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Communication Network Evolution in Organizational Communities

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Organizational communities are typically defined as populations of organizations that are tied together by networks of communication and other relations in overlapping resource niches. Traditionally, evolutionary theorists and researchers have examined organizational populations that comprise organizational communities by focusing on their properties rather than on the networks that link them. However, a full understanding of the evolution of organizational communities requires insight into both organizations and their networks. Consequently, this article presents a variety of conceptual tools for applying evolutionary theory to organizations, organizational communities, and their networks, including the notions of relational carrying capacity and linkage fitness. It illustrates evolutionary principles, such as variation, selection, and retention, that lead to the formation, growth, maintenance, and eventual demise of communication and other network linkages. This perspective allows us to understand the ways in which community survival and success are as dependent on their communication linkages as they are on the organizations they connect. The article concludes with suggestions for potential applications of evolutionary theory to other areas of human communication.

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The past 25 years have witnessed significant developments in the application of evolutionary and ecological theory to the study of organizational populations and communities (Aldrich & Ruef, 2006; Astley, 1985; Baum, 2002; G. R. Carroll & Hannan, 2000; Hawley, 1986). Only recently, however, has this extensive body of work begun to inform theory and research in organizational communication (see, for example, Bryant & Monge, 2008; Dimmick, 2003; Monge & Contractor, 2003, chap. 9; Shumate, Bryant, & Monge, 2005; Shumate, Fulk, & Monge, 2005). This article outlines key elements of evolutionary theory and explains how they have been usefully applied in organization studies. Subsequently, the field of communication

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networks is used to demonstrate new conceptualizations that can be derived from an evolutionary perspective. These include a community ecology approach to organizational linkages, the concept of relational carrying capacity, and the variation, selection, and retention (V-S-R) of network links.

Organizational communities are typically defined as “a spatially or functionally bounded set of populations” of organizations that are tied together by networks of communication and other relations in overlapping resource niches (Aldrich & Ruef, 2006, p. 240). Traditionally, evolutionary theorists and researchers have examined organizational populations that comprise organizational communities. This article extends the application of evolutionary theory to community and population communication networks. It focuses on evolutionary principles, including V-S-R, that lead to the formation, growth, maintenance, and eventual demise of network linkages. This perspective allows us to understand the ways in which community survival and success are as dependent on communication and other organizational linkages as they are on the organizations these linkages connect.

Evolutionary theory has a number of advantages over more traditional approaches to the study of networks of organizations. First, the community ecology perspective examines the evolution of organizational populations and the communities in which they exist. This shifts attention away from single, individual organizations toward populations of organizations and their relations with other organizational entities (Aldrich, 1999). Second, community ecology explores the role of environmental resource niches and organizational adaptation, seeing these as fundamental driving forces in the maintenance of communities. Just as populations in communities partition their resources into niches that can only sustain finite numbers of organizations, communication networks have a limited carrying capacity that can sustain a finite number of links. Third, evolutionary theory provides a generalized, dynamic theory of change (Baum & Rao, 2004). Thus, rather than taking a static perspective on institutions, evolutionary theory highlights how organizations and their communication networks change in terms of birth, growth, transformation, decline, and demise (Poole & Van de Ven, 2004).

These three theoretical issues are emphasized throughout this article. The first section provides a brief overview of evolutionary theory from the perspective of communities and the populations that comprise them and relates this approach to the study of interorganizational networks. The second section highlights environmental resource niches and their carrying capacities as important concepts within community ecology. The third part explicates how the evolutionary mechanisms of V-S-R operate on community relationships to generate dynamic transformations in networks over time. Fourth, a network structuring process for studying network evolution is briefly described along with some empirical work that has successfully employed network analysis techniques to examine organizational communities. The conclusion of the article suggests how the study of network evolution may be insightfully applied by communication scholars working beyond the areas of organizational communication and networks.

A community ecology view of organizational networks

Community ecology

Sociocultural evolutionary theory (Campbell, 1965b), now more commonly called community ecology, organizational ecology, or institutional ecology (Baum & Powell, 1995), is a growing theoretical perspective designed to account for the birth, growth, transformation, and eventual demise of human social systems (G. R. Carroll & Hannan, 2000). As noted by Hannan and Carroll (1995), organizational communities are "broader set[s] of organizational populations whose interactions have a systemic character, often caused by functional differentiation. Some analysts refer to such communities as organizational fields or societal sectors" (p. 30; see also DiMaggio & Powell, 1983). A population is a collection of entities that share important similarities and depend on the same mix of resources to survive. In the organizational literature, populations are typically distinguished conceptually according to their unique *organizational forms* (McKelvey, 1982), which consist of their unique properties. Financial institutions such as banks can be thought of as sharing one organizational form, credit unions as sharing another, and venture capital firms as sharing yet another.

Organizational communities draw on a shared resource environment and include functionally different but interdependent populations and their relationships to one another. W. P. Barnett (1994) suggests that organizational communities be defined as populations "of organizations united through bonds of commensalism or symbiosis" (p. 351), which means that they are held together by ties that range from competitive to collaborative.

A number of communities have been explored in the literature. Bryant and Monge (2008) studied the evolution of the children's television community over a 50-year period; the study consisted of eight separate populations, including content providers, advertisers, government regulators, and children's advocacy groups. Leblebici, Salanck, Copay, and King's (1991) analysis of the radio broadcasting community from the 1920s to 1960s showed that the populations of financing organizations, production companies, distribution organizations, and broadcasters worked together and against each other to acquire national and local listening audiences, their common resource base. Powell, White, Koput, and Owen-Smith (2005) recently studied the evolution of the biotechnology community. They examine five core populations that comprise the community: universities and other basic research organizations, new biotechnology firms, venture capital firms, pharmaceutical companies, and government regulators.

Evolutionary theory applied to organizational community networks

Networks are typically defined as a set of objects or "nodes" tied together by a set of relations, often called *links* or *ties* (Wasserman & Faust, 1994). Though not labeled as such, it is easy to see that W. P. Barnett's (1994) description of community meets the definition of a network in that it consists of a set of objects, or *nodes*, called populations, and a set of formal and informal relations linking the organizations that comprise them (Rao, 2002). It is important to distinguish substantive network relations from their properties. *Substantive relations* refer to the contents of the network links such as *communicates with*, *obtains information from*, *reports to*, *regulates*, *finances*, *cooperates* or *competes with*, and a host of other possibilities. These are the types of relationships that tie the various members of networks together. *Network relational properties* refer to the characteristics of these relations, such as reciprocity or transitivity (Monge & Contractor, 2003).

Current community ecology applications implicitly focus almost exclusively on objects, such as the organizations and populations that comprise the communities, and neglect the links that tie these entities to each other. Apart from including cooperative and competitive relations and some insights about community integration and closure, work to date has largely ignored the role of networks in these evolutionary processes. DiMaggio (1994) noted that "organizational ecologists rarely collect systematic data on relations among organizations in the populations they study" (p. 446). Baum and Oliver's (1991) research on the institutional links of childcare organizations in Toronto, and Podolny, Stuart, and Hannan's (1996) study on linkages in the semiconductor industry are notable, but rare, exceptions. Even the "bonds of commensalism and symbiosis" that W. P. Barnett (1994) used to define organizational communities, which include competition and cooperation, are not treated as linkages from a network perspective; rather, they are viewed as general characteristics of the evolving populations and communities. This constitutes an important oversight. Social science has a tradition of investigating both properties of populations and the relationships between them. In the same way that it is useful to bring in contextual relationships into the examination of individual behavior, it is useful to bring community links into the examination of population behavior.

