increases their innovation speed (Burt 1999); the vantage points also help them secure rare acquaintances with valuable innovation resources, make them attractive and become candidates for new innovation opportunities (Burt 2000; Verona et al. 2006). Similar to the most key benefit claimed in the traditional literature, digital brokers can also achieve the power and information control by brokering exchanges between disconnected actors who lack access to each other within their innovation networks (Gulati 1999). By acting as the third party who benefit, brokers can exercise control over ‘whose interests are served’ (Burt 2000: 354), and manipulate the relations by strategically playing isolated digital ventures against one another (Brass et al. 1998) to expand their power for innovation.

However, excessive structural holes may expose the intermediary actors to conflicting allegiances (Podolny and Baron 1997) increasing the difficulty to optimize innovation performance. When digital innovation is distributed among diverse actors, excessive structural holes induce thick boundaries to the flow of knowledge which hinder the diffusion and realization of innovation (Brown and Duguid 2000; von Hippel 2005). The high maintenance cost is another issue argued by Burt (2002); unlike guanxi cultivated in the long run, structural holes chase short-term benefits, as new direct links may appear between those who have not yet known each other leading to the decay of previous structural holes. When distributed digital ventures at the periphery of the innovation network connect with the focal venture at the core, they tend to build direct links to each other to reduce their dependence on the core venture whose brokerage benefit then is deprived (Baum et al. 2003). Hence, maintaining structural holes consumes considerable efforts that attenuate their primary benefits, as Batjargal (2010) found, the Chinese do not benefit from structural holes as the spanning cost is higher than its return.

2.3 The Effect of Guanxi on Structural Holes in Chinese Innovation Networks

The root of structural hole theory is in Western contexts (Burt et al. 2000), but whether it is valid in
China with a contrasting institutional mechanism and cultural norm is worth exploring. In order to reduce uncertainty in immediate environments, the Chinese rely on their guanxi heavily that serves as a protection against dysfunctional legal systems and a substitute for formal institutional orders (Haveman et al. 2016), and tend to preserve socially proximate guanxi ties leading to cohesive innovation networks with poor structural holes (Batjargal 2005). Additionally, the collectivistic value affects the ways in which the Chinese perceive structural holes and organize their innovation networks (Luo 2007). Embedded in Confucian culture, the control benefit can barely be realized since the Chinese do not appreciate the brokerage, consistent with the work of many scholars. For example, Xiao and Tsui (2007) revealed the controlling behavior is incongruent with the dominant spirit of the Confucian philosophy. Frye (2000) found brokerage is perceived as unethical as it triggers competition between two contacts to maximize the broker interest. Burt (2000: 354) indicated that by manipulating ‘accurate, ambiguous, or distorted information’ strategically between two sides, the broker has a ‘disproportionate say in whose interests are served,’ adding value to the broker at the expense of the group as a whole. Thus, the digital actors with high concerns for renqing and mianzi tend to keep them away from controlling the information and relations at the expense of deteriorating collective interest and tarnishing personal reputation within their innovation networks. Apart from attenuated control benefits, the Chinese brokers cannot fully realize their own knowledge benefit for innovation because the social cognitive mechanisms valuing communal-sharing make them attribute a significant share of the pie as the group contribution and a small proportion as the broker contribution (Verona et al. 2006; Xiao and Tsui 2007). Also though the bridging function of structural holes increases brokers’ bargaining power, the severe sanction mechanisms prevent them from taking advantage of this power to achieve their fair share (Saxenian and Quan 2005). The two mechanisms in combination substantially decrease the material and intellectual gains from brokerage thereby reducing their returns from structural holes (Xiao and Tsui 2007). When brokers have to bear the high cost of maintaining structural holes while gaining a low return, they pay more social costs so that they are less willing to brokerage leading to fewer structural holes in their innovation networks (Burt 1992; Davison and Ou 2008).

