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Levels of Multiplexity in Entrepreneur's Networks: Implications for Dynamism and Value Creation

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Abstract: Relationships and networks are important to how entrepreneurs create value. However, many aspects about relationships and networks remain poorly understood because their characteristics are often reduced to one-dimensional variables or dichotomous measures. This paper unpacks the concept of multiplexity and proposes a hierarchy of four different levels (*social, relational, strategic, and closed*). Each level is associated with a different level of dynamism which governs how rapidly entrepreneurs can alter their network. The hierarchy of multiplexity and associated levels of dynamism, have implications regarding different value creation processes that are associated with these network conditions.

Keywords: entrepreneurship, networks, multiplexity, dynamism, value creation

JEL Classifications: M00 – General

1 Introduction

The concept of interest in this paper is multiplexity (see also Shipilov et al. 2014; Hite 2005; Hoang and Antoncic 2003; Rogers and Kincaid 1981) and its variation. Multiplexity is broadly defined as the “layering of different types of exchanges within the same relationship” (Hoang and Antoncic 2003, 169) and can be extended to include the layering of exchanges *across* multiple relationships (e.g., Shipilov 2012). Multiplexity is an important concept for at least three reasons: “(a) organizations are simultaneously embedded in different kinds of relationships, (b) these relationships are interdependent [i.e., they interact] and (c) this interdependence influences organizations” (Shipilov 2012, 215).

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Multiplexity presents a theoretical lens through which to *integrate* prior research about the importance of individual relationships, their content, and their network structure. Without such an integrated approach, much network research risks being “unrealistic” (ibid., 216). For instance, by not fully considering multiplexity within or across relationships, we risk significant assumptions about how much endogeneity entrepreneurs have over their network (Stuart and Sorenson 2007), and about whether social capital is simply the sum of available resources (Gedajlovic et al. 2013). Relationships evolve at very different rates, for different reasons, and cannot readily be aggregated or summed.

Despite the potential richness of multiplexity in network research, prior network research has largely studied network content and structure *separately*. While calls for more integrative approaches are decades old (e.g., Harary 1959; Boissevain 1979) and regaining attention (e.g., Kilduff and Brass 2010; Shipilov 2012), only recently have researchers begun to explore interactions of content and structure within and across relationships (Shipilov et al. 2014). Most recent research on entrepreneurial networks has continued to be dominated by structural analyses, which are enabled by reducing each relationship to a variable or dichotomous form (e.g., strong versus weak, or bonding versus bridging). Such a reduction conceals the multidimensional characteristics of each relationship and their interdependence, and also assumes that their characteristics are stable (e.g., Martinez and Aldrich 2011). As a result of a lack of attention to multiplexity, we still know little about how entrepreneurs manage multiple content flows in their network and leverage them to create different forms of value.

Research on network content focuses on the diversity of content flows within a given relationship (e.g., Larson and Starr 1993; Yli-Renko, Sapienza, and Hay 2001) to identify strategies of managing inter-organizational interdependence at the level of a single relationship. For example “market data, technical knowledge, new support services, or capital through favorable payment terms are added to the initial transfer of a component part or materials from a vendor to the entrepreneurial firm” (Larson and Starr 1993, 10). Each additional layer of exchange increases the value of the relationship and increases the interdependence between the entrepreneur and the partner, until a point at which it becomes more efficient to access additional resources via other relationships (Kenis and Knoke 2002; Beckman, Haunschild, and Phillips 2004). Still under-researched, is the reality that the exchanges may be layered across relationships with multiple partners.

Research on network structure focuses on patterns of interconnections between partners (e.g., Soh 2003; Zaheer and Bell 2005), and the diversity of partners in the network (e.g., Baum, Calabrese, and Silverman 2000; Jack 2010; Lechner, Dowling,

and Welpé 2006). It highlights the importance of being more centrally connected in a network and the importance of the interconnections in a given network. Indeed, “it is not an exaggeration to claim that existing empirical findings point to the centrality of networks in every aspect of the entrepreneurial process” (Stuart and Sorenson 2007, 211). However, the structure perspective tends to treat all relationships the same, thus downplaying their qualitative differences and their interdependence.

This paper attempts to integrate network content *and* structure conditions by unpacking the concept of multiplexity. A hierarchy of multiplexity is proposed, including different levels of analysis, from the level of a single relationship to the ego-network level (i.e. the set of partners to which the entrepreneur is directly connected and their interconnections). Historically, multiplexity has been conceptualized in relatively ambiguous ways. The proposed hierarchy of multiplexity differentiates four distinct levels of multiplexity (*social, relational, strategic, and closed*). Each level involves an increasing level of interdependence across an increasing number of relationships in the entrepreneur's network.

Each level of multiplexity is also increasingly stable. This stability (and its antithesis, dynamism) is important to entrepreneurial networks, which are inherently dynamic (e.g., Elfring and Hulsink 2007; Jack, Dodd, and Anderson 2008; Jack 2010), and evolve with the firm (e.g., Hite 2005; Hite and Hesterly 2001). Studying multiplexity in entrepreneurship thus requires an investigation of how each level of multiplexity affects the dynamism of the network. Dynamism is defined here as the rate and degree of change within the network, and has been identified as a “key factor” in studying how networks change over time (Jack et al. 2010).

