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Networks and Institutions

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INTRODUCTION

Research on institutions and networks has proceeded on largely separate trajectories over the past few decades. The former is more associated with work in organizational and political sociology, and the latter serves as the wellspring of research in economic sociology. To be sure, a number of loose linkages exist between the subfields. For example, many institutional studies presume that professional or inter-organizational networks serve as conduits for the diffusion of appropriate practices and ideas. Indeed, much institutional research conflates 'simple' diffusion with 'deep' institutionalization. Meanwhile, research on networks often considers how categorical or status variations in network structures shape social comparison and stratification processes. But these points of intellectual cross-fertilization have remained undertheorized.[1]

We think there is much to be gained from a more analytically driven dialogue between these literatures. We argue that networks and institutions mutually shape one another. Over time, this co-evolutionary process creates, sustains, and transforms social worlds. The cognitive categories, conventions, rules, expectations, and logics that give institutions their force also condition the formation of relationships and thus the network structures that function as the skeletons of fields. But networks are more than just the scaffolds and circulatory systems of organizational fields. They are also the source of 'horizontal' distinctions among categories of individuals, organizations, and actions, as well as 'vertical' status differentials. While institutions shape structures and condition their effects, networks generate the categories and hierarchies that help define institutions and contribute to their efficacy. Thus, any effort to understand institutional processes must take networks into account, and vice versa.

Our argument draws on core concepts from institutional and network theory that are utilized across both lines of work. Despite their portability, however, they have rarely been theoretically integrated. Using institutional theory, we highlight the undertheorized relational aspects of both fields and logics. Starting in network theory, we

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emphasize the important institutional features of embeddedness and social capital. Our goal is to do more than review existing points of contact or stimulate joint discussion. We aim to provide a roadmap for future research that will directly address two critical animating questions. First, how do institutional practices and forms emerge from networks? Second, how do institutionalized categories and conventions shape the structure and effects of networks?

We begin with a brief excursion through several canonical works in institutional analysis, highlighting the implicit, but nonetheless strong, network underpinnings of these theoretical arguments. For symmetry, we select several well-known empirical studies that directly measure network effects to account for the transmission of institutional practices and structures. Next we revisit four foundational ideas – organizational field, institutional logic, embeddedness or the non-contractual basis of contract, and social capital – which contain both network and institutional insights that are, we contend, indissoluble. We then develop answers to our key questions about emergence and constraint against this background.

NETWORKS ARE CARRIERS OF INSTITUTIONAL EFFECTS

In their classic paper, Meyer and Rowan (1977) observed that the formal structures of organizations 'dramatically reflect the myths of their institutional environments.' They argued that organizations are driven to incorporate practices and procedures defined and buttressed by widely prevalent, rationalized concepts in the larger society. These practices were institutionalized through professional standards and prestige hierarchies, and reinforced by public opinion. Consequently, Meyer and Rowan contended that the building blocks of formal organization 'litter the societal landscape.'

This canonical article incorporated network ideas in several key ways, although subsequent work has tended to overlook its structural aspects. In part, this neglect may be traced to a contrast that Meyer and Rowan emphasized between organizations where survival depended on managing the contingencies of boundary-spanning relations and others that had to respond to ceremonial demands which were present in their environments. This continuum suggested that managing relational networks involved matters of coordination and control, while more institutionalized settings necessitated efforts at symbolic management. But Meyer and Rowan also emphasized that all organizations are embedded in both relational and institutionalized contexts. They stressed that the complexity of relational networks generated 'explosive organizing potential,' and this greatly increased both the spread and number of rationalized myths. Central to this process of transmission and standardization were trade and professional associations and inter-organizational coalitions.

The generative potential of networks as transmission channels is readily apparent in the Meyer and Rowan paper. Similarly, DiMaggio and Powell (1983) argued that the great rationalizers of the latter half of the twentieth century were the professions and the modern State. The growth and elaboration of professional networks spanning organizations contributed, they argued, to the rapid spread of various models of organizing. Networks were also essential components of DiMaggio and Powell's conception of an organizational field, which emphasized both connectedness (Lauman, Galaskiewicz, and Marsden, 1978) and structural equivalence (White, Boorman, and Breiger, 1976). The institutional development of an organizational field hinged on: (1) increased interaction among participants; (2) the development of well-defined status orders and patterns of coalition; (3) heightened information sharing; and (4) mutual awareness and responsiveness. The twin imprints of the relational sociologies of Harrison White and Pierre

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Bourdieu clearly stamp this account of field evolution and institutional formation.