However, the knowledge benefit may not disappear entirely when the intermediary actor prefers to play an integrator rather than a controller in brokering conditions (Verona et al. 2006; Xiao and Tsui 2007). When different cliques exist inside the digital venture or between digital ventures, effective coordination and communication across boundaries is vital (Oh et al. 2004). Thus entrepreneurs with high concerns for renqing and mianzi tend to bridge the boundaries to facilitate the knowledge flow, and to bring dispersed actors together, making the whole network share the broker knowledge benefit for digital innovation (Gu et al. 2008). Specifically, in doubly distributed innovation networks, a variety of digital ventures with their heterogeneous knowledge struggle to create novel components based upon shared digital platforms (Yoo et al. 2010). The connection between these ventures is most likely dialogical, with each venture follows their own innovation trajectories interlaced with one another affecting the innovation of the whole network (Yoo et al. 2008). When the middle persons at the focal node of the innovation network build new links between otherwise disconnected contacts, they foster the knowledge flow through the whole network, and allow separate actors to access mutual knowledge and then to recombine it in novel ways, which accelerate the innovation progress (Arora et al. 2002). In this way, the brokers tend to become the integrators by filling their holes and turning indirect ties into direct ties to help isolated actors access knowledge from not only their partners but also their partners’ partners (Ahuja 2000). As distributed actors engage with various innovation trajectories in a trading zone (Boland et al. 2007), they cross boundaries to leverage knowledge for innovation.

The above review shows that our insight into how guanxi and structural holes affect the acquisition and integration of knowledge in Chinese innovation networks is still very limited. Next we will discuss in more detail how these mechanisms affect one another and construct our model and hypotheses.
3 Research Design, Model and Hypothesis Building

We use a mixed-methods approach involving a sequential approach which begins with a qualitative method to expound the theoretical constructs of the model and follows with a quantitative method to test the hypotheses. Generally, mixed-methods research is used to obtain a more systematic account of a phenomenon (Zachariadis et al. 2013). Qualitative methods can not only develop propositions but also identify the mechanisms in which complex phenomena interact between them, while quantitative methods are able to identify unobvious regularities in a larger sample where qualitative methods would not have been able to do so. In our study, we use interviews not only to explore the relations and construct our hypotheses but also to make better sense of the quantitative results by revisiting our interview data. In parallel, our quantitative analysis of the survey makes us test these relations and estimate their impact which is then discussed in combination with our qualitative results and theory.

Our model depicted above (Figure 1) captures the two stages of the digital ventures, and explores how guanxi and structural holes affect the acquisition and integration of knowledge in digital innovation networks. Specifically, the first part of the model investigates the role of family or friend guanxi and structural holes in knowledge acquisition at start-up stage. When the venture is new with limited resources, the emphasis would be on gaining knowledge from external networks that may be fostered by family or friend guanxi but hindered by structural holes. Respectively, the second part examines the role of business guanxi and structural holes in knowledge integration when ventures grow up. As they confront increasing competition, the focus would shift to knowledge integration that may be promoted by business guanxi while impeded by structural holes. The model further explores the moderating effect of business guanxi on the relation between structural holes and knowledge integration. In order to gain qualitative evidence on the model efficacy and build 5 hypotheses along the paths to map the effects, we conducted interviews with 48 entrepreneurs who were all founders of the 41 digital ventures in Beijing, the products of which included digital games, video software, and mobile apps. The venture age ranges from 2 to 20 years with sizes varying between 10 to 500 staff. The average age of the founders was 42. We asked about informal guanxi among the network members, and how such guanxi affects their knowledge processes. Each interview lasted about 45 minutes, and the qualitative analysis involved coding interview transcripts to identify key themes and categories (Nandh Kumar and Jones 1997). The analysis began with some initial codes and enabled further ones to emerge progressively. By recursively moving back and forth between data and theories, we checked whether the data support the emerging themes and whether theories make sense of the empirics (Maxwell 1992).