Since the purpose of entrepreneurship is (generally) to create value, this study also explores implications of multiplexity and dynamism regarding the longevity of each value creation opportunity. For example, new knowledge leading to the discovery of a new opportunity is much shorter lived than continuously extracting a profit from brokering systemic resource asymmetries across disconnected partners. Based on what the literature says in relation to different multiplexity and dynamism conditions, this study identifies different value creation processes that are associated with those conditions.

A hierarchy of multiplexity and its implications are presented here in three major sections, followed by discussion and conclusions. First, the relevant literature is reviewed in relation to the content and structure of entrepreneurial networks, its variance, and associated value creation processes. Second, the concept of multiplexity is elaborated on as a means to marry the content and structure dimensions in ego-networks. Four levels of multiplexity are identified

(*social, relational, strategic, and closed*) and associated with their own level of dynamism and combination of value creation processes. The discussion section then identifies future research opportunities based on this hierarchy, and is followed by a summary of this study's contributions.

2 Theoretical Background

Network studies throughout the organizational, sociological, and entrepreneurship literatures have largely concentrated on only one of the two dominant network attributes – network content or network structure (see reviews by Borgatti and Foster 2003; Hoang and Antoncic 2003; Slotte-Kock and Coviello 2010; Kilduff and Brass 2010). Thus, research has been unable to capture the full diversity of these organizational forms or the diversity of processes by which networks can be adapted or leveraged to create value. As a result, the role of endogeneity and agency remains poorly understood (e.g., Stuart & Sorenson) as do its effects on the dynamism and value creation. (e.g., Stam, Arzlanian, and Elfring 2014) These reviews indicate great interest for improved clarity regarding multiplexity provided it can combine both attributes and contribute to resolving some of the debates about how entrepreneurs create value from different forms of networks.

2.1 Network Content

Research on network content focuses on the diversity and interaction of content flows within a given relationship (e.g., Larson and Starr 1993; Yli-Renko, Sapienza, and Hay 2001). In other cases, prior research focuses on the diversity of contexts in which different types of content are exchanged (e.g., Johannisson 1986; Johannisson, Ramirez-Pasillas, and Karlsson 2002), but remains vague about the structure of relations. Each relationship may include bi-directional sharing of resources (e.g., intangible resources such as knowledge), or directional transfers of resources (e.g., tangible resources such as products or cash) (see Borgatti 2005 for an overview of several kinds of content flows). Debates remain regarding the benefits and drawbacks of different conditions by which content flows, such as transactional economics or strategic alliances (Owen-Smith and Powell 2004).

On the one hand, transaction-cost economics (TCE) argues that value is created in the form of transactional efficiency by encapsulating the degree of asset-specificity of the relationship in a single price metric. Turning every transaction into a price-based decision conserves the time and energy invested

in each fleeting arm's-length transaction (Williamson 1981). This efficiency within each transaction creates additional value by enabling a greater scale of transactions or larger portfolio of relationships (Kale, Dyer, and Singh 2002; Hoffmann 2007). By detailing simple ground rules or terms of exchange (Gulati and Singh 1998; Larson 1992) each exchange may be handled independently and with minimal additional information or governance costs (Williamson 1981; Dyer and Singh 1998).

On the other hand, the strategic alliance (SA) literature argues that value is created in the form of synergies that may be sustained over prolonged periods of time (Harrison et al. 2001), and reinforced by a more integrated system (Lorenzoni and Lipparini 1999). In this value creation process, entrepreneurs benefit from situations where layers of content are complementary (Harrison et al. 2001; Lorenzoni and Lipparini 1999), interweaved (Ritter and Gemünden 2003) and increasingly mutually beneficial (Larson 1991, 1992). As demonstrated in the multilateral relationships literature (Das and Teng 2002; Gulati and Singh 1998), synergies may also be obtained by coordinating interactions of content flows involving more than two partners.

2.2 Network Structure

Research on network structure focuses on patterns of interconnections between partners (e.g., Soh 2003; Zaheer and Bell 2005), and on the diversity of partners in the network (e.g., Baum, Calabrese, and Silverman 2000; Jack 2010). This stream of research, however, discounts the qualitative characteristics of relationships and usually investigates only one kind of resource exchange at a time (e.g., financial investment, trade of goods and services, joint research and development, etc.) in order to focus on nuances of the network structure.

Despite the increasing consensus that network size and centrality are important (Stuart and Sorenson 2007), debates remain regarding the benefits or drawbacks of the structural conditions beyond the entrepreneur's immediate connections, such as whether closed or open networks catalyze or inhibit creating value (e.g. Burt 2005). The dividing argument in the literature regarding network structure can be summarized as whether it is better to be a *tertius gaudens* (Burt 1992) or *tertius iungens* (Obstfeld 2005). Which structure is better, depends on what kind of value one is trying to create. The *tertius gaudens* is the "third who enjoys" (Burt 1992; Simmel 1950), and creates value in the form of appropriating (Ricardian) rents by leveraging their intermediary position between others. Such entrepreneurs benefit from being the main channel of

content flows in their network and from taking advantage of information (and other resource) asymmetries. This reflects a process by which they create value by actively selecting from whom to receive content and to whom to redistribute it (Burt 1992; Kogut 2000). Because the *tertius gaudens* benefits from a lack of connections between other partners, they strive to keep others separated. If the gap in their ego-network can provide sustained value over time (as with licensing and distribution agreements), then these entrepreneurs may try to keep their network structure static. Else, they may continuously seek new connections for which they become an intermediary (like entrepreneurs who create new fast-moving markets and broker bundles of intellectual, financial or human capital).