Consequently, including networks as an integral part of ecological study offers new opportunities for broader understanding. Monge and Contractor (2003) recommend that network scholars hypothesize community change on the basis of both ties and nodal attributes. Nodal attributes include variables such as organization size, age, regional location, and revenue source. For example, in an educational population, some schools may be public and others private. Network characteristics may include the type and strength of a dyadic relationship between two organizations as well as global measures that describe the degree to which a whole network is fragmented. For example, some population networks may be more centralized than others. All these attributes could be used as independent variables in statistical models that analyze "whether the observed graph realization exhibits certain hypothesized structural tendencies" (Contractor, Wasserman, & Faust, 2006, p. 686).

Organizational community links are often categorized as either commensalist, within populations, or symbiotic, between populations (Hawley, 1986). Commensalist relations range along a continuum from cooperative, often called mutualistic, to competitive (Aldrich, 1999). Organizations may choose to establish network relations with at least some, but probably not all, of the other members of their own population as well as with members of other populations that comprise the community. Connections with members of other populations are more likely to be mutually beneficial, but competitive relations can ensue when they rely on the same major resource. For example, populations of different media organizations, such as cable and the telephone industries, compete for the same customers for delivery of Internet access. As competitive links differ in fundamental ways from collaborative links, it is vital to carefully differentiate between them for the purpose of evolutionary analyses.

Resource niches in community networks

A central aspect of community ecology is its concern for the ways in which functionally different organizational populations divide the resources available to them. Hawley (1986) argues that communities comprise all those populations that share a common resource space, that is, the whole set of overlapping niches that contain the resources to support each of the populations. Organizational populations typically emerge when a few new organizations enter a new or previously uninhabited resource niche within an existing community. Niches are defined by a finite resource space in that they can be described as having carrying capacities that limit the size of the populations that can be sustained within them. This means that the evolution of organizations and their networks is inherently tied to the number of organizations that exist at a given time, generally referred to as the organizational *density* in a given niche (Hannan & Freeman, 1977). As the density of populations in a niche changes over time, there are often accompanying changes in the number and nature of relationships between organizations within populations as well as between organizational populations within communities.

Niche density

The community ecology perspective offers several theoretical explanations for the development of such density-dependent dynamics between community members and their relationships. One suggests that populations within communities go through a series of stages that are determined by their niche density, that is, the number of organizations in the populations (Hannan & Freeman, 1977, 1984). In the first phase, there are only a few new entrants, and they put little strain on niche resources. Under these circumstances, organizations typically cooperate rather than compete with each other. Consequently, members of the population thrive, although they struggle with the special problems of being young and small, often referred to as the liabilities of newness (Stinchcombe, 1965) and smallness (Aldrich & Auster, 1986).

In a second phase, outsiders witness the success of the new population, see potential opportunities for their own success, and enter the new population. It is during this phase that other organizations and institutions typically confer legitimacy on the growing population (DiMaggio & Powell, 1983), thus increasing its attractiveness to others. Population growth accelerates rapidly, and the increasing organizational density begins to strain niche resources. At this point, organizations start to seriously compete for resources both within their own populations and with organizations from other populations within their community. In the third phase, the rapidly growing population begins to approach the carrying capacity of the niche. Competition dominates as cooperation wanes, and organizations begin to fail. Consolidation frequently occurs as more successful organizations acquire weaker ones (Astley, 1985), thus transforming the population.

A complementary evolutionary explanation is articulated in resource partitioning theory (G. R. Carroll, 1985), which distinguishes members of the same population according to organizational attributes such as size and resources. According to this theoretical perspective, larger organizations tend to become *generalist* in nature, seeking to capture most, if not all, of the resources in the niche, thus dominating the center of the resource distribution. In contrast, smaller firms entering mature populations tend to *specialize*, seeking to maintain themselves by acquiring resources in specialist niches that are not dominated by the generalists (G. R. Carroll & Hannan, 2000). Although relationships between large generalists that consume most of a niche's resource tend to be competitive, the functional differentiation of small specialists shields them from direct competition with such giants. If specialist organizations are sufficiently distinct from their generalist counterparts in terms of the resources they require, the level of competition between specialists and generalists is thus minimized. The process of carving out a specialist niche is similar to the efforts of new populations to establish credibility and legitimacy; as long as there is a low density of specialists, competitive pressures remain low.

Even with the subdivision into specialist niches, however, continued growth of a population approaches and eventually exceeds the carrying capacity of the niche. At this point, the entire population, not just individual organizations, starts to decline, depending in part on whether the resources in the niche are renewable. Hawley (1986) argues that communities develop into functionally integrated systems, with each population contributing to the overall livelihood of the community. Astley (1985) observes that as system integration continues, communities tend toward closure as they begin to deplete the resources in their environments. As this happens, organizations and populations begin to rely more on each other for vital resources than on their environments. This makes the community as a whole vulnerable to the resource limits in each individual niche, as the loss of organizations in one population leads to the decline of related populations that rely on them.

Links and resource acquisition

Viewing the evolution of networks at the level of populations and communities is not the only application of the theory. Evolution can also be considered from the point of view of the individual nodes, their individual paths of development, and the mutual influence they have on one another. Maturana and Varela (1980) suggest that if nodes are autopoietic systems (i.e., self-reproducing), they may couple with other autopoietic nodes in such a way that each becomes indispensable to the other. The identification and study of such phenomena in organizational networks should be a fruitful area for research, but as the authors point out, coupling is not a necessary outcome of linking between systems. In other words, links between organizations may remain discretionary to the organizations involved. Thus, evolutionary theory can be used to investigate individual linkages as strategies for survival (Koka, Madhavan, & Prescott, 2006).

Organizational relationships themselves can be thought of as mechanisms for acquiring and consuming resources. Organizations invest resources such as people, time, money, and expertise to create relationships and linkages that provide other resources. As Burt (1992) expresses it, they expend economic or human capital in order to build their *social capital*, that is, their connections to the network, from which they hope to profit. Communication and other network links can be classified as an investment that is either internal or external. Internal costs are "those costs that the parties to a network have to bear for establishing, maintaining, and managing their interorganizational relationships" (Ebers & Grandori, 1997, p. 272). External costs are negative network externalities, disadvantages incurred by organizations due to being excluded from the network (Ebers & Grandori, 1997). Tongia and Wilson (2007) report that nodes that are excluded from the network experience large, negative effects. Spending resources on acquiring links is thus of critical importance.

One way to consider the investment required for linkages is in terms of the link life cycle. Burt (2000) demonstrates that linkages tend to experience a "*liability of newness*," that is, younger links tend to decay more rapidly than older links. From a resource perspective, this suggests that once a certain fixed investment has been made, ongoing resource contributions necessary to maintain the link may decrease. For example, one need not call an old friend regularly to retain the relationship. To the extent that this kind of resource efficiency may emerge from institutionalization of the link (Berger & Luckmann, 1967), there may also be a concomitant cost in terms of relational formality. In other words, the adherence to certain relational norms or understandings may become more critical such that transgressions are considered violations of trust rather than mere oversights. Uzzi's (1997) study of interorganizational networks in the fashion industry suggests this dynamic, where resource exchanges are loosely tracked but failure to adhere to certain promises is met with deep scorn.