The hypothesis development is summarized as follows. When digital start-ups are vulnerable with limited resources, they are assumed to be highly dependent on their family or friend guanxi that carries a commitment advantage due to a high level of relational proximity (Anderson 2008). By providing emotional support and resource access, families or close friends may buffer the depressed affection of nascent entrepreneurs toward innovation pressure and give them a shelter from opportunism (Pollack et al. 2012; Chen et al. 2013). As an interviewee mentioned, “when I started my firm, it was tough to gain an initial user base, which made me very stressful. My friend pulled me into a mobile media [innovation network] and introduced me to the CEO of a mobile operator firm, who has a very high social status. He allowed me to share his digital product platform, and provided me exclusive information regarding its affordance and constraint, so that I had more opportunities to design innovative and welcoming apps upon his platform. I knew he is not the person with whom I can easily develop
guanxi. This favor from my friend was priceless. He gave me hopefulness and encouragement to make me realize I am not alone when I struggled with the start-up pressure.” Many scholars have studied the role of relational proximity in knowledge acceptance: a high relational cohesiveness makes young entrepreneurs less willing to withhold resources but more motivated to credit each other’s perspectives (Yli-Renko et al. 2001); the lock-in effect produced by intimate networks increases members’ motivation to input cognitive resources that fosters the assimilation and obtainment of knowledge (Hansen 2002). The high relational proximity facilitates the flow of cognitive resources throughout the innovation networks that decreases the cost of receiving knowledge across structural holes and lowers start-ups’ entry barrier to digital innovation (Nambisan 2013). Thus we hypothesize that:

**H1:** For knowledge acquisition in doubly distributed innovation networks, Chinese entrepreneurs primarily rely on family or friend guanxi at their start-up stages.

However, excessive reliance on structural holes at this time likely induces three issues among Chinese start-ups: first, structural holes within digital innovation networks may slow down the communication progress among distributed actors who barely know each other (Batjargal 2005), as an entrepreneur said, “it is a broken communication. When I connect the component with the interface, I have to talk to the designer via a third person. It’s very inconvenient.” Secondly, structural holes are likely to trigger the creation of boundaries to the flow of information leading to a bottleneck in knowledge diffusion (Batjargal 2010), that decreases the innovation efficiency since the quality of information deteriorates as it transfers from an actor to the other in a chain of intermediaries (Baker 1984), as reflected in the interview, “it takes a long time to pass on information from one by one. When I receive this ‘multiple-hand’ information, I cannot tell if it is authentic or still valid. These holes break the data flow and slow down the innovation progress.” Third, a mismatch of strategies may be further induced as a reflection of dispersed, vague and distorted information (Batjargal 2004). It is consistent with the result of an interview, “maybe you call me a pessimist, but I believe people tend to hoard information in order to keep their power in hand.” These issues as discussed above may amplify the knowledge discontinuity that exacerbates start-ups’ difficulty in acquiring fine-grained knowledge across structural holes. Specifically, based on the transactive memory theory (Wegner 1986), the knowledge of who knows what is essential for the development of collective intellectual capital for innovation, but dispersed commutation likely maximizes the silo effect and minimizes the collective learning intensifying the efforts needed for knowledge acquisition that start-ups cannot afford (Gulati 1999). It can also be seen in an interview, “to those people whom I don’t know directly, I rather work on my own...Converting information into knowledge needs a common ground, without which what we get from structural holes is only an abundant of messy information, but it's hard to create across these holes.” Also, knowledge obtainment is not just a matter of copy and paste from the sources to the recipients but a new generation process where mutual trust is highly vital to remove the barrier to tacit, embedded knowledge transfer, while unsmoothed information mobilization may hinder trust building that amplifies the stickiness of knowledge flow around structural holes (Szulanski 1995). Last, Obstfeld (2005) noted how a mature firm could maximize its benefit from a network of start-ups who are too vulnerable to protect their core techniques, while unfocused strategies induced by structural holes aggravate their exposure to unethical brokerage and potential malfeasance (Bizzi 2013). As a nascent entrepreneur mentioned, “In order to survive, I joined in the digital innovation alliance in Zhongguancun. However, to prevent my firm from falling into a dangerous situation, I must keep vigilant. I verify all the information originated from unknown sources.” Thus we hypothesize that:

**H2:** Excessive reliance on structural hole spanners impedes knowledge acquisition at start-up stages.

As digital start-ups grow, the Chinese increase their reliance on business guanxi with an implicit rule of favour exchange (Peng 2003) among actors in asymmetric social status. From an affective view, rening makes entrepreneurs give favors to those in need with confidence that these favors can automatically become the obligation of the receivers to repay them in future (Tsai 2001). From a hierarchical perspective, the underlying asymmetric social status of mianzi is a fundamental aspect of exchanging favors that giving someone face symbolizes a big favor giving leading to a greater favor in
return (Luo 2007). It can be presented in the interview, “gei mianzi [giving someone face] is very significant in China. The Chinese care about their mianzi, especially those with more social power. So saving the face of the big shots can help you develop a renqing with them that may return you a bigger favor in the future.” With favor mobilization, heterogeneous cognitive and social resources can flow freely throughout the innovation networks, with which actors can tinker flexibly to inspire critical reflection, question those taken for granted, promote perspective taking and enhance sense-making of the diversity of practice-based knowledge (Huang et al. 2017; Gupta et al. 2007). Such strong accommodation between each other’s perspectives homogenizes each other’s mindsets that promote increasing cognitive proximity among independent entrepreneurs (Lin 2001), as Boschma (2005) found among relatives, friends and business partners, business partners have the closest cognitive proximity with the entrepreneurs. This ‘optimal cognitive distance’, at which the network actors’ knowledge bases demonstrate adequate complementarities to learn from each other, while maintaining fluent communication throughout reciprocal understanding (Nooteboom et al. 2007; Cantner et al. 2010), can enhance their capacity to leverage mutual expertise so as to foster the coordination, integration and transformation of knowledge into novel ideas across their pragmatic boundaries (Schutz et al. 2009).

As in the interviews, “when I joined in the innovation network, I expected to learn from each other because we have similar expertise and experiences. It is like that I wouldn’t discuss technical issues with my mother.” “We have an alliance for digital innovation where all the members have a similar background in creating and designing digital products, so it is easy for us to communicate and discuss the potential of a creative idea. Sometimes they can give me the suggestions that are exactly what I wanted.” This view is in line with the work of many scholars: an appropriate similarity in market and technology intelligence can reduce the stickiness of the embedded knowledge flow (Dyer and Singh 1998); members with more matched cognitive embeddedness can better assimilate the tacit knowledge from each other (Buttner 1992); persons with more shared mental models are more willing to exchange ideas that others viewed as useful (Robert et al. 2008). Thus we hypothesize that:

**H3:** For knowledge integration in doubly distributed innovation networks, Chinese entrepreneurs increase their reliance on business guanxi at their growing stages.

Nevertheless, excessive reliance on structural holes at this time amplifies the incompatibility of personal values and behaviors of heterogeneous actors (Bizzi 2013). Brokers embracing a cost-benefit calculus tend to manipulate information to exploit personal power, while others who value social obligation like to pass on information in collective interest (Marks et al. 2001). As members uncover conflicting beliefs and behaviors, they may produce unpleasant affections, as when brokers control information for personal gain, the isolated actors have to pay for it inducing their resentment toward brokers (Bizzi 2013). Also, brokers deriving personal benefits from structural holes decrease other brokers’ chances, so that all brokers may perceive each other as competitors and have hostile attitudes toward each other; the shared perceptions of potential opportunistic behaviors further deepen mutual monitoring and dependence, which prevent brokers from relinquishing control and heighten their risk of being overloaded (Costa et al. 2007). All of these issues may reduce the network actors’ motivation to leverage, integrate and coordinate knowledge, as interviewees stressed, “in their mind, there is no cooperation...He [broker] blocked me from Wang [a chief operator] in private, so I had to find Wang via him every time.” “If I know someone keeps taking advantage of me, I will keep away from him. I won’t cooperate with him anymore...They [brokers] compete mutually. They hold each other in play.” Furthermore, the increased dissimilarities in actors’ social and technical worlds, induced by excessive structural holes, prevent them from building shared understanding and thus pose the action problem, exacerbating the knowledge heterogeneity and hindering the coordination of cognitive pieces (Obstfeld 2005; Yoo 2013). Some scholars have stressed the positive relation between structural holes and knowledge heterogeneity. For example, Sandström (2004) found that a greater number of structural holes imply a higher degree of heterogeneity in knowledge. It can be seen from the interview, “we [user interface designers, software programmers, product managers] have different expertise and handle problems in various ways. I respect this fact, but I don’t think it is conducive for leveraging our
expertise to innovative. Rather, it decreases our efficiency. They often give me some redundant information that I thought as unhelpful. " Thus we hypothesize that:

**H4: Excessive reliance on structural hole spanners hinders knowledge integration at growing stages.**

Last, business guanxi is supposed to fill structural holes and pull previously disconnected actors together into an in-group to dampen personal controlling behaviors and enhance collective intelligent benefits (Xiao and Tsui 2007). Specifically, trust building among the Chinese is very tough as they do not make any assumption about anyone’s goodwill apart from their relatives or close friends, so most business dealings rely heavily on personal and entrepreneurial trustworthiness (Redding 1990). Thus within an interwoven business network where the Chinese perceive the brokerage as unethical, and prestige flows via mouth-to-mouth dissemination, those who have a higher concern for renqing and mianzi are less willing to profit from the brokerage at the expense of losing the future benefit and tarnishing personal reputation (Batjargal 2005). Also, the collectivistic value makes the Chinese who stay at the boundaries of isolated actors fill the holes and act as a ‘real’ bridge in order to accelerate the flow of information and foster the mixture of dispersed cognitive pieces so that the whole in-group can share the intelligence benefits that belonged to brokers (Tan et al. 2015). As an entrepreneur highlighted, “the persons who stand on two boats, we perceive them as disloyal. I don’t think they are smart. Rather they are short-sighted. The brokerage ruins their reputation. The group interest should always come first. In China, the flames rise higher when more persons add fuel to it.” By providing the favor of introducing unknown contacts to know each other, integrators invest their renqing that can extend through the network quickly leading to a greater return such as public acknowledgement and personal credibility, since the Chinese tend to trust those persons who are introduced by their trustworthy sources (Lin 2001; Reve and Lu 2001). As interviews showed, “the Chinese take renqing seriously. With renqing in place, many things can be done smoothly. By the official rule, completing a procedure takes one day, but it may be done in a minute if you have a renqing with the person in charge. Renqing is like money that can be banked and retrieved later. However, if you want to be the leading sheep, you control relations and get caught, you screw up!” “Zhu introduced Li to me and asked me to bring Li into an in-group. Zhu had ever helped me so I trusted him very much. When I verified Li with Zhu, I turned to trust Li and brought Li into that circle.” “Introducing unknown talents to know each other can help me achieve a good reputation in this circle.” In this way, a buffer zone appears around which an abundance of cognitive and social resources flow in the form of favor exchange, renqing accumulation, and mianzi preservation. When isolated actors get access to the buffer zone, with ‘taking in outside perspectives’ (Schutz et al. 2009), they cross pragmatic boundaries to negotiate their ‘hard-won’ knowledge perspectives reflectively and transform their embedded intelligence jointly for resolution, where expansive learning springs up to foster the integration of knowledge into increased ‘wakes of innovation’ (Boland et al. 2007). As an entrepreneur said, “my friend brought me to this circle, and I have learned how other big shots use their ways of thinking to solve problems. I have a full picture of each other’s expertise and clearly see how they put pieces of thoughts together, transform these into a plan and make it work. My friend is like the glue holding us together.” Thus we hypothesize that:

**H5: Business guanxi moderates the effect of structural holes on knowledge integration in doubly distributed innovation networks at entrepreneurial growing stages.**