From DiMaggio and Powell's perspective, status orders shaped patterns of information exchange, creating a core and periphery structure that channeled the flow of news and personnel within organizational fields. The policies and structures of the most central organizations in a field were more likely to be emulated by others. While many subsequent researchers picked up on the mimetic aspects of this phenomenon, the underlying structural elements received less attention (see discussion in Mizruchi and Fein, 1999). Nevertheless, this account of field structuration emphasized how shared meanings and typifications, as well as stable role structures, emerged out of repeated interaction.

In one of the most comprehensive empirical studies of institutional transformation, Scott and colleagues (2000) analyzed the profound changes that occurred in health care delivery in the San Francisco Bay Area between 1945 and 1990. They demonstrate the effects differing forms of legitimacy have on hospital survival rates. In the period following World War II, physicians and their professional code of conduct dominated health care standards. Federal financing and the regulation of health care arose in the late 1960s and greatly expanded in the 1970s and 1980s. That growth was accompanied by increasingly salient technical forms of legitimacy. In recent decades, the health care industry became more intensely competitive. For-profit entities entered the field in large numbers, and managerial legitimacy increasingly shaped evaluative standards. Scott and colleagues' rich analysis documented that earlier professional and regulatory standards were not extinguished by the new managerial and market orientations; rather, each successive era displayed more heterogeneus forms of legitimacy.

Consequently, as the health care field evolved, 'three logics – professional, public, corporate – were all present, active and contending with one another' (Scott et al., 2000: 316). Federal funding and oversight of health care eroded professional sovereignty, opening the door for more market-based criteria. The key point, however, is not that a new managerial logic replaced physicians or bureaucrats, but that health care became a complex, multi-level field in which both the number and novelty of inter-organizational connections between hospitals and other types of health care institutions expanded dramatically. 'Managers appear to have been the beneficiaries, not the agents' of deinstitutionalized professional power (Scott et al., 2000: 328).

The forces that transformed the health care field were varied and numerous, ranging from policy legislation to medical specialization to the increasing complexity of service delivery. These broad changes were typically ushered in by new linkages, formed by accreditation bodies, shifting organizational control structures, inter-organizational alliances and coalitions, as well as new affiliations with purchasers, intermediaries, service providers, and government. These network realignments not only brought with them participants who changed the boundaries of the health care field, but the new entrants were also carriers of novel ideas that profoundly altered the meaning of health care. Scott et al. (2000) captured this change in relationships and meanings aptly in their discussion of the shift from the doctor–patient relationship to one of a health care provider–consumer transaction. This upsurge in linkages and connections were critical to accreditation, health care provision, and fiscal solvency; but these new relationships also remade the taken-for-granted understandings of the medical field.

Each of these pillars of sociological institutionalism argues that social networks transmit ideas and practices in distinctive ways. Networks also reflect key micro-level interactions that influence institutional dynamics. To illuminate the recursive nature of institutional and network influences, we turn to several notable empirical studies that demonstrate the potent force of social networks. Though the orientations of the authors differ

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and the objects of inquiry vary, we argue that these prominent papers carry a common message that networks are shaped by social comparison processes in which institutionalized categories are highly influential.

NETWORKS ARE STAMPED BY INSTITUTIONAL CATEGORIES

Galaskiewicz and Burt (1991) analyze how corporate officers evaluated nonprofit organizations in the Minneapolis-St. Paul region and decided whether to make significant charitable contributions to them. In the Twin Cities, the networks of high-profile corporate philanthropists and leaders of the nonprofit community were closely inter-connected. The authors tested to see whether the spread of evaluative standards operated through the mechanisms of cohesion or through structural equivalence. The frame of reference in the former is the dyad, stemming from a history of past experiences, while the latter is the larger social system. Dyadic influence processes operate on a one-to-one basis, while structural equivalence effects draw on perceptions of similarity rather than direct communication. Consequently, structural equivalence processes are driven by what officers presume others in comparable positions are doing.