The carrying capacity of networks

The network perspective on community ecology developed so far focuses both on the organizations and populations that comprise communities and on the nature of the communication and other resource networks that tie organizations to other members of their populations and to organizations from other populations in their communities. This perspective suggests that communities can have two distinct carrying capacities. The first is the number of organizations that the resource niches of the communities can support, a *member carrying capacity*. The second is the number of linkages that the organizations and communities can support, a *relational* *carrying capacity*, which can be thought of as an upper bound on network density. A relational carrying capacity suggests that there are network characteristics that can influence the degree to which nodes can connect to one another apart from the resources available for their individual survival (i.e., the determinant of member carrying capacity).

Member density and network density are not necessarily linearly related. If population growth follows the traditional logistic curve (G. R. Carroll & Hannan, 2000), the members of the population will grow at an expanding rate until it reaches the inflection point of the curve where growth will begin to decline. The network relations among the members of the population, however, can grow at a rate that may approach a geometric expansion. Specifically, this relationship means that as the number of organizations in populations or communities, *N*, increases, the number of possible linkages, *L*, may increase by as much as $N(N-1)$, which is a substantially faster rate. Of course, links may perish, which will impact this growth rate. Nonetheless, if cooperation and competition are viewed as separate networks, the potential size of the two networks taken together is $2N(N-1)$. To generalize this observation, if there are *R* multiplex relations, the potential size of the network is $RN(N-1)$. If the member carrying capacity and relational carrying capacity expand at different rates, it is quite possible that rapidly expanding populations will reach their linkage carrying capacities before the populations reach their member carrying capacities.

Theoretically, network density can vary between two boundaries: (a) no links between nodes, a completely unconnected network, and (b) links connecting all nodes, a completely connected network. Empirically, large networks such as community networks typically display a fairly low density in comparison to the $RN(N-1)$ possibility space (see, for example, Powell et al., 2005), suggesting that there are factors that work to suppress the level of link density. This generalization, however, comes from a comparison of static networks of different sizes rather than the same network that is evolving over time. Further, the exponential growth in the space of potential links $RN(N-1)$ tends to outpace even substantial growth in actual links; thus, overall density can decline even as links continue to be added.

The story is more complex at the nodal level. Recent work by Leskovec, Kleinberg, and Faloutsos (2005, 2007) has identified a network process called *densification* wherein the average number of links per node, what might be considered the *nodal carrying capacity*, tends to grow as the number of nodes in the network grows over time. This process is generally bounded by two factors, which in combination delimit growth. The first is where the average number of links per node remains constant as the number of nodes increases. The second is where the fraction of links to other nodes remains constant as the number of nodes increases.

Leskovec et al. (2007) found that empirical networks fall between these boundary conditions but vary substantially in the manner in which they do so. They modeled the relationship between growth in number of nodes and link density as an exponential function that varies between 1 and 2, a power law: 1 represents a constant average number of links per node over time and 2 represents an increasing number of links per node such that network density remains constant. Leskovec et al. (2007) examined the evolution of several different large networks. Two were academic citation networks and four were communication networks including e-mail and affiliation networks. The two citation networks showed a strong growth relationship between increases in the number of nodes and increases in the fraction of links connecting those nodes. The link growth or densification coefficients (referred to as alpha, "α") in these two cases were 1.68 and 1.66, and the addition of nodes coincided with a large increase in the average connections per node. However, the human communication networks they studied had much weaker link growth rates. The coefficients for the four communication networks were 1.18, 1.15, 1.12, and 1.11, and addition of new nodes only slightly increased the average connectivity. Their research demonstrates that different kinds of empirical networks display different link density growth rates, that is, they have different exponents for the growth function. This suggests that different kinds of networks have different link carrying capacities. Further, all the networks demonstrated a decline in overall network density over time (i.e., the densification coefficient for all empirical networks was less than 2), meaning that the percentage of nodes to which the average node was connected declined as the network expanded. These findings suggest that a network can support only a limited number of links at a given point in time. Thus, empirical evidence seems to support the theoretical ideas developed in this article for an evolutionary link carrying capacity.

Leskovec et al.'s (2005, 2007) work indicates that there is a relationship between network size and the extent to which individual nodes carry links independently of resource availability. That is, in cases where there are enough resources for new nodes to enter the network, new links are not added until *after* the new nodes have entered. This suggests that links might not be sustained by precisely the same resource space as nodes do for survival.

This suggestion requires empirical validation as Leskovec et al.'s results could be explained in at least two ways: buffering and complexity. First, in terms of buffering, it is possible that link growth and survival are bounded by the same resource space as node growth and survival (Baum & Oliver, 1991). In this case, there may be adequate resources for the formation of new links, but nodes simply choose not to increase their linkages beyond a certain point in a network of a given size because of diminishing returns. Following Hawley (1950), Astley (1985) argues that most organizations use expanding relations with other organizations to acquire resources from each other rather than directly from the environment. This strategy eventually brings a community to closure wherein most variations in the external environment have little or no effect on the community members. Once this insulation is complete, however, there may be limited value to be gained from increased linking. When a new set of nodes enters the network, however, it is possible that they bring with them connections to different environments that will now influence the existing nodes. Thus, nodes seek to expand their own networks to regain maximum insulation.

The second possibility is based on arguments from complexity theory. Kauffman's (1993) simulations of evolutionary processes indicate that increased complexity can lead to demise even when resources are available because complexity limits the ability of organizations to make fitness-improving adaptations. McKelvey (1999) calls this a complexity catastrophe. Linkages may require some resource or property in order to be useful to nodes, but this property cannot be easily obtained from the pool of general resources used for nodal sustenance. Such properties could include those created within the operation of the network itself. For example, the degree of interdependence or coupling between nodes via linkages could serve as a constraining function. Galbraith's (1973, 1974) work on the information-processing capacity of individuals illustrates this idea, suggesting that individuals seek to reduce the number of interdependent relationships due to their limited ability to deal with an influx of information.

Leydesdorff (2003) applies the ideas of coupling and complexity to communication networks. He suggests that when a network becomes more loosely coupled, the individual nodes gain degrees of freedom in their ability to conduct reflexive analyses. That is, when the local processing of each node is not governed by (i.e., is tightly coupled to) the network as a whole, it can make local adaptations based on the patterns it perceives. Depending on the circumstances, this flexibility may be beneficial for nodes. As new nodes enter the network, coupling will tend to be looser. As Leskovec et al. (2007) show, nodes increase their linkage load as the network grows, but the network itself becomes less dense. Thus, nodes are free to make more linkages without increasing their level of coupling to others.

In cases where relational carrying capacity can be shown to be the result of relational properties such as coupling rather than simply the exhaustion of relational benefits such as buffering, evolving networks may potentially operate as morphogenetic systems (G. A. Barnett, 2005; Contractor, 1994; Salem, 1997). In the densification example given above, it could be said that the α identified by Leskovec et al. is a function of the coupling in the network. Yet, as the exponent that relates link growth to node growth, α also determines future linkages and therefore the future coupling in the network. Such a network is self-referencing (Contractor, 1994) as the network's present structure is impacted by its structure at earlier points in time (Monge & Contractor, 2003).