### 4 Quantitative Research and Quantitative Results

We used web-based surveys to test the hypotheses. We measured the items using seven-point Likert scales ranging from 1=strongly disagree to 7=strongly agree. We selected 300 digital firms founded in Beijing, covering digital products, software as well as apps and divided them into two types: the ventures with age below 3 years were start-ups, and the remaining were growing ventures. In order to collect reliable data, we asked key informants to respond the surveys who were engaging in digital innovation networks and able to use their social connections to obtain knowledge resources. We distributed 450 questionnaires and deemed 225 usable for the quantitative analysis, of which 100 were start-ups,
and 125 were growing ventures. Start-ups had a mean age of 2.2 years with average size of 16 persons. Growing ventures had a mean age of 11 years with average size of 151 persons. We measured structural holes (SH) with 4 items by asking respondents in their innovation networks if they felt easy to (1) gain non-redundant information, (2) control relations among disconnected actors, (3) manipulate various information among disconnected actors, (4) touch the new information and opportunities early (Burt 2002). We measured family or friend guanxi (FG) with 5 items by asking respondents in their innovation networks if they (1) had a brotherhood affection toward network actors, (2) felt obliged to concern about the feelings of network actors before making decisions, (3) felt willing to help network actors who are in need, (4) believed that network actors are frank with them, (5) believed that they can count on network actors when they have difficulties (Chan et al. 2002). We measured business guanxi (BG) with 6 items by asking respondents if in their networks they (1) felt obliged to grant a favor for network actors first, (2) felt embarrassed if they do not return a favor to network actors, (3) felt happy to receive a favor from network actors, (4) viewed favor exchange as a vital part of guanxi maintenance with network actors, (5) felt a sense of obligation to preserve the face of network actors, (6) felt embarrassed to damage network actors’ reputation (Yen et al. 2011). We used 4 items to measure knowledge acquisition (KA) by asking respondents if they had (1) accessed diverse information, (2) learned from network actors’ experiences, (3) gained technical training from external sources, (4) assimilated complementary knowledge from their innovation networks (Tsai 2001). We measured knowledge integration (KI) with 3 items by asking respondents if they had (1) spanned diverse expertise to create a shared understanding, (2) blended new expertise with existing skills for innovation, (3) leveraged dispersed information pieces into coherent knowledge for innovation (Grant 1996).

Table 1 presents the measurement results of the two samples. For each sample, we conducted an exploratory factor analysis of three measures using a principal axis factoring analysis with oblimin and Kaiser Normalization rotation. Specifically, KMO was 0.766 and 0.751 indicating that the data was suitable for factor analysis. The data also showed support for each three factors that have eigenvalues greater than 1 as well as 94.505% and 91.535% of the variance respectively. The primary loadings exceeded 0.692 and 0.622, as well as both Cronbach’s alpha was 0.914 and 0.902 implying high internal consistency reliability. Furthermore, we carried out a confirmatory factor analysis by Amos, using the two-step approach raised by Anderson and Gerbing (1988). First, all indexes displayed a good model fit with each sample (for start-ups: CMIN was 487.155 with 394 DF, NFI was 0.991 and RMSEA was 0.019; for growing ventures, CMIN was 734.155 with 398 DF, NFI was 0.901 and RMSEA was 0.031). Second, we examined the convergent validity by testing the significance of the factor loadings and its gap to the standard deviation (SE) (Koufteros 1999). All item loadings were above the suggested cutoff of 0.6 (Hair et al. 1998) with a strong significance level (***p < 0.001), all SE values were round 0.1, and all the C.R. values were above 0.7 implying a good convergent validity. Finally, we used the square root of the AVE to examine the discriminant validity. We found that all square roots of the AVE shown on the diagonal of the correlation matrix were greater than the off-diagonal construct correlations, indicating distinctness in its discriminant validity (Koufteros 1999).

Regarding the structural model, we used Amos to test the hypotheses (results in Figure 2). First, the coefficient of family or friend guanxi was positive and significant for knowledge acquisition ($\beta = .46$, p<.001) that supported H1. Secondly, the coefficient of structural holes was negative and moderately significant for knowledge acquisition ($\beta = -.09$, p<.01) that supported H2. Third, the coefficient of business guanxi was positive and significant for knowledge integration ($\beta = .23$, p<.001) supporting H3. Fourth, the coefficient of structural holes was negative and significant for knowledge integration ($\beta = -.12$, p<.001) which was in line with H4. Finally, the interaction coefficient for business guanxi and structural holes was positive and highly significant for knowledge integration ($\beta = .42$, p<.001) supporting H5, and Figure 3 plotting the interaction showed that the negative relation between structural holes and knowledge integration is buffered when business guanxi is high.
Table 1. The measurement results of the start-ups and growing ventures samples