In a community that is closely knit and in regular contact, one might expect direct interaction and cohesion to trump structural equivalence. Instead, Galaskiewicz and Burt find the opposite. In the Twin Cities, the importance of structural equivalence reflected common norms and standards magnified within a professional community while demonstrating how the field's informal stratification orders conditioned individual acceptance of these norms. As the authors put it, when an opinion comes to be shared within ego's profession, 'ego is expected to follow rapidly to avoid the embarrassment of being the last to espouse a belief that has become a recognized feature of occupying his or her position in the contributions community' (Galaskiewicz and Burt, 1991: 90).

Galaskiewicz and Burt recognize the strong parallels between their account of the Twin Cities nonprofits community and DiMaggio and Powell's (1983) explanation for how and why organizations, and the structure of organizational fields, change over time. Indeed, they explicitly note that 'an important component of DiMaggio and Powell's argument is the network of contacts among organizations or their agents' (Galaskiewicz and Burt, 1991: 88). Within this philanthropic community, the manner in which evaluative categories varied across organizations could be predicted by how corporate contributions offices were stratified within the status hierarchy of their profession.

Palmer, Jennings, and Zhou (1993) analyzed the influence of institutional, political, and economic factors on the adoption of the multidivisional form (MDF) by large U.S. corporations in the 1960s. To assess how institutional factors influenced the transition to an MDF, they measured the professional training and social network connections of key organizational decision makers, focusing specifically on elite business school training of corporate chief executive officers and interlocks among corporate boards of directors. They also assessed economic and political considerations, including corporate strategy and performance, as well as the influence of managerial rivalries, both inside companies and in external coalitions.

This impressive effort to test rival theoretical arguments found ample support for both economic and institutional factors, but little for an explicitly political view. Both corporate industrial diversity and geographic dispersion stimulated the adoption of the multidivisional structure. Differentiated companies (i.e., firms involved in multiple unrelated lines of activity) and those with facilities spread across the nation, encounter problems that a multidivisional structure purports to solve. Institutional variables also proved to be robust. Most notably for our

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purposes, networks were critical factors in the transition to a multidivisional form. Corporations in which CEOs had graduate degrees from elite business schools were more likely to adopt the MDF than firms with executives who did not hold elite degrees. Boards of directors with interlock ties to firms that had already adopted an MDF structure also influenced adoption. Not surprisingly, corporate board connections to non-MDF firms did not (Palmer et al., 1993: 120). Thus, institutional backgrounds and social connections jointly condition corporate strategies.

Davis and Greve (1997) analyzed the diffusion of two practices that were adopted by corporations in the 1980s as a defense against hostile takeovers. The 'poison pill' and the 'golden parachute' were embraced by companies and their managers to raise the costs of an unwanted takeover bid. Both of these practices were initially controversial but came to be adopted by the majority of U.S. corporations. Yet despite their similarities, the 'pill' spread quickly and the 'parachute' diffused more slowly. Interestingly, the channels of social influence varied too. Pills spread through cohesive ties among members of corporate boards of directors, while parachutes were adopted on the basis of geographic proximity. Corporations adopted golden parachutes as other firms in their local metropolitan area did so.

This intriguing analysis revealed a puzzle: the same individuals – members of corporate boards – decided to adopt both practices, but the tools spread at different speeds through divergent routes. Davis and Greve ask what factors accounted for these different patterns of diffusion. Social networks provide one compelling answer. Pills spread from one corporation to another across the nation because the corporate director network has a national reach. Boards that shared directors were the conduits through which this mechanism to deter hostile raiders spread. Golden parachutes, in contrast, circulated locally. Their diffusion was rapid in some areas, but in other regions the practice never took hold. In the status-bound corporate world of New York City, for example, protecting the CEO was seen as a duty of boards, but in the more rough-and-tumble entrepreneurial world of Silicon Valley, parachutes were eschewed. The mechanism at work here was social comparison among local elites, who looked to their regional reference groups for a sign of whether their CEO should be protected against unexpected job loss. This 'parochial' social comparison process resulted in a slower rate of diffusion than the more national and cosmopolitan transmission of pills through director networks.

Davis and Greve point out that these local and national network channels were also characterized by different normative standards. The poison pill was couched in a language of fending off unscrupulous raiders. This defense was perceived as appropriate and legitimate by board members; and thus championed by them in different corporate settings. Contact with directors in similar industry sectors and in corporations of comparable status became the venues for diffusion of a practice that came to be regarded as accepted and necessary.