The *tertius iungens* is the “third who joins” (Obstfeld 2005), and creates new value in the form of re-combining available resources (aka Schumpeterian rents, see also Danneels 2012). They create value by brokering new relationships that bring others together to *collectively* mobilize resources, to create new paths for content flows, and to explore new combinations of content and common goals with others in the network (e.g., Obstfeld 2005). This form of brokering reflects a process by which entrepreneurs experimentally create interconnections in their network, and draw others together to pool resources, explore opportunities, and share common goals (March 1991; Moran and Ghoshal 1996). Establishing common goals and establishing shared values is a precursor to effective collaboration (Abreu, Macedo, and Camarinha-Matos 2008). This collaborative value creation process may be relatively short-lived once the new idea or new combination of resources has proven to be useful. The value creation may also involve prolonged mobilization of a group of interconnected people (as with the execution towards a longer term shared outcome). These entrepreneurs may thus benefit from perpetuating an abundance of interconnections between others and their associated content, and may thus continuously strive to bring others together and keep them engaged.

2.3 Integrated Approaches

The two debates above (TCE vs. SA and *tertius gaudens* vs. *tertius iungens*) set the background against which to review the emerging literature that integrates both perspectives, with a focus on the multiplexity literature. Multiplexity is not a novel concept (Hite 2005; Hoang and Antoncic 2003; Rogers and Kincaid 1981), and is analogous to a “mixture of relations” (Harary 1959). However, multiplexity is not yet a mature concept and there is a risk that the concept will

become ill-defined and lose appeal before it achieves its full potential to integrate the content and structure perspectives.¹

How one integrates content and structure, and whether multiplexity is a useful concept depends on the research question at hand. For example, some studies analyze networks of different types of content, but treat them as independent, such as Podolny and Baron (1997) which explored correlations of centrality measures across different networks within the same organization. However, this study did not investigate overlapping relationships (i.e., multiplexity) between the same pairs of actors; nor did it need to for their research on job mobility. A similar approach was taken in Lechner, Dowling, and Welpe (2006) wherein networks of different types were included in the same study, but interdependencies across them were not. Instead, they justified omitting such interdependencies by relying on the tendency of entrepreneurs “to label their economic exchange partners and classify them according to the main benefit that the partner provides” (p. 529).

The social capital literature also integrates network structure, tie strength and content (e.g., Batjargal 2003; Gedajlovic et al. 2013), but only in a manner that aims at assessing the aggregate available social capital, not its configuration as a social system with interdependent parts. While combining network structure and tie strength is increasingly popular (e.g., Patel and Terjesen 2011 is an excellent example), tie strength is a construct that is entirely different from multiplexity (this difference is discussed in greater detail in the Relational Multiplexity section). For researchers interested in the diversity and interdependence of resources and actors in an entrepreneur's network, a different approach is required that is conceptually closer to systems dynamics theory than resource based concepts like social capital.

The next section intends to provide an improved clarification of the concept of multiplexity as a means to integrate content and structure in such a way that permits investigation of (a) how entrepreneurial networks evolve, and (b) how entrepreneurs leverage their evolving network to create value. The latter point stresses that the resources in the network are not necessarily valuable per se, but their (combined) use is (see also Penrose 1959, 24). It is hoped here, that an improved conceptualization of multiplexity may then enable more precise and nuanced longitudinal analysis and theory regarding how firms create or sustain competitive advantage over time.

¹ In comparison, the concept of dynamic capabilities suffered from a lack of early conceptual clarity as seen in the decades-long attempts to crystallize the concept (Grant 1996; Winter 2003; Helfat and Peteraf 2009; Helfat and Winter 2011).

3 A Hierarchy of Multiplexity

The following subsections review extant conceptualizations of multiplexity to propose four levels of multiplexity: *social* multiplexity, *relational* multiplexity, *strategic* multiplexity, and *closed* multiplexity. The hierarchy is then presented in this sequence, because each level of multiplexity builds on the previous one, as the number of relationships, their interactions, and their interdependence increases. We start with a binary concept of multiplexity at the level of an individual relationship and end with a multi-dimensional concept at the level of the ego-network. As explained in each of the subsections, different levels of multiplexity have implications for the level of dynamism in the entrepreneur's network and which value creation processes they are associated with.

3.1 Social Multiplexity

The most common conceptualization of multiplexity is as a dichotomous layering of “business” and “social” relations within a single relationship (e.g., Hite 2008; Jack, Dodd, and Anderson 2008; Jack et al. 2010; Ferriani, Fonti, and Corrado 2013). This conceptualization carries the label “social multiplexity” because (in management research) the business relationship is being multiplexed by the social dimension. At this level, the business relationship remains quite simple and transactional and the “added social dimension [is] enriching previously instrumental ties” (Jack, Dodd, and Anderson 2008, 128). Operationalization of social multiplexity is conventionally as a dichotomous status (socially multiplex or not) and does not reveal the multidimensional nature of either the business (or social) relations.