5 Discussion and Implications

Our findings manage to answer our research question and thus make three contributions. Our primary contribution is the recognition of guanxi as a shock absorber to lessen the knowledge discontinuity and heterogeneity amplified by excessive structural holes situated in Chinese digital innovation networks. Our result regarding structural holes’ disadvantages in the Chinese context is different from their claimed benefits in western worlds (Burt 1992; 2000). Specifically, the loosely coupled layers of doubly distributed innovation networks leads to knowledge being too distributed and heterogeneous; meanwhile, networks with excessive structural holes induce issues of poor communication and coordination, restricted information mobilization and a mismatch of strategies, amplify the incompatibility of personal values and behaviors, as well as intensify the dissimilarity in actors’ capacities and expertise, which in turn exacerbate the knowledge discontinuity and heterogeneity. Within the Chinese society built upon interwoven networks of social relations, guanxi pulls previously non-connected digital players together into an in-group, around which cognitive and social resources flow in the form of favor exchange, renqing accumulation, and mianzi preservation. By promoting cognitive and relational proximity at an optimal level, guanxi creates a buffer zone (Figure 4) that fosters the acquisition and integration of knowledge for innovation. In this sense, our focus on how business guanxi and structural holes beneficially coexist to coordinate the innovation networks, contributes a novel network con-
figuration meshing guanxi and structural holes in a complementary way, which promotes the distinctive recombination of dispersed knowledge pieces around structural holes for innovation.

Second, although we identify the detrimental effect of structural holes in the Chinese context, we do not deny the significance of those central actors who occupy nodal positions in their networks. Rather we contribute to the literature by systematically presenting how Chinese structural-hole holders facilitate the acquisition and integration of knowledge to coordinate the knowledge discontinuity and heterogeneity in innovation networks. Specifically, we stress the pivotal role that ‘integrators’ take who sit at the boundaries of various worlds in the network, in influencing the other actors’ relationships and activities to mediate and orchestrate their innovation networks, when and where it is needed. Unlike traditional brokers controlling the information inflow and outflow to maximize their personal benefits, Chinese integrators tend to serve as a ‘real’ bridge or an ‘honest broker’ (Obstfeld 2005), by opening the gate to bring outsiders into a buffer zone, where the previously isolated actors around structural holes are connected, and the otherwise non-connected pools of knowledge are enriched.

Third, we uncover evidence on when and what type of guanxi is used the most for China’s digital ventures complementing the literature in network theory. By making a distinction between family or friend guanxi and business guanxi, and identifying the role each guanxi plays in entrepreneurial start-up and growing stages, we capture the dynamics of guanxi in entrepreneurship network relationships and stress the relationship control among various Chinese digital ventures. Within a layered modular architecture, the distinctiveness of a mature digital venture depends on its capacity to build a digital platform, encompassing loosely coupled layers of devices, networks, services, and contents, attracting various actors to remix digital components across for digital innovation (Yoo 2013). Thus it is vital for mature ventures to utilize their business guanxi strategically, with an implicit rule of exchanging favors among actors in asymmetric social status (Peng 2003). By developing proper incentives to attract small start-ups to join the innovation network while controlling the core components, the established ventures reconcile the co-presence of competition and cooperation among different actors based on a common platform (Henfridsson and Yoo 2014). However, for those start-ups that cannot afford a digital platform and seek to create novel components across multiple design hierarchies, we found that they have no choice but to rely on their family or friend guanxi, which can convey them a commitment advantage. It is hence key for Chinese entrepreneurs to identify the relative advantages of family or friend guanxi and business guanxi to apply the right guanxi at the right time.