Parachutes were much more difficult to legitimate. They were perceived by some to reflect naked managerial self-interest, while others saw them as payoffs for weak managers. Questions about the appropriateness of parachutes were answered locally, by looking to the behavior of central individuals and companies in the regional economy. In short, the relevant networks for diffusion and the pace at which they communicated specific practices were shaped by the broader institutional context in which they were situated. Davis and Greve's analysis affords keen insight into how network configurations are conditioned by institutional forces. Understanding why the same boards take signals about adopting pills from distant, but connected rivals while turning to local community members for signals about the legitimacy of parachutes requires not only attention to networks, but to the meaning of

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practices, categorical distinctions and status hierarchies.

We find strong common analytical underpinnings in these different, notable accounts of institutional influences and network effects. Numerous scholars identify networks as the channels through which institutional effects flow, and see networks of like-minded individuals as central reference groups that promote widely emulated practices. The presence of these common elements in a handful of important empirical studies lends credence to our claim that networks and institutions mutually influence one another. To pursue this argument, we move from empirical studies to conceptual claims, and offer a brief exegesis of four core ideas that are widely used in both network and institutional analyses. We demonstrate that core concepts in institutional and network theory are analytically richer and more useful when they take each other into account.

FOUNDATIONAL CONCEPTS

Organizational fields

Fields are simultaneously master concepts and fundamental empirical sites for institutional analysis. Much recent (and some not so recent) work has focused on genesis and change in such diverse fields as politics, the arts, law, gastronomy, and the chemical industry (Clemens, 1997; DiMaggio, 1991; Dezalay and Garth, 1996; Ferguson, 1998; Hoffman, 2001; Rao, Monin, and Durand, 2003). These rich narrative efforts, as well as more abstract treatments, rely heavily on relational language to describe the contours and characteristics of fields. Perhaps more importantly, organizational action within fields is understood largely in terms of affiliation, competition, and shared membership, all features that emphasize how social relations shape institutions (Fourcade 2007).

Consider two related definitions of fields. In one view, an organizational field is a community of organizations that engage in common activities and are subject to similar reputational and regulatory pressures (DiMaggio and Powell, 1983; Scott et al., 2000). Through a more politically filtered lens, a field is seen as a space of positions whose characteristics are jointly defined by the configuration of their inter-relationships and by the struggles of actors who seek to claim them (Bourdieu and Wacquant, 1992). These two definitions bracket contemporary institutional parlance, where 'field' carries three distinct, but only partially decomposable connotations. We highlight each sense of the term, and then argue that their indissolubility results from the relational threads that cross-cut them. Networks both structure and integrate fields.

The fields of institutional theory are recognizable arenas of social action, as such they are *fields of endeavor*. A more dynamic view suggests differentiated *fields of play* where more or less attractive positions convey opportunity, and constrict the possibilities of various social groups. Finally, fields are molded into their characteristic shapes by rules, conventions and expectations that define appropriate activities and legitimate positions. Thus, this view emphasizes *fields of force* that regulate social action.

Relationships are moves in games and fundamental components of the fields on which they are played. As such, concrete network structures map past struggles, and shape possibilities for the future by differentially channeling resources to contestants. Networks also push and pull players into finite sets of positions. Thus, the positions and affiliations participants claim are only partially under their control. The presence and absence of ties render a confusing struggle clear to observers and participants alike by allowing them to classify and order both the players and their moves into categories (forms, identities, strategies) and hierarchies (status orders). A fundamental insight of network theory, often neglected in institutional analyses, is that relationships are both pipes that channel resource flows as well as

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prisms that help render action sensible (Podolny, 2001).

Networks are essential to fields in at least two senses: they are both a circulatory system and a mechanism for sensemaking. Fields are shaped by networks, which condition the formation of relationships and help establish their consequences. But it is only against the backdrops of particular fields that rationalities and strategies of action are sensible. The relational aspects of fields are the threads that weave together the term's disparate meanings.

Institutional logics

Logics constitute the rules and conventions of a particular organizational field. In broad terms, an institutional logic is the constellation of beliefs and associated practices (the schemas and scripts) that a field's participants hold in common. These packages of beliefs and practices are organizing principles and recipes for action. They have instrumental, normative, and cognitive implications (Friedland and Alford, 1991; Whitley, 1992; Thornton, 2004). Logics provide rationales for action. They are most influential when they are consistent and easily taken-for-granted. But when multiple competing logics are in play in the same setting, they can trigger conflict and/or generate new accounts of activity.