This self-referencing nature may have a stabilizing effect on the network, thus allowing it to grow within a characteristic state space (Thom, 1983). For example, an increase in linkages could lead to an increase in coupling that leads to a decrease in α, thus bounding the parameter values of each within a stable range. However, network properties do not necessarily change in a simple fashion the way that node or link expansion does. Properties such as reciprocity and transitivity, which may have a strong impact on coupling, often operate quite independently of density (Robins, Pattison, Kalish, & Lusher, 2007). Further, the links that have most recently been added are not necessarily the links that are dropped if the relational boundary condition is reached (Burt, 2000), so the process is usually irreversible. This creates the possibility that the stabilizing feedback loop shifts to becoming self-reinforcing. In such a case, a network could experience overly rapid growth or, more likely, precipitous decline.

Thus, communities may decline over time because they have exceeded either their member carrying capacities or their relational carrying capacities. If one or more of the populations exhaust their resource spaces, the demise of these members can potentially lead to the demise of the larger communities. However, it is also possible for communities to collapse because the linkages that hold them together are no longer sustainable due to the increased complexity of maintaining them, even if the populations of which they are comprised continue to have sufficient resources for their individual survival.

Evolutionary mechanisms of network change

V-S-R in communities

Built fundamentally on evolutionary ideas originally formulated by Darwin (1859/2003), Lamarck (1904/1984), and others, community ecology is at its core a generalized theory of social change (Campbell, 1965b). It focuses on the mechanisms by which populations that comprise the community relate to one another in order to acquire the set of resources that will enable them to thrive or, at minimum, survive. Community ecology examines the dynamic processes by which populations adapt to their environments, the complex set of resources they contain, and each other. Campbell (1965b) argued that sociocultural evolution operates according to three guiding principles, succinctly summarized as V-S-R (see also Hawley, 1950, 1986). Campbell (1965a) explains these as follows:

> For an evolutionary process to take place there need to be variations (as by mutations, trial, etc.), stable aspects of the environment differentially selecting among such variations and a retention-propagation system rigidly holding on to the selected variations. The variation and retention system(s) are inherently at odds. Every new mutation represents a failure of prior selected forms. (p. 306)

These processes operate on multiple levels, including that of the community, and are sufficient to account for changing attributes of organizations, populations, and communities, as well as changing characteristics of community networks. The ability to rely on the same theoretical processes at different levels is an advantage of the evolutionary approach. As Eisenberg et al. (1985) describe, interorganizational linkages are often discussed in the literature as though they are of one type, but they are more appropriately considered at the institutional, representative, and personal levels. V-S-R can be expected to operate at each of these levels, perhaps in different ways and with differing consequences in each.

Variation focuses on alternative possibilities, both those available in the environment and those generated by human choice. For example, Delacroix and Carroll (1983) show that the episodic occurrence of social upheavals over a span of 100 years in Argentina and Ireland led to the emergence of a broader set of alternative newspapers during those periods. Similarly, Anderson (1999) describes how venture capitalists support entrepreneurs who create new organizations to develop new ideas.

Selection is the process of accepting one or more alternative variations and rejecting the others. Haveman (1992) found that as technology and economic factors changed in the California savings and loan industry, organizations could reduce their risk of failure, that is, of being "selected out," if they made certain changes but not others. Miner and Raghavan (1999) show how mimetic processes often lead organizations to select the routines and practices of others they deem successful, thereby rejecting a host of alternatives. In the case of strategic alliances, this may mean choosing a partner that other successful firms have already chosen. For relational selection, this may mean reviewing a host of communication and other relations, rejecting many alternatives, trying some, and picking a few. Selection is often described in terms of the relative *fitness* of communities, populations, or their members. Fitness is defined as an entity's propensity to survive and reproduce in a particular environment (Mills & Beatty, 1979). As a relational concept, fitness identifies the differential ability that organizations, populations, and communities have in accessing resources such as money, talent, and skills. It also pertains to differences in the quality of their traits. These differences do not guarantee selection, but they increase its probability.

Retention is the process of institutionalizing a selected variation, establishing it as an ongoing characteristic of the organization, population, or community, and maintaining it over time. Nelson and Winter (1982), for example, examined the role of routines as a retention mechanism for institutionalizing organizational procedures. March, Schulz, and Zhou (2000) examined the set of academic rules that had been selected and retained, and in some cases, modified and then retained, by Stanford University from 1891 to 1987. The retention of routines and rules provides continuity to organizational communities and populations. Similarly, numerous studies of industrial networks have found that organizations tend to maintain previously established communication and other alliances rather than creating new links (cf. Gulati, 1995; Shumate, Fulk, et al., 2005).

Usher and Evans (1996) provide an interesting example of V-S-R processes operating on a population. They studied the changes that occurred to the population of gas stations in Edmonton, Canada, over a 30-year period. Originally, the population consisted exclusively of service stations that were providing gasoline and repair services. Over time, station owners began to experiment with new forms by transforming their repair stations into spaces to sell gardening equipment or to rent cars. Out of this variation process emerged three new forms (self-service gasoline pumps, stations with car washes, and self-service pumps with convenience stores) that were able to outcompete the original service stations and thus began to replace them (selection). As the success of these newer forms became apparent, newly founded stations began to employ them (retention). At the end of the study period, organizations adhering to each of the four forms were present, with the newer three continuing to grow in numbers, and the original form slowly declining.

V-S-R in networks

We described earlier how network linkages can also undergo transformation via V-S-R. In new communities, there are few populations and few other organizations within each population to which an organization can connect. As communities and populations grow, the number of alternatives expands. Every other population and organization to which an organization can connect is a potential variation. Organizations often search for information to help them determine the nature of alternative potential partners and how they vary from each other. Zajac and Olsen (1993) describe a three-step process, which consists of an initializing stage, a processing stage, and a reconfiguring stage. In the first stage, organizations explore the various possibilities and partners for linking. In the second stage, they select and try one or more of the alternatives. In the final stage, they establish and retain the relation, or opt to modify and potentially deepen the relationship, or proceed to terminate it.

This process of V-S-R in organizational partnerships can be extended to communication linkages as a whole. In the variation stage, organizations or individuals within organizations experiment with different linkages, seeking many sources of advice or information. This variation in linking partners may also be accompanied by a variation in communication techniques, such as formal and informal or mediated versus in person. After a certain period of trial, nodes may develop a set of biases or habits (Hodgson & Knudsen, 2004) and prefer one partner and one communication style over another. These practices become selection mechanisms, where only those partners or communicative arrangements are permitted that conform to a network's normative requirements. As Berger and Luckmann (1967) describe, over time people develop expectations of how to act with one another based on the perceived habits of the other. As time passes, the organization or individual may begin to institutionalize these biases and habits via formal rules or procedures. Relationships are formalized through contracts, new employees are trained to follow communicative norms, and evaluation standards emerge for judging the quality of relationships in general (Knudsen, 2002; Leydesdorff, 2003). Thus, evolutionary mechanisms of V-S-R can be seen to operate at the level of network relationships such as the establishment of communication links.

Communication scholars have also drawn on concepts from complexity theory to investigate communication network evolution (cf. G. A. Barnett, 1993; Richards, 1993; Tutzauer, 1993). Developing a theoretical framework that outlines the application of self-organizing systems theory to the structuring processes in group decision making, for example, Contractor and Seibold (1993) argue that random variation in just one group member's behavior can set the direction of the whole group's evolutionary path. If certain boundary conditions apply, the group's normative structures change due to such behavioral "random fluctuations" (p. 540), opening up new possibilities for change for the group while making previous ones impossible. Richards also notes the potential for bifurcation points in the evolution of communication networks and describes how they may differ greatly in terms of their sensitivity to conditions at early points of development.