The business component of a socially multiplex relationship is a simple arm's-length transaction that is associated with value creation as per transaction-cost economics. Value is created via cost savings and scalability because these arm's-length relationships are relatively easy to manage (Williamson 1981; Dyer and Singh 1998). These relationships may be characterized by common “contacts [or] spot market transactions” (Aldrich 1999, 235). The social dimension enables faster transactions or transactions at non-market rates, and are analogous to socially embedded relationships (Uzzi 1999; Ferriani, Fonti, and Corrado 2013). The interactions within the relationship are accelerated because the social or affective component of the relationship enables faster fine-grained information transfer, increases trust in fulfilling the exchange, and accelerates agreement on the terms and conditions of the exchange. In plain words, social

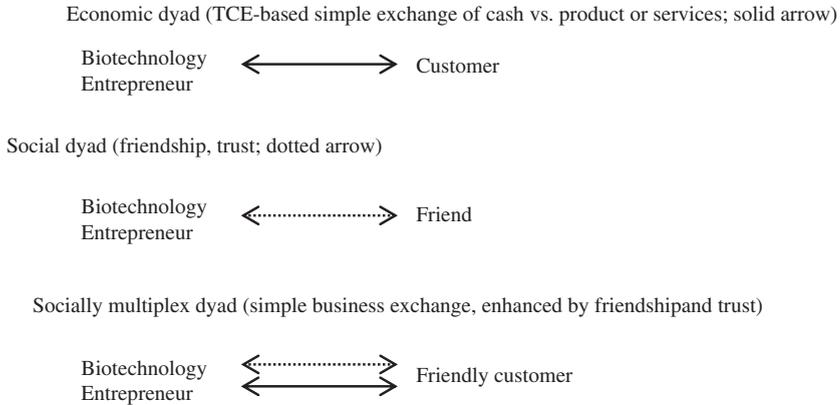


Figure 1: Comparison of economic, social and socially multiplex dyads.

multiplexity greases the wheels of economic exchange. Figure 1 visualizes an economic dyad (according to TCE), a social dyad, and a socially multiplex dyad of a hypothetical biotechnology entrepreneur.

3.1.1 High Dynamism

Ego-networks with social multiplexity tend to have high levels of dynamism, where dynamism is the rate and degree of change within the network. Socially multiplex ego-networks occur when entrepreneurs “bounce ideas around” within their social and professional networks (Jack, Dodd, and Anderson 2008) and commence a “frantic search for people who could provide information on new opportunities and on the feasibility of the business plan” (Elfring and Hulsink 2007, 1857), including friends. These networks have an unstable structure (whether dense or sparse) due to the high turnover of relationships, the low likelihood that the entrepreneur’s contacts get to know each other, and the even lower likelihood that all relationships will simultaneously be active.

The feedback and input an entrepreneur receives in any given relationship is independent from other relationships. Because of this independence, the entrepreneur can add, activate or abandon any relationship within their network without materially affecting the rest of the network. As a result, the network is “fluid, flexible and constantly changing” (Jack 2010, 130), and the frequent changes can be managed on an ongoing basis; ergo, social multiplexity is associated with high levels of dynamism.

3.1.2 Value Creation by Rapid Recombination or Redistribution

For socially multiplex networks, value is created by experimenting with combinations of relatively independent inputs from a wide variety of contacts. The nature of the value created resides in the discovery or creation of a potential opportunity that can later provide more tangible value upon execution of the opportunity. Whether the eventual opportunity provides Ricardian (distributive) or Schumpeterian (combinatorial) rents remains secondary to the value inherent in process of generating an opportunity in the first place. Due to the fleeting nature of each interaction, any exchange of resources within them need to be efficient. It is then up to the entrepreneur to figure out which combinations of resources to explore and which resources to ignore. If one relationship does not work out or the opportunity shifts in scope, the entrepreneur can adapt quickly to the new circumstances by initiating new relationships or asking for referrals (Zhao and Aram 1995; Vissa 2012).

When an opportunity for Schumpeterian rents is perceived, then the requisite relationships and their content flows may be “pulled together for a given run and then disassembled to become part of another temporary alignment” (Miles and Snow 1992, 67). Due to the high level of dynamism, entrepreneurs with this network condition are oriented to short-term value creation, in which “it may be more important to mobilize effort around a specific set of [temporarily perceived] objectives than to worry too much about what these objectives are” (Hill and Birkinshaw 2008, 441). Particularly in hypercompetitive environments, this “continuous morphing” process may be an effective survival mechanism (Rindova and Kotha 2001).

The entrepreneur may also perceive a temporary opportunity to create value via extracting a Ricardian rent from resource asymmetries as per *tertius gaudens* logic, at a time scale that is accelerated by the social embeddedness of each relationship. The resource asymmetries and rents may also be asynchronous, in that input from one contact may be profitably redistributed to another contact at a later point in time. These entrepreneurs are in the position to create value from quickly redistributing flows across diverse contacts without further need for consideration of complementarities or conflicts across contacts. Entrepreneurs with such networks act as redistribution hubs and often add little value to individual content flows, leaving them largely unchanged.