Three different approaches to the idea of logics rely on relational underpinnings, but their structural features are rarely elaborated. Consider first the idea, drawn from work in the Carnegie School tradition of organization theory, that organizational action is routine-based, rule-governed, and triggered by conventions that match concrete situations and actions to the needs of particular positions (Cohen, March and Olsen, 1972; March and Olsen, 1984). These logics of appropriateness do more than simply set the grounds for concrete action in particular situations. When strung together across roles, they represent the authority structure of an organization by 'defining the relationships among roles in terms of what the incumbent of one role owes to the incumbents of other roles' (March and Olsen, 1984: 23). In contrast to classic Weberian notions of authority, it is the linkages among conventional recipes for action that are central, defining characteristics of organizations. When spread across the categorical distinctions provided by organizational roles, logics comprise formal structures.

Clemens (1993, 1997) extends the idea of logics by recognizing that the social world is rife with alternative models for organizing any particular endeavor. In her view, organizational repertoires are templates that structure concrete relationships within organizations and convey scripts for behavior that link forms of organization to cultural expectations (Clemens 1993: 758). In this sense, logics offer a mechanism by which institutions direct the formation and mobilization of networks, while providing a means for expectations and regulations to exert force upon the participants in a field. The analytic link she makes between institutional logic and organizational form is an important one that deserves further explication.

Institutional logics, then, are inextricably tied to concrete structures that define the authority relationships that characterize organizational forms. Logics do more, however, than forge collections of roles into formal organization. Friedland and Alford (1991) offered a now widely held view of logics as central, distinguishing features of fields. In their view, the content of a field's dominant logic renders networks much more than mere affiliations. Without institutional logics, 'it will be impossible to explain what kinds of social relationships have what kind of effect on the behavior of organizations and individuals' (Friedland and Alford, 1991: 225). Logics make networks meaningful features of social and economic worlds precisely by disciplining (though not determining) the formation and implications of relationships. The presence or absence of connections and

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the resources that flow through them as well as the meanings that participants and observers attribute to relationships depend upon prevailing logics. The same relationship or affiliation may exist under the auspices of multiple institutional logics, which provides leverage to elaborate the ways in which relationships carry the social into instrumental exchanges.

Embeddedness: the non-contractual basis of contract

Classic research in organizational theory (Dalton, 1959; Gouldner, 1954) and a foundational work in economic sociology (Macaulay, 1963) demonstrated that even highly purposive economic exchanges are enmeshed in and freighted with social expectations. Organizational and economic actions result from a complex lamination of motivations and meanings that participants draw from the various fields in which they participate. Macaulay's (1963) key finding that businessmen often disregard the legal rights and responsibilities inherent in contract in favor of more social means of dealmaking and dispute resolution underscored how social relations cemented economic transactions. His study offered a starting point for Granovetter (1985) who, drawing on Polanyi's (1957) insight that market relationships are embedded in both economic (contract) and non-economic (friendship, familial) institutions, illuminated how concrete social relationships shape economic activity.

Granovetter's (1985: 500) argument that social relationships are fundamental to economic processes has been highly influential. Nevertheless, we concur, to a degree, with critics of the embeddedness perspective (Krippner, 2001; Lie, 1997) who argue that a purely relational view of market activity loses some of the evocative features of Polanyi's original, more institutional definition. Social ties are fundamental to economic relations, certainly. What we find more interesting is the insight that economic relationships (as well as any other collective social activity) can be understood in terms of multiple institutional arrangements and logics, only some of which are instrumental. Relationships matter precisely because their meanings are variable and depend on the orientations of participants to the various logics and contexts them sensible.

Return, for a moment, to Macaulay's (1963: 61) discussion of contract and consider the oft-cited example of a businessman who notes: 'You don't read legalistic contract clauses to each other if you ever want to do business again. One doesn't run to the lawyers if he wants to stay in business because one must behave decently.' There is certainly a story about trust, forbearance, and the shadow of the future implicit in these statements. Much less explored, however, is the idea that 'behaving decently' is defined against a particular social and institutional backdrop.