In competitive circumstances, organizations are often forced to make strategic choices about which organizations to compete with. Some compete on market segment, others on price or quantity, and others on yet different criteria, which means that they can be embedded in several "conflicting competitive networks" (Gimeno, 2004, p. 837) at the same time. Competitive links can be thought of as constituting an *affiliation network* around shared resources. Each organization that draws on a particular resource can be considered to share this link with others that draw on the same resource. A highly central organization would thus be one that was competing for many different resources within a community, whereas an organization on the periphery of the network would be one that linked to specialized resources. This model could be used to capture the idea of resource partitioning (G. R. Carroll, 1985; G. R. Carroll, Dobrev, & Swaminathan, 2002). Rather than modeling resource partitioning via the assessment of the number or diversity of resources used, researchers could model resource centrality. Some resources, such as raw materials, might be linked to only a few organizations (giving them low-degree centrality scores), but if the output of these few organizations were widely sought after in the community, the raw materials would have high closeness centrality. Thus, it is possible to conceive of resources as being partitioned between core and periphery rather than generalists and specialists.

Link and network fitness

Communication and other links can display fitness and fitness variations in ways that are similar to those displayed by nodes, though this property has not been explored in the theoretical and research literatures. When fitness has been addressed in networks, it has usually been at the nodal level. Barabási (2002) assigned a fitness value to Internet Web sites that showed "their ability to compete for links" (p. 96) and "how similar or different the nodes in the network are" (p. 102). By considering the product of this fitness value and the preferential attachment principle, he was able to generate a value that predicted link attraction in the World Wide Web (Pastor-Satorras & Vespignani, 2004; see also Kauffman, 1993, for a genotype network model based on nodal fitness).

Though a valuable contribution, this formulation addresses the fitness of nodes for linking rather than the fitness of the links themselves. *Linkage fitness* refers to the propensity for a relationship to sustain itself, that is, to survive or to reproduce itself. It is important to point out that the terms *thrive*, *survive*, and *dissolve* are not normative and do not imply goodness or badness. For example, relations may thrive that society may normatively view as bad, such as the relations between illicit drug cartels and money laundering institutions. A link is an interesting evolutionary entity in that it is jeopardized by several selection events. For a link to survive, both of its nodes must survive. The nodes must also conduct themselves in a manner consistent with the link's continuation, either by continuing to actively maintain it (e.g., in communication links) or by refraining from severing it (e.g., Internet hyperlinks).

Some links are fit in that they are both providers of important resources to one or both partners in the relationship and are easy to sustain. Others are less fit, providing some benefit, but perhaps only the minimal amount necessary to be sustained. Some relationships may fall below the sustainable level and, as a consequence, are dissolved. The level of fitness of communication links is partly determined by their reliability in addition to the quantity and quality of their content. Such links may be fit in that they perform predictably, perhaps serving to reduce environmental uncertainty even if their substantive content is of little value to the entities that sustain them. Other links tend to provide intermittent benefits, where the fitness is partly created by the expectation or promise of some large future payoff. Thus, different dimensions of individual link fitness can determine whether a relationship is nurtured and survives or whether it atrophies over time and fails.

Link fitness can also be thought of in terms of the link's ability to reproduce itself or copies of itself. For example, some communication links are specifically designed to only last for limited periods of time before they dissolve, as in the case of relations among various organizations that collaborate on project teams, such as the fashion industry, aerospace projects, and home construction (Djelic & Ainamo, 1999). The dissolution of the relationship in such cases is not a sign of a lack of fitness. Fitness could be indicated by whether a similar partnership, either between the same organizations or of a similar form, was engaged in by one or both of the organizations in the future. If organizational decisionmakers perceive their linking strategies as successful, they are likely to reproduce similar relationships in the future rather than modifying their relational repertoires (Miller, 1999).

Thus, links can be considered to have measurable fitness values for different linkage characteristics. Further, the fitness of the entire network, which includes all links, will determine whether populations and/or their organizational communities thrive, survive, or dissolve. The link fitness value constitutes a relative measure of a well-defined link property, such as strength or dependability, and the network fitness value is based on the aggregation of individual link fitness values. These fitness values are often at odds. Evolutionary theorists have long detailed how the fitness of parts of an organizational system can be optimized in response to lower level competitive pressures, while the fitness of the overall system remains suboptimal (Baum, 1999). The same concepts apply when it comes to the fitness of links and the networks constituted by them. Links with previous partners, for example, are often reestablished as they appear more attractive to individual organizations seeking to maximize their returns from linking. Over time, however, the resulting lack of variation in partnering could lead to suboptimal levels of innovation returns from collaborating at the network level. Under these circumstances, a collection of the fittest links would constitute a network of low fitness. Such multilevel fitness dynamics become apparent in innovation networks such as the research and development web that weaves together biotechnology firms. The most influential firms tend to diversify their alliance structures at higher costs by linking to novel network entrants (Powell et al., 2005) to avoid this suboptimization at the network level. By doing so, they ensure that the whole community network continues to thrive, which in turn increases their individual survival.

A network structuring process

Evolutionary theory, including the Darwinian concepts of V-S-R, can be used for fresh theorizing about the evolution of communication and other network structures. However, doing so requires not only an understanding of evolutionary theory but also insights into the aspects of networks that are most likely to be affected by these processes. Monge and Contractor (2003) provide a multitheoretical, multilevel (MTML) "network structuring" framework for communication and other networks within which to formulate an evolutionary perspective. As shown in Figure 1, there are four parts to the model. The first is the endogenous, inherent structure of the network itself, the properties of the relations that comprise the network, such as mutuality, transitivity, and clustering. The second is the attributes of the objects, such as whether institutions are for profit or not; these properties are viewed as exogenous to the network itself. The third is the influence of other networks and/or that same network at earlier points in time, also viewed as exogenous to the focal network. "Other networks" refers to other relations within the same organization, population, or community, whereas the same network at earlier points in time refers to the network's history. The fourth is external factors, environmental processes that influence the evolution of networks.

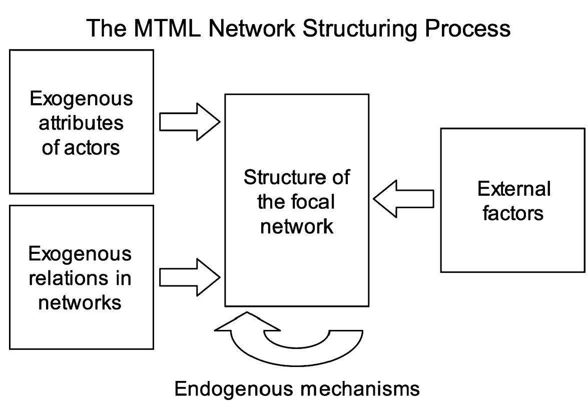

Figure 1 The multitheoretical, multilevel network structuring process (adapted from Monge & Contractor, 2003, p. 70).