3.2 Relational Multiplexity

While the dichotomous concept of social multiplexity captures the influence of social embeddedness on business transactions, it does not include the

multidimensional nature of many business relations. Social multiplexity also blurs the distinction between multiplexity and tie strength; multiplexity emphasizes relationship content while strength and embeddedness emphasizes relationship context.² An example of blurring multiplexity and tie strength is Hite's (2003, 27) "interaction extent" construct. Nonetheless, Hite's empirical examples of interaction extent also reflect how multifaceted business relationships can be! For instance, her quote from Chad at DataTools includes no fewer than five different types of business relationship layered within the same dyad:

I'm selling my products through them. But I'm also doing work for them. So it kind of goes both ways ... They are [also] a competitor ... In this whole relationship, they are actually every single one of these that I can think of [supplier, customer, vendor, broker, previous employer]. (Hite 2003, 28)

In line with Hite's (2003) work on relational embeddedness, and the need to labels this form of multiplexity differently from social multiplexity, we find "relational multiplexity" to be a better fit. Relational multiplexity consists of a *single* relationship that includes *multiple* interdependent layers of business and social exchanges, and is visualized in Figure 2 (see also Kapferer 1969; Doreian 1974 for relational multiplexity studies with a more sociological emphasis). Whereas socially multiplex relationships are largely governed by TCE, relationally multiplex relationships are governed by the same mechanisms as strategic

Relationally multiplex dyad



Each arrow represents a different type of interaction within the same relationship, such as (but not limited to) material supplies, finished products, cash intellectual property, advice and friendship. The interactions are interdependent.

Figure 2: A relationally multiplex dyad.

² Multiplexity (in the dichotomous business-social sense) may of course correlate with tie strength over time, where tie strength is characterized by emotional intensity, duration, friendship, trust, or closeness (Granovetter 1973; Capaldo 2007). Empirical research indicates that "business" relationships may develop such "social" characteristics over 3–6 years (Jack, Dodd, and Anderson 2008; Jack et al. 2010), if ever. However, these time scales are not trivial to entrepreneurship and we therefore cannot assume any immediate correlation between multiplexity and tie strength (see also Granovetter's (1973) footnote 3 about an imperfect correlation between multiplexity and strength). While multiplexity has been operationalized as tie strength (Rowley, Behrens, and Krackhardt 2000), tie strength remains a crude proxy for the multidimensional nature of content flows (Capaldo 2007; Bliemel and Maine 2008; Shipilov 2012).

alliances. Relational multiplexity conditions characterize relationships wherein multiple content flows interact, and are typified by high levels of inter-organizational interdependence. These conditions require consideration of how multiple flows complement, substitute or counteract each other.

3.2.1 Moderate Dynamism

Each relationally multiplex dyad (e.g., relationships with multiple layers of flows) is relatively stable. Because the layers of flows are interdependent, it is more likely that the entrepreneur will incrementally change one of the flows, rather than disruptively change them all simultaneously. Prior research argues that multiplexity tends to increase incrementally over time (Johannisson 1986; Boissevain 1979). If a relationally multiplex dyad does change completely, then it may be required to find a direct substitute relationship with the same degree of relational multiplexity. Such direct substitution poses a challenge, because the likelihood of finding a direct substitute is increasingly unlikely with increasing levels of relational multiplexity. Therefore, turnover in relationships is expected to be low. A more likely alternative to direct substitution is when the relationally multiplex dyad may be “peeled away” layer by layer and each incremental change is substituted with a separate less multiplex relationship. As a result, dynamism is expected to be moderate; lower than in socially multiplex networks, but not low.

3.2.2 Dyadic Synergistic Value Creation

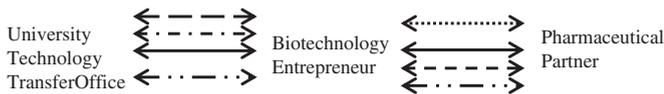
Value in relationally multiplex relationships and networks is created when the interdependencies of resource flows can be managed such that the interdependencies between content flows catalyzes complementarities or synergies (Larson 1991; Larson and Starr 1993). Generating such synergies may be achieved by partners “pooling their idiosyncratic and complementary resources” (Schreiner, Kale, and Corsten 2009, 1411), which results in increasingly durable relationships (Jack and Anderson 2002; Beckman, Haunschild, and Phillips 2004). The utility and durability of these relationships then increases until it becomes more feasible for additional resources to be sourced from other relationships (Kenis and Knoke 2002). Such synergies are evidenced in many strategic alliances. High relational multiplexity may also inhibit value creation if content flows are in conflict with each other or if unlocking synergies requires too much time and effort. Recent research on multiplexity indicates that network evolution

(and thus value creation) is driven primarily by aversion to such conflicts and is not driven by the pursuit of synergies (Sytch and Tatarynowicz 2014).

3.3 Strategic Multiplexity

Just as multiple flows can be interdependent within relationally multiplex dyads, such interdependencies can occur across relationships. By expanding relational multiplexity from the level of a dyad to a pair of dyads, we arrive at Shipilov's (2012) three "key premises" for strategic multiplexity: (a) simultaneous embeddedness in diverse and (b) interdependent relationships, in a way that (c) their interdependence plays an important role for the entrepreneur. Under these strategic multiplexity premises or conditions, the interdependence is controlled via the entrepreneur. Prime examples of this are the vertical alliance chains in the biotechnology industry (Stuart, Ozdemir, and Ding 2007), where the strategic alliance with a pharmaceutical company may be contingent on a patent licensing agreement with a public sector institution, as illustrated in Figure 3.