The idea that lawyers should be excluded is not because they are personal strangers but because they view the same relationship through a different institutional lens, which helps explain why they find the businessman's approach 'startling' (Macaulay, 1963). As Macaulay noted, where businessmen see orders that can legitimately be cancelled, lawyers see the same exchanges as contracts whose violation carries strongly negative consequences. Economic exchange has a non-contractual basis, but that bedrock is both relational and categorical. The meaning of a relationship and the actions appropriate to it depend jointly on the parties to the tie *and* the broader institutional and professional milieus to which they belong. Put differently, relationships are multiply embedded and the social entanglements that make economic exchange possible are the joint outcome of both networks and institutions. We make a similar claim about our final concept, social capital, which more closely situates individual activities in both fields and networks.

Social capital

Like 'embeddedness,' the voluminous and disparate uses of 'social capital' have

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rendered the concept slippery. At a basic level, capital is a resource that can grow with investment and use. Social capital, then, is capital derived from relationships external to the individual (Lin, 2001). In other words, social networks convey an array of resources to individuals at differential rates. Viewed instrumentally, that capital can be invested with some expectation of returns. The networks that convey social capital can be either concrete, measurable relationships or more diffuse affiliations based on group membership.

The latter sense of membership owes much to Durkheim and treats the collective effervescence and shared identification of social groups as both a public and a private good that can be harvested for personal and collective benefit (Putnam, 2000). In Alejandro Portes' terms (1998: 52), 'involvement and participation in groups can have positive consequences for the individual and the community.' Other scholars take a narrower view, focusing more explicitly on concrete relationships of exchange. Burt (2005: 4), for instance, notes 'One's position in the structure of ... exchanges can be an asset in its own right. That asset is social capital, in essence, a conception of location effects in differentiated markets.' In this formulation, social capital derives from the structure of the collective, but the returns are to the individual, based on differential positions within networks, rather than on the interplay of affiliation and identification emphasized in more categorical, membership-based treatments.

Two often-cited general definitions of social capital combine both these aspects in a fashion that is instructive for our effort. Both situate social capital within a particular context, while treating it as an imperfectly fungible resource. Coleman (1990: S98) recognizes that social capital is plural: 'Social capital is defined by its functions. It is not a single entity, but a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors ... within the structure.' Note three features of this definition. First, there are multiple 'social capitals.' Second, social capital does not equally facilitate all activities. Third, the activities for which this capital is an efficacious resource are located within the structure that defined it. Put more succinctly, social capital is contextual: it derives from and only pays dividends in certain situations.

Pierre Bourdieu offers a subtly different definition of the concept. He emphasizes a broader notion of social structure and a more explicit emphasis on resources, distinguishing social capital from both cultural and human forms of capital: 'The aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition' (Bourdieu, 1985: 248). This definition is also a complicated one, but note that it makes social capital an outcome of both direct ties and recognizable membership. Perhaps more importantly, Bourdieu's emphasis on institutionalized relationships returns us to the consideration of fields, a complementary concept in his theory of practical action. Here, capital (of whatever form) is derived from the arrangements that characterize particular fields, and it is within those fields that different varieties of capital can be mobilized to serve disparate ends.

We argue that this close look at key concepts from institutional theory and network theory demonstrates that the approaches are indissoluble. Fields are fairly barren without the interpretive lenses and resource channels created by networks. Logics render networks and organizational structures sensible in particular fields, but many, if not most, activities are amenable to multiple logics. Thus, the ability of logics to shape social action depends intimately on the structures in which activities take place and the partners with whom they are undertaken. Expanding the reach of all four concepts to more fruitfully capture such relationships will be particularly important to the growing number of

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studies that examine the genesis and dynamics of institutions and networks. In the following section, we abstract from our foregoing discussion to sketch an analytic framework that takes up this challenge.

CONTEXT OR CO-CONSTITUTION?

We have documented a set of analytic connections between networks and institutions. Canonical works in neo-institutional theory rely explicitly on network imagery and mechanisms, while exemplary empirical pieces demonstrate that networks are central to explanations of institutional phenomena. Likewise, four master concepts – field, logic, embeddedness, and social capital – mix both relational and categorical claims. We believe these interdependencies can be understood in two ways. The first, less radical view treats networks and institutions as mutually reinforcing, contextual features of social systems. The second line of argument examines how networks and institutions co-constitute one another. Put differently, the first view sees institutions as the landscape and networks as the social relations on that field. The second view argues that fields influence which relations are possible, and how these relations are forged can alter the landscape in profound ways. We hold the second view.