Community models

The original structuring model presented in Figure 1 focused on single organizations, but it can be expanded to apply to evolutionary processes at the population and community levels as well. At the population level, the network is a set of organizations tied together by their relations with the other organizations in the population. The network exhibits a set of unique structural characteristics and properties. For example, some population networks may be more centralized than others. Attributes may differentiate members of the population. In a cooperation network of a population of educational institutions, some schools may be public and others private. Other networks refers to other sets of relations among the members of this same population such as financial support or competition for funding. At the community level, the model represents a set of relations among populations that comprise the community. Populations in this community may be distinguished by attributes such as whether they are governmental or private in nature, contrasting, for example, government research centers and private research centers. Each of these other networks has its own relations and structural properties, attributes, and network relations with other populations in the community. Each level is also affected by external, environmental factors, such as resource munificence.

The MTML network structuring process can be applied to networks at single points in time, using decomposition of network relations (mutuality, transitivity, etc.), nodal attributes, and autoregressive and other networks to identify statistically significant parameters that led to the creation of the focal network. An example is Monge and Matei's (2004) study on global telecommunication flows. An evolutionary perspective, however, must more fully account for the growth and decline of both nodes and linkages. This requires a time-based model that permits the addition and subtraction of nodes and linkages to the network. Often, this can be accomplished via network computer simulations (Monge & Contractor, 2003, chap. 4), where each time period provides an opportunity to modify nodes and linkages in accordance with evolutionary principles.

Empirical examples

Despite the potential value of the theory outlined in this article and the availability of many new network research tools (Börner, Sanyal, & Vespignani, 2007), little network research has followed a comprehensive approach to network evolution. As demonstrated in a recent review by Provan, Fish, and Sydow (2007), most empirical studies concentrate on individual links only and collect cross-sectional snapshots instead of longitudinal data. One exception is Powell et al.'s (2005) analysis of the evolution of the biotechnology industry. They found that both nodal and population-level attributes had an effect on linking behavior, leading to changes in overall network properties that then influenced the selection and retention of links. For example, at the network level, the dominant form of link changed over time, whereas at the population level, different linking strategies could be observed for organizations of different size and position in the community.

Bryant and Monge's (2008) study is an example of research that looks at community relationships, that is, relationships between populations of different organizational forms (see also Shumate, Fulk, et al., 2005). They examined the evolution of the children's television community from 1953 to 2003 using network analysis to test evolutionary hypotheses about the eight maturing populations that comprised this organizational field. The research showed that the composition of the cooperative and competitive ties in the network changed over time. It investigated the transformations of relationships between populations of organizations rather than between individual organizations and related these to the densities of their organizational niches. It was also concerned with the community's carrying capacity for organizations and their links. Environmental regulatory events external to the community were included as a special kind of exogenous variable affecting the network relations under investigation. The findings from this research supported the evolutionary postulate that in early stages of community development, mutual ties are prevalent, whereas in later stages, with increasing levels of population density, competitive linkages become more prominent.

Lee's (2008) research provides an extension of evolutionary processes to multidimensional networks. She studied the evolution of multidimensional communication networks among the organizations that comprise the global "information and communication technologies for development community" between 1991 and 2005. Historically, network scholars have studied unimodal (one population), uniplex (one relationship), and unilevel (one level) networks. Multidimensional networks comprise multiple populations and/or multiple relations and/or multiple levels. Lee showed that "multimodal (within and across organizational populations) and multiplex (two types of networks) dynamics are significant drivers of tie formation" (p. vii) over time. The research showed that multiple networks evolve together in organizational communities and that the evolution of one type of network predicted the evolution of other types of networks.

Multilevel influences

One of the advantages of evolutionary theory is that it can be applied at multiple levels without the need to adjust the fundamental principles of V-S-R. For example, Hannan and Freeman (1977, 1984) apply the theory to organizations, whereas Nelson and Winter (1982) apply it to routines within organizations. Monge and Contractor (2003) draw on Kontopoulos's (1993) heterarchical model of multilevel co-evolution to describe how higher-level determinants influence processes at lower levels and vice versa. As they describe, networks may differ in the degree to which various network levels influence each other via micro- and macrodetermination (Monge & Contractor, 2003, p. 12).

One way to specify network structuring from a multilevel, evolutionary perspective is to assess the mutual influence that different network structures might have on one another. For example, a network triad consists of three dyads. If, in a given environment, a triadic property such as transitivity is favored, this will necessarily have an impact on the fitness of dyadic links. Links within closed triads will be more likely to survive because of the other links that surround them. Similarly, triads can be influenced by higher-order structures. For example, if the environment favors central nodes that occupy brokering positions between several otherwise disconnected others, then transitive triangles are discouraged. Thus, selection mechanisms at higher levels can affect those at lower levels.

Retention can also play an important part in network structuring. Organizations tend to link to those with whom they have linked in the past (Shumate, Fulk, et al., 2005), which might favor the generation of some higher-order forms as new variations. More generally, the inertia of individual links within a network may have important consequences for overall network evolution. It is possible that certain structures, such as highly central brokers or dense cohesive clusters, are unlikely to emerge in networks where inertia is too strong. This inertial effect can be mediated by nodal attributes such as size as well as by network characteristics. One way to assess this possibility would be to compare citation networks to communication networks. In citation networks, links are always retained once they are forged, but this is not the case in communication networks. Leskovec et al. (2007) demonstrate that as citation networks have higher densification levels than communication networks, it is possible that they exhibit other unique structural properties due to this difference in retention at the dyadic level.

Conclusions

This article has provided an initial application of the theory of evolution to the study of human communities in general and to the analysis of communication and other network structures in particular. Evolutionary theory and community ecology encompass a number of important conceptual shifts. First, emphasis is placed on populations of organizations, groups, and individuals and their interrelations rather than on individual entities. Second, it requires researchers to take a dynamic, over-time perspective on organizational change rather than a static, cross-sectional one, thus looking at processes that lead to both growth and decline in the populations and communities of interest. Third, it ties organizational and communicative processes to the resources that constitute their environments, thereby including the larger contexts in which change occurs. Fourth, it provides a multilevel framework, which makes it possible to uncover lower-level properties that give rise to sustainable relationships or catastrophic events at higher levels.

Additionally, this article has provided a theoretical analysis of the evolution of communication and other community networks. Community networks were shown to have relational carrying capacities just as community populations have organizational carrying capacities. Networks that evolve over time display increasing density at a lower level than their theoretical capacities would suggest. Further, research has shown that this tendency depends significantly on the type of network. E-mail, affiliation, and other communication networks achieved only 20% of their theoretical maxima, whereas citation networks displayed more than 60% of their potential connectedness (Leskovec et al., 2007).

We have presented evolutionary theory as a generalized theory of change. Because communication networks and organizational communication comprise our areas of expertise, it has been natural for us to consider the implications of evolutionary theory for these domains. Scholars have been intrigued by social network change over time, studying, for example, the increasingly swift transformation of the international telecommunication network (G. A. Barnett, 2001) and using computer simulations to theorize about the co-evolution of multidimensional knowledge networks (Carley & Hill, 2001). In their examination of the effects of an organizational funding crisis on a governmental agency's e-mail network, Danowski and Edison-Swift (1985) found that the network expanded in terms of its nodes and their interaction frequency before returning to its precrisis structure. G. A. Barnett and Rice (1985) discovered fluctuations in the electronic conferencing networks of groups of researchers and noted that the rates of network change increased over an extended period of time before decreasing, suggesting that it took time for it to stabilize.