Strategically multiplex dyads



Each arrow represents a different type of interaction within the same relationship. For example, the left-hand relationship may consist of interdependent exchanges in material supplies, cash (licensing fees), IP, and scientific advice, whereas the right-hand relationship may consist of interdependent exchanges in finished products, cash (sales commissions or royalties), IP, and managerial advice. Both relationally multiplex ties become strategically multiplex due to the interdependence of content flows *across* them, coordinated via the entrepreneur.

Figure 3: A strategically multiplex pair of dyads.

3.4 Low Dynamism

As with relational multiplexity, each dyad is relatively stable. The interdependence across dyads is expected to reinforce stability (Beckman, Haunschild, and Phillips 2004; Sytch and Tatarynowicz 2014). If a change in flows did happen, it could have a wide reaching impact, propagated through mechanisms like domino effects (Hertz 1998). Because "withdrawal in one context may jeopardize existing relationships in other contexts" (Kim, Oh, and Swaminathan 2006, 711), entrepreneurs will likely initiate changes less

frequently and more thoughtfully than with only relational multiplexity or social multiplexity conditions. Thus, we deduce that strategic multiplexity is associated with low levels of dynamism.

3.4.1 Coupled Synergistic Value Creation

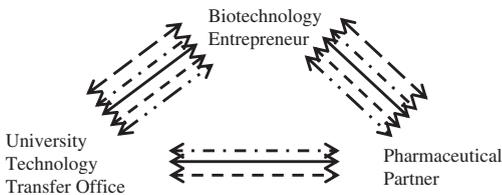
As with relational multiplexity, value is created when synergies are unlocked. However, with strategic multiplexity, synergies can be inherent in the combination of flows within *and across* multiple relationships in a portfolio, thus creating coupled synergies. As long as the entrepreneur's partners are not directly interconnected (as with the next level of multiplexity), the aforementioned *tertius gaudens* logic still applies (Burt 1992): the entrepreneur benefits from Schumpeterian rents due to their access to a greater diversity of content flows (Burt 1992; Hoffmann 2007), from collecting Ricardian rents from being the sole channel of content flows, or from playing disconnected partners off against each other (Burt 1992; Kogut 2000). Each of these activities requires the entrepreneur to “actively maintain and exploit the separation between parties” (Obstfeld 2005, 104), while maintaining their role in coupling the flows of others. The efforts required to establish and maintain strategic multiplexity are likely to reward structurally efficient networks of strategic alliances, which provide “access to diverse information and capabilities with minimum costs of redundancy, conflict and [structural] complexity” (Baum, Calabrese, and Silverman 2000, 267). Particularly the version to conflict is echoed by Sytch and Tatarynowicz (2014). There are also risks associated with strategic multiplexity. For instance, failure in one relationship may affect another (Baum, Calabrese, and Silverman 2000; Larson 1992; Hertz 1998), or the entrepreneur may be circumvented and disintermediated if the synergies can be obtained without their coordination.

3.5 Closed Multiplexity

This level of multiplexity includes interactions of flows via the entrepreneur, and also *around* the entrepreneur. Analogous to triadic closure (Simmel 1950), if an entrepreneur has multiple relationally or strategically multiplex relations, then it is likely that they will become interconnected, as long as they are not in conflict (Sytch and Tatarynowicz 2014). When there is interdependence of flows between the entrepreneur and their direct partners as well as around the entrepreneur

(between their respective partners), then we arrive at closed multiplexity, as visualized in Figure 4.³ This level is observed in triads and cliques (Knocke and Kuklinski 1982; Luce and Perry 1949; Gimeno and Woo 1996; Shipilov and Li 2012; Sytch and Tatarynowicz 2014), and entire communities (Mucha et al. 2010), wherein all stakeholders (including the entrepreneur) consider how their collective resources can be combined to a greater and mutually beneficial whole. Closed multiplexity conditions can amplify the potential permutations and combinations of resources and their flows in the entrepreneur's network (Obstfeld 2005).

Closed multiplexity in a triad



Each arrow represents a different type of interaction within the same relationship. For example, the entrepreneur exchanges IP, cash, equity, research advice and other interdependent resources with the university technology transfer office, and also exchanges similar interdependent resources with the pharmaceutical partner. When investing in the biotechnology entrepreneur, the pharmaceutical partner may seek out complementary IP from the university and may negotiate equity distributions with both parties. If the entrepreneur is also an academic, then the pharmaceutical partner may also exchange cash and contract research channelled via the university to further engage the (academic) entrepreneur and their lab.

Figure 4: Closed multiplexity in a triad.

3.5.1 Very Low Dynamism

Closed multiplexity is expected to result in very low levels of dynamism. Because the relationships are *each* relationally multiplex and *all* interconnected, a change in one content flow could quickly induce changes in most other content flows throughout the ego-network. Thus, entrepreneurs may need to invest significant time and energy to coordinate and reconcile the interests of *all* partners involved before driving any change. Such complex stakeholder

³ The term “closed” emphasizes the structural closure involved, but does not imply closeness or strength. Calling it “network multiplexity” would have been too ambiguous about the structural characteristics. While prior uses and definitions of “network multiplexity” suggest a network level concept, multiplexity has historically remained a dyad level concept (Dhanaraj and Parkhe 2006; Krohn, Massey, and Zielinski 1988). Other labels include economic multiplexity (Gimeno and Woo 1996) which fails to emphasize the closed structure of the entrepreneur's immediate (ego-) network.

environments may cause longer-term lock-in until a quantum shift (Miller and Friesen 1984) or change in equilibrium (Gersick 1991) is triggered by suddenly removing or adding a partner and all their (direct and possibly indirect) relationships.