Many institutionalists have recognized that networks are important contexts for understanding institutional process (Jepperson, 1991; Davis, Diekmann, and Tinsley, 1994; Dobbin and Dowd, 2000). Contextual effects are key, but more important, we believe, is the idea that networks and institutions are co-constitutive. In other words, networks shape institutions but institutions sculpt networks and direct their growth. Genesis and change, not just context, are at stake in the merger of structural and cultural approaches to complex social systems.

Our argument rests on the idea that categorical distinctions are at the heart of institutions, and the concrete relationships that are the basis of networks have a dual character. Like other well-known dualities – between persons and groups (Brieger, 1974), meanings and structures (Mohr, 1998), organizations and environments (Stinchcombe, 1965) – we take meaningful social categories to be defined in large part by relationships' participants from within and across them (White et al., 1976). At the same time, the likelihood and implications of particular relationships stem from the categories that collaborators occupy and span. As a result, categories and relationships jointly bound and determine action in social systems.

Understanding how networks and institutions co-evolve to shape social and economic arrangements requires us to attend to the myriad ways that relationships and categories influence each other. We argue that one force behind that shaping is organizations and individuals who strive to navigate settings where multiple institutional logics either co-exist or collide.[2] If logics offer templates for action and organizing while rendering existing and potential relationships meaningful, then settings where multiple logics overlap will be particularly fertile ground for institutional entrepreneurship. Some of those in structural locations that engage multiple logics – as in art and commerce, patient care and administrative efficiency, or altruistic medical donations and income generation – can use their circumstances to forge new opportunities or craft multivocal identities. In settings where numerous logics reflect conflicting or incompatible demands, ambiguous identities and multiple networks offer room to maneuver. Still, the tensions that are generated by ambiguity, multiplicity, and contradiction can be daunting to individuals and organizations.

Practical action draws on both relationships and categories, and, in so doing, links networks and institutions. Such efforts are most visible in settings characterized by conflicting logics, multiple audiences, and

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ambiguous categories. Participants in specific fields draw on categories and associated logics to make sense of their worlds and direct their relationships and affiliations. At the same time, relationships and affiliations offer participants disparate types and amounts of capital, depending on their institutional context. Continuity and change in categorization systems and network structures alike depend on discernable patterns in the formation of ties and affiliations.

How, then, do we explore the generative relationship between networks and institutions? A thorough-going elaboration of a 'network-institutional' research program is beyond the scope of this chapter. We opt instead to reconsider some of our own work on the evolution of the human therapeutic and diagnostic biotechnology industry and on the institutional changes that surround the commercialization of academic research. In the former setting, multiple logics of discovery associated with different types of organizational partners encourage biotechnology firms to create and maintain diverse network ties in order to innovate and develop novel products. These ties span multiple types of organizations to form a field where relationships and outcomes alike are stamped by the categorical features of partners. In the latter setting, logics associated with the commercial use of science are imported into the established field of public science, sparking both structural and institutional transformations. We address a set of research questions that emerge from treating skilled, but constrained, performances as a mechanism linking relationships and categories.

The key questions we consider are:

(1) How do the meaning and consequences of relationships depend on the character of the participants?
(2) How do the effects of macro-structures depend on the types of participants that comprise them?
(3) How do locally situated individuals pull down global categories and draw on external relationships in their daily activities?
(4) How does situated action escape its local context to alter global categories and external relationships?

These questions do not exhaust the connections between networks and institutions. Nevertheless, we believe that initial answers to these queries will aid in developing a theory of social and economic life that treats networks and institutions as flip sides of the same analytic coin.

We begin by revisiting our work on the evolution of inter-organizational collaboration in human therapeutic and diagnostic biotechnology. The commercial field of the life sciences provides us with fertile ground to answer our first two questions. We first discuss how the same collaborative activities, for instance joint R&D efforts, have very different implications for biotech firms depending on the organizational form of partners. Here categorically different forms of organization bring different logics to the same activities. As a result, the likelihood and effects of any particular tie depends on institutional features of the partner.

R&D undertaken with pharmaceutical firms, for instance, differs dramatically from scientifically comparable research conducted with academic, university-based collaborators because pharmaceuticals