Wellman and associated scholars have done significant research (Wellman, 2007) on the way individuals adapt their personal networks to the social environment. Within a given neighborhood and social context (social class, era in time), there tends to be a common template for which ties (such as parents, friends, neighbors) are used to access which resources (such as childcare assistance, advice, and financial support), but as the social conditions change, the templates change. Although the work of these scholars and others represents a longitudinal perspective on networks and discusses possible causes for the changes observed, their analyses could be extended with the application of formal evolutionary theory. Specifically, evolutionary theory suggests that scholars identify V-S-R mechanisms that may underlie the observed changes and be useful for predicting future changes.

We would also be remiss if we did not point out the potential of evolutionary theory for the broader field of communication. Three brief examples should suffice from the areas of mass communication, small group communication, and online communication. Indeed, some scholars have already begun this exploration for their own areas of specialization. For example, examining media consumption patterns, Dimmick (2003) has applied niche theory to reveal how competition between media organizations for consumers is structured as an evolutionary process. But this is just a beginning in the mass media area. Media effects scholars interested in the interrelationships between media content and individual characteristics of media consumption might also find it advantageous to consider them as co-evolutionary, mutually influential processes. Additionally, the study of stereotypes and other cultural artifacts may be illuminated by examining them from a V-S-R perspective in conjunction with the transformation of relationships between social groups. Mass communication scholars interested in exploring how political discourse changes over time can also draw on the principles of evolutionary theory. Agenda-setting

(McCombs & Shaw, 1972), priming (Iyengar & Kinder, 1987), and framing (Gans, 1979; Snow & Benford, 1988) processes follow V-S-R in the sense that all three concepts deal with the differential proliferation of certain perceptions, attitudes, and media angles over others. It is well understood that there are systematic limits to the diversity of media coverage, and they could be explored in more depth by using evolutionary approaches. If various audiences are viewed as providing communication niches within which issues can thrive, frame differentiation can be studied as a resource partitioning phenomenon. The theory suggests that media frames are unlikely to thrive in a reception environment that includes competing views, which may help to explain the transformation of media fare in general, and news coverage in particular, over the past few decades.

The area of small group communication has begun in recent years to explore the role of transactive memory systems (Wegner, 1987) in building and maintaining distributed collective human knowledge repositories. Transactive memories require people to know who in the group knows what, to communicate new knowledge when they receive it, and to be able to retrieve information from others in order to perform their work (Brandon & Hollingshead, 2004; Hollingshead & Brandon, 2003; Liang, Moreland, & Argote, 1995; Moreland & Myaskovsky, 2000). Fulk, Monge, and Hollingshead (2005) suggest that evolutionary theory could aid in studying the updating process by examining the V-S-R of knowledge within the system. A community ecology perspective could also be applied to how knowledge is communicated by examining the entry and exit of experts as well as the patterns of linking to them. It is possible, for example, that experts with outdated information who are experienced communicators may be able to outcompete emerging experts simply on the basis of their position in the community. In such cases, communities could evolve toward becoming increasingly inaccurate knowledge repositories.

The third example of an area that benefits from an investigation of the evolution of communication systems is new communication technologies. Williams (2006) and others have explored the emergence of social groups in virtual gaming environments. Results suggest that within the confines of rather artificial game worlds, certain types of features are consistently selected for and retained, whereas others fail or go extinct. Drawing on game interaction logs as well as interviews with players, Williams studied differences in size, leadership style, and member turnover, which ultimately placed guilds of players into distinct niches that emerged in adaptation to the gaming environment. This is clearly an evolutionary process. Additionally, the evolution of the network configurations underlying these collaborative formations could be studied as networks that evolve in response to characteristics of the game environment that are mediated through social interactions.

The study of network evolution may profit from insights generated by a variety of approaches. In addition to focusing on V-S-R processes as they have been conceptualized in the area of organizational ecology, network evolution can also be analyzed by employing Maturana and Varela's (1980) notion of autopoiesis. G. A. Barnett, Chon, Park, and Rosen (2001), for example, theorize about the Internet as a communication system that has evolved from previous ones such as the global telecommunication system. These researchers show that although the basic organization of the system remains the same in the sense that it is constituted by nation-states occupying distinct geographic locations, its structure has evolved, now encompassing linkages in cyberspace that have emerged from other kinds of linkages (G. A. Barnett et al., 2001).

The application of evolutionary theory to the study of organizations, organizational communities, and their communication networks is not without limitations. Three factors are important for researchers to consider. First, evolutionary theory as a general theory of change must be appropriately aligned with the phenomena of the specific population or community under study. In the case of network evolution, for example, the mechanism of selection should be informed by an understanding of why some links would be preferable to others and what type of resources are valued for survival. This insight can help researchers maintain a focus on fitness as a propensity for future survival rather than a tautological result of survival in the past.

Second, the data requirements for studying ecological processes are substantial. Testing evolutionary theory requires longitudinal data covering a sufficiently long yet environmentally stable period of time to enable researchers to observe and distinguish variation, selection, and/or retention. The period must be long enough for significant variations in the network to occur, that is, for a substantial number of links to have been added or lost. However, the period must also include at least one time interval in which conditions were sufficiently stable for a consistent set of selection forces to operate (e.g., Powell et al., 2005). Substantive insights regarding the phenomenon under study should guide the choice of data and variables. Resource environments that appear unstable from one perspective may be quite stable from another. For example, consider environments in which resource munificence fluctuates substantially over time. It might be reasonable to infer that different selection criteria apply to different phases of these organizational environments. However, following Baum and Oliver's (1991) theory that organizations use community links to buffer themselves from resource shocks, it could be argued that the selection criteria for links are quite stable because organizations anticipate resource fluctuations and thus seek to build surplus community linkages.

Finally, it is important to note that the logic of evolutionary explanation sometimes poses a challenge to researchers seeking to predict future outcomes from present or historical conditions. Evolutionary theory suggests that networks, organizations, and communities adapt to the forces in their environments. Early uses of evolutionary theory assumed "historical efficiency" wherein strong forces produced strong effects (G. R. Carroll & Harrison, 1994). Environments were viewed as beyond the influence of the populations that resided within them (March, 1994). Thus, it could be argued that environmental conditions determined organizational outcomes via evolutionary processes. Recently, however, scholars have begun to realize that environments often co-evolve with their populations and communities, which in turn compete and co-evolve with each other (Bryant & Monge, 2008; Monge &

Contractor, 2003). This co-evolution is often self-referencing (Contractor, 1994), contains positive feedback (G. R. Carroll & Harrison, 1994), and is sometimes path dependent (Pierson, 2000), all of which may undermine the classical model of historical efficiency. As G. R. Carroll and Harrison suggest: "In settings where the underlying force is not as strong [as other forces or in other settings] or where there is a significant amount of noise, assuming historical efficiency becomes potentially problematic. The system may not have had sufficient time to adjust or its outcomes may be obscured or even influenced by noise" (p. 723). This suggests that scholars who use evolutionary theory to study communication ecologies need to determine if strong historical efficiency is (or should be) at work. If it is, standard analytics should work. If it is not, then explanations need to incorporate some combination of historically weak forces, positive feedback processes, path dependence, and stochastic processes and/or noise. This is likely to lead to accounts of evolutionary processes in terms of patterns and constraints that have propensities to develop along specific lines that simultaneously lead to the exclusion of other paths. Evolutionary theory incorporates the three fundamental processes of V-S-R but challenges the existence of causal mechanisms that operate identically in all contexts and at all times. The solution to this seeming dilemma is to include these other factors in the predictions and research rather than to assume historical efficiency or reject prediction as a whole (G. R. Carroll & Harrison, 1994).