3.5.2 Collective Synergistic Value Creation

This level of multiplexity catalyzes value creation at the level of the collective (i.e., including all members of the clique within the entrepreneurs' ego-network), and is brought about via explorative brokering processes (Aldrich 1999; Obstfeld 2005), wherein synergies are explored within *and across* relationships (Schreiner, Kale, and Corsten 2009). Such collective synergies may also catalyze greater support, inertia and collective action (Aldrich, Rosen, and Woodward 1987; Dubini and Aldrich 1991), and thus perpetuate the exploration of collective synergies. Closed multiplexity also has drawbacks because there is greater redundancy of content and connections, and thus wasted time and effort in maintaining non-essential relationships (Burt 1992; Kenis and Knoke 2002; Hoffmann 2007).

In summary, this study has conceptualized four levels of multiplexity by elaborating on multiplexity at the relational level and then expanding it to the ego-network level. Each level of multiplexity affects the level of dynamism in the network and is associated with different value creation processes. These levels of multiplexity, their defining characteristics, levels of dynamism and associated value creation processes are summarized in Table 1.

4 Discussion

4.1 Implications for Theory

The first and central implication of this paper is regarding the precision with which we conceptualize and describe *what* a relationship or ego-network is, how it evolves, and how it can be leveraged to create value. Multiplexity provides a conceptual foundation with which to extend beyond dichotomous classifications of ties (e.g., bridging versus bonding, or weak versus strong) and network structures (e.g., brokerage versus closure). It enables a more detailed understanding of the multitude of exchanges that happen in each relationship, and can be extended to include studying how multiple different exchanges interact

Table 1: Levels of multiplexity, defining characteristics, dynamism, and associated value creation processes.

Multiplexity level (example references)	Characteristics	Dynamism	Associated value creation processes
<p>Social multiplexity: Layering of a business transactions and a social exchanges within a single relationship (Jack, Dodd, and Anderson 2008; Jack et al. 2010)</p>	<p>Simple economic exchanges that occur in context of a social relationship. The economic exchange may be short-lived, with simple terms and conditions that are encapsulated in the price of the exchange. The social relationship may be more sustained, and accelerates each economic exchange.</p>	<p>High levels of dynamism as the entrepreneur contacts anyone they can (including friends) for input about their ideas and other business resources.</p>	<p>Efficiency and scalability is attained by experimenting with (combinations of) flows across a broad range of independent relationships. The immediate value created is in gaining access to others’ resources at favorable rates, including faster feedback which the entrepreneur can combine to discover or create a more sustainable opportunity.</p>
<p>Relational multiplexity: Layering of <i>multiple</i> business and social exchanges within a single relationship (Hite 2003)</p>	<p>Layering of multiple interdependent business and social exchanges within the same relationship. E.g.: licencing of IP and technical advice, in exchange for royalties and equity, supported by personal trust.</p>	<p>Moderate levels of dynamism as the entrepreneur incrementally adjusts the level of multiplexity within a relationship, or seeks an equally multiplex substitute.</p>	<p>Synergies are sought within each relationship by diversifying, recombining and pooling resources.</p>

(continued)

Table 1: (continued)

Multiplexity level (example references)	Characteristics	Dynamism	Associated value creation processes
<p>Strategic multiplexity: Interdependence of two or more relationally multiplex relationships in a portfolio (Shipilov 2011)</p>	Layering of multiple interdependent exchanges within two or more relationships. The interdependence across relationships is coordinated via the entrepreneur and the relationships are not interconnected.	Low levels of dynamism as the entrepreneur seeks out synergies within and across relationally multiplex relationships.	Synergies are sought by coupling multiplex flows across pairs of relationships in a portfolio. Ideally, each relationship is as multiplex as it needs to be to create synergies, with no redundant or conflicting flows.
<p>Closed multiplexity: Interdependence of all relationally multiplex relationships in a triad or closed ego-network (Gimeno and Woo 1996; Shipilov and Li 2012; Sytch and Tatarynowicz 2014)</p>	Layering of multiple interdependent exchanges within an interconnected network of three or more relationships. The interdependence of exchanges is coordinated via the entrepreneur and directly between the entrepreneur's partners.	Very low levels of dynamism. Longer periods of stability are punctuated by radical change events.	Synergies are sought at the collective (clique) level by combining multiplex flows directly with and around the entrepreneur.

across relationships. As a result of a more precise conceptualization, research on entrepreneurial networks can investigate how entrepreneurial networks evolve and are leverage to create value at a level of detail usually reserved for systems dynamics models (akin to Siggelkow 2002, but inclusive of relationship partners). Such precision would help advance research beyond aggregated descriptors such as social capital (e.g., Gedajlovic et al. 2013), structural efficiency (Baum, Calabrese, and Silverman 2000), or relational mix (Lechner, Dowling, and Welpe 2006).