Our study has three key research implications. First, we raise a new concept of ‘a buffer zone’ created by guanxi that extends the existing concept of ‘trading zone’ (Boland et al. 2007). Specifically, by underlining the socio-technical nature of innovation networks which are shaped by not only digital technologies but also cultural context, Lyytinen et al. (2015) stressed that digital innovation involves social translations that occur at the boundaries of communities, in a ‘digitally enabled trading zone’ (Yoo et al. 2010), where actors cross pragmatic boundaries (Carlile 2002) to mutually negotiate, trade and interrelate their knowledge. Considering the cognitive fragmentation and complexity, we highlight the ability of guanxi to create a buffer zone for Chinese digital ventures where favour exchange, renqing accumulation and mianzi preservation emerge to foster the acquisition and integration of knowledge in order to realize the potential for innovation. It thus presents a research implication on conflict management between diverse voices in a negotiation, sense-making and sense-giving process in the Chinese context (Boland and Tenkasi 1995). Second, we stress the importance of the ‘integrator’ role in the Chinese innovation network context. Specifically, we highlight the willingness of those hub actors to act as ‘structural-hole fillers’ and their capacity to perform as the glue holding the network together, which provide an implication on the difference identification among ‘knowledge broker’ (Hargadon and Sutton 2000), ‘social broker’ (Lyytinen et al. 2015) and ‘honest broker’ (Obstfeld 2005). Also, by showing that actors occupying excessive structural holes very likely encounter boundaries rife with tensions (Carlile 2002) that amplify the knowledge discontinuity and heterogeneity, we contradict the work of Burt (1992; 1997; 2000), who claimed the control benefit that accrue to structural holes in typical western cultures and economies, producing an implication for researchers to pay more attention
to their potential detrimental effect in the Chinese context. Finally, by exploring how different types of guanxi affect different knowledge management activities at varying entrepreneurial stages, we highlight that developing guanxi between digital players is a more dynamic process where a transition from being treated as an outsider to insider may happen. This finding is different from the traditional guanxi valuing long-term cooperation (Ambler et al. 1999), or swift relationship highlighting one-time transaction in online marketplaces (Ou et al. 2014), and provides a research implication on the dynamics of entrepreneurship network relationships in collaborative knowledge processes.

Besides research implications, our study also underlines two practical implications. First, our focus on the ‘integrator’ role produces an implication on incentive creation for structural-hole filling. Specifically, our finding helps Chinese entrepreneurs realize the significance of cultivating guanxi with the persons who occupy yet-to-be-filled structural holes so as to make them inspired and committed to the innovation network where and when it is needed the most. Embedded within the Confucian culture, entrepreneurs should utilize intelligently mianzi and renqing to encourage the structural-hole-filling behavior. For example, entrepreneurs can honor privileges to those integrators to attract more persons who remain at the boundaries of separated contacts to fill holes for their mianzi gaining. Besides saving mianzi, giving someone face is also a significant motivator for hole-owners to serve as hole-fillers. The Chinese value their mianzi, especially those who have more power, and thus giving them mianzi by introducing them to new and useful contacts or privileged circles can help the integrators accumulate more renqing essential for their future development. The alliance organizers can also arrange more social events to facilitate the exchange of favor among collaborative innovators so as to make each other feel attached and committed to the innovation network. Furthermore, our focus on the significance of the ‘integrator’ role provides suggestions for Chinese entrepreneurs to perform as a competent coordinator or orchestrator in their innovation networks. Specifically, considering the knowledge heterogeneity, it is vital for the integrators to foster the creation of a common language or a common ground for interaction and communication, which promotes the mobilization and codification of tacit knowledge among the network actors. Also, it is crucial for the integrators to facilitate the relational embeddedness to increase the network members’ willingness to contribute their knowledge for innovation. Thus we suggest the integrators create a guiding culture to the innovation network so as to build the collective identity and develop long-term relationships among the network actors.

6 Conclusions

Using a mixed-methods research approach, we found that by creating a buffer zone around which knowledge resources flow in the form of favor exchange, renqing accumulation, and mianzi preservation, guanxi fosters the acquisition and integration of knowledge, coordinating the knowledge discontinuity and heterogeneity, amplified by structural holes in Chinese digital innovation networks.

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