Evolutionary theory and ecological theory have been usefully applied across the spectrum of the humanities and social sciences. Important areas include economics (Nelson & Winter, 1982), globalization (Held, McGrew, Goldblatt, & Perraton, 1999), literature (J. Carroll, 2004), psychology (Tooby & Cosmides, 2000), religion (Atran, 2002), and sociology (DiMaggio & Powell, 1983), to name but a few. As this article has attempted to demonstrate, this generalized theory of social change holds considerable promise for the field of communication as well. As theory and research evolve in the years ahead, it is highly likely that evolutionary theory will play a key role in our understanding of the complex dynamics of human communication.

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L'évolution des réseaux de communication dans les communautés organisationnelles

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Résumé

Les communautés organisationnelles sont généralement définies comme des populations d'organisations liées ensemble par des réseaux de communication et par d'autres relations, dans des niches de ressources qui se chevauchent. Traditionnellement, les théoriciens évolutionnistes et les chercheurs ont examiné les populations organisationnelles constituant les communautés organisationnelles en se concentrant sur leurs propriétés plutôt que sur les réseaux qui les lient. Toutefois, une pleine compréhension de l'évolution des communautés organisationnelles requiert un aperçu à la fois des organisations et de leurs réseaux. C'est ainsi que cet article présente une variété d'outils conceptuels permettant d'appliquer la théorie évolutionniste aux organisations, aux communautés organisationnelles et à leurs réseaux, incluant les notions de capacité de transport relationnel et de valeur sélective des liens. Il illustre certains principes évolutionnistes, comme la variation, la sélection et la rétention, qui mènent à la formation, la croissance, le maintien et la mort de la communication et d'autres liens de réseaux. Cette perspective nous permet de comprendre les façons par lesquelles la survie et le succès des communautés dépendent autant de leurs liens de communication que des organisations qu'elles lient. L'article se termine par des suggestions d'applications possibles de la théorie évolutionniste à d'autres domaines de la communication humaine.

Die Evolution von Kommunikationsnetzwerken in Organisationsgemeinschaften

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Organisationsgemeinschaften werden typischerweise als Populationen von Organisationen definiert, welche miteinander verknüpft sind durch Kommunikationsnetzwerke und andere Beziehungen in sich überlappenden Ressourcen-Nischen. Traditionell haben Evolutionstheoretiker und Forscher Organisationspopulationen, welche Organisationsgemeinschaften ausmachen, eher fokussiert auf ihre Eigenschaften untersucht als hinsichtlich des Netzwerks, was sie verbindet. Ein umfassendes Verständnis der Evolution von Organisationsgemeinschaften verlangt allerdings Einsichten in die Organisationen wie auch ihrer Netzwerke. Folglich präsentiert dieser Artikel eine Vielzahl von konzeptuellen Werkzeugen für die Anwendung der Evolutionstheorie auf Organisationen, Organisationsgemeinschaften und ihrer Netzwerke, einschließlich der Idee von relationaler Tragfähigkeit und Verknüpfungstauglichkeit. Aufgezeigt werden evolutionäre Prinzipien wie Variation, Selektion und Erinnerung, die zu Formation, Wachstum, Aufrechterhaltung und möglichem Niedergang von Kommunikation und anderen Netzwerkverbindungen führen. Diese Sichtweise erlaubt uns zu verstehen, dass das Überleben und der Erfolg von Gemeinschaften genauso abhängig sind von ihren kommunikativen Verbindungen wie von den Organisationen, welche sie verbinden. Der Artikel schließt mit Vorschlägen für eine mögliche Anwendung der Evolutionstheorie auf andere Gebiete der menschlichen Kommunikation.

La Evolución de la Red de Comunicación de las Comunidades Organizacionales

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Resumen

Las comunidades organizacionales son típicamente definidas como poblaciones de organizaciones unidas por las redes de comunicación y otras relaciones en nichos de recursos superpuestos. Tradicionalmente, los teóricos evolucionistas e investigadores han examinado las poblaciones organizacionales que componen las comunidades organizacionales focalizándose en las propiedades en vez de en las redes que los vinculan. No obstante, una comprensión completa de la evolución de las comunidades organizacionales requiere el entendimiento de ambas, las organizaciones y sus redes. Consecuentemente, este artículo presenta una variedad de herramientas conceptuales aplicando la teoría de la evolución a las organizaciones, a las comunidades organizacionales, y sus redes, incluyendo las nociones de apoyo relacional – capacidad y aptitud de vinculación. Se ilustran los principios evolucionarios, incluyendo la variación, la selección, y la retención, que lleva a la formación, el crecimiento, el mantenimiento y la desaparición eventual de la comunicación y las otras redes de vinculación. Esta perspectiva nos permite comprender las formas en las que la sobrevivencia comunitaria y el éxito son tan dependientes de sus vínculos de comunicación como lo son de las organizaciones a las que ellos se conectan. Este artículo concluye con sugerencias para la aplicación potencial de la teoría evolucionaría a otras áreas de la comunicación humana.

组织性社区传播网络的演进

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组织性社区一般被界定为因传播网络或其他资源交叉关系而粘合在一起的组织群。进化论研究者和理论家传统上关注组织群的资产而非将其连接的网络，来检验由组织性社区构成的组织群。然而，若要全面理解组织性社区的演进，我们必须理解组织和它们的网络。因此，本文展示了将进化论用于组织、组织性社区及其网络，包括承载关系的能力以及联系的合适性，的多种概念工具。本文阐释了包括变异、选择和保留在内的进化论原则。它们导致传播和其他网络联系的形成、发展、维持和最终消亡。从这个角度出发，我们可以理解社区的生存及成功对其传播性网络的依赖，其程度等同于对将其连接之组织的依赖。本文最后讨论了进化论在人类传播其他领域内的应用。

조직적 커뮤니티들에서의 커뮤니케이션 네트웍 발전에 관한 연구

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요약

조직적 커뮤니티들은 전형적으로 커뮤니케이션 네트웍들에 의해 함께 연결되는 조직들의 모집단으로 정의된다. 전통적으로, 진화론적 이론가들과 연구자들은 그들을 연결하는 네트웍보다는 그들의 특성들에 집중하는 것에 의해 조직적 커뮤니티들을 구성하는 조직적 모집단들을 연구해 왔다. 그러나 조직적 커뮤니티들의 발전을 완전히 이해하기 위해서는 조직들과 그들의 네트웍들 모두를 잘 살펴보아야 한다. 따라서, 본 논문은 조직들과, 조직들 커뮤니티들, 그리고 네트웍들에 대한 발전이론을 적용하기 위하여 여러 다양한 개념적 틀을 제시하고자 하는바, 이들은 관계적 이행능력과 연계 적절성 등이다. 본 논문은 변수, 선택, 보유등 커뮤니케이션과 다른 네트웍 연계들의 형성, 성장, 유지, 그리고 결과적인 붕괴를 이끄는 발전적 원칙들을 설명하고 있다. 이러한 전망은 어떻게 커뮤니티의 존재와 성공이 그들의 커뮤니케이션 연계들에 의존하고 있는가에 대한 이해를 도와준다. 본 논문은 여타 휴먼 커뮤니케이션 영역에 대한 진화론의 잠재적 응용들에 대한 제안으로 결론을 맺고있다.