The second implication concerns our temporal understanding of network dynamism and change and affects how we conceptualize *when* a relationship or network exists and for how long it creates value. Particularly, early stage networks are known to be highly dynamic (e.g., Elfring and Hulsink 2007; Jack, Dodd, and Anderson 2008; Jack 2010), which means opportunities are short-lived. The dynamism is an artefact of the actions of the entrepreneur. While the dynamism is largely endogenous, each change is not necessarily strategic. Strategic changes tend to occur at higher levels of multiplexity. At the social and relational level, there is a growing body of evidence of how multiplexity evolves (e.g., Hite 2003, 2005; Jack, Dodd, and Anderson 2008; Jack et al. 2010; Ferriani, Fonti, and Corrado 2013). However, beyond the relational level, evidence of changes in strategic or closed multiplexity remains sparse or anecdotal. Notable exceptions include Gimeno and Woo (1996), Hite (2008), Shipilov and Li (2012), and Sytch and Tatarynowicz (2014). A particularly interesting study of (relational) multiplexity and the evolution of alliance portfolios is provided by Beckman et al. (2014), who study *de novo* semiconductor firms and relate the (external) multiplexity of board members to the speed of alliance portfolio development, including manufacturing alliances, technology licensing alliances, and joint product development alliances. However, their study does not include interdependence of content across alliance partners or other types of partners (e.g., venture capital firms or universities), and thus is limited to the level of relational multiplexity.

Despite these advances, it would be fruitful for future research to continue explore the origins and evolution of multiplex relations, especially while considering the agency of the entrepreneur *and* their partners. Likewise, empirical testing of the level of dynamism and associated value creation processes remain fruitful areas of research. Such empirical research would contribute significantly to the “general acceptance that network analysis should really consider both structure of the network and nature of interactions between network actors” (Jack 2010, 129). Methodologically, progress is being made that can enable such empirical research, including multi-method approaches (Jack 2010; Abreu, Macedo, and Camarinha-Matos 2008), multi-level approaches (Shipilov 2012),

set-theoretic approaches (Bliemel, McCarthy, and Maine 2014), and multi-theoretical approaches (Contractor, Wasserman, and Faust 2006; Slotte-Kock and Coviello 2010).

Overall, this paper offers a conceptual foundation with which to investigate each level of multiplexity, and associated levels of dynamism and value creation processes. The theoretical background draws heavily on the entrepreneurship literature, but also on literature and examples from areas including strategy and sociology. Consequently, this research and many of the arguments presented here may also apply more broadly to inter-personal networks within organizations, and inter-organizational networks.

4.2 Implications for Practice

Table 1 provides an overview with which entrepreneurs can become more cognizant of their network conditions, and question which courses of action are most appropriate. For instance, entrepreneurs may initially focus on social and relational multiplexity to guide decisions about which relationships to enhance and which to dissolve. Thereafter, entrepreneurs may focus on strategic and closed multiplexity to evaluate which relationships to make interdependent, which to keep independent, as well as which new relationships to forge, and which to dissolve. Questions they may ask themselves include: Should they introduce others in their network to explore new combinations of content flows? Should they keep partners separated and avoid becoming circumvented? Should they cull their network and focus their energy only on a select subset of relationships?

Answers to these questions will depend on the stage of development of the firm (Hite and Hesterly 2001) and the nature of value creation opportunities the entrepreneur (or manager) wants to pursue: (Schumpeterian) exploration of new combinations and new connections or (Ricardian) exploitation of asymmetries and exploitation of disconnections. The answers may also be guided by their level of dependence on others in their network (Pfeffer and Salancik 1978). For example, if entrepreneurs are overly dependent on a single key relationship, they may try to mitigate their dependence by attempting to standardize the relationship and find a substitute partner. Alternatively, they may embrace the dependence, renegotiate and alter the relational multiplexity within that relationship (e.g., Yli-Renko, Sapienza, and Hay 2001). Or, they may aim to stabilize the relationship by attaining strategic multiplexity, such as by introducing additional partners to form a multi-lateral alliance (e.g., Das and Teng 2002; Gulati and Singh 1998).

As entrepreneurs explore such scenarios, this research can help them consider the temporal dynamics (i.e., dynamism) of such changes: Can they change

part of the network without having to reorganize their entire network? Are changes to the network likely to be prolonged, requiring multiple incremental efforts over time, or are they likely to occur in more radical and rapid shifts?

4.3 Limitations and Future Research Directions

Unclear causality between multiplexity and value creation remains a limitation. At present, this study only associates different value creation processes to each level of multiplexity. Further research may be required to determine when multiplexity is an intended outcome, a by-product or a prerequisite to each value creation process. For instance, (how) does multiplexity change during the process of creating value? How does such a change affect subsequent opportunities to create value? Particularly the qualitative literature about entrepreneurial networks contains examples of deliberate multiplexing as well as examples of multiplexity occurring as a factor of a pre-existing relationship (e.g., the theory development sections of Ozdemir et al. (forthcoming) include several references and their examples). Thus, exploring the causality or temporal sequence of both remains an area for future research.

5 Conclusions

The benefits of relationships and networks are generally recognized in entrepreneurship (e.g., Hoang and Antoncic 2003; Slotte-Kock and Coviello 2010) and in the broader inter-organizational literature (e.g., Borgatti and Foster 2003; Kilduff and Brass 2010). However, most research on network conditions has been limited to focussing on either the content of relationships or their structure. As a result, there are missed opportunities to understand how multiple content flows are layered within *and across* relationships in a network structure. In response to this opportunity, this study articulates a hierarchy of multiplexity to integrate network content and structure, and proposes four levels of multiplexity: social, relational, strategic and closed. Each level of multiplexity is associated with its own level of dynamism and value creation processes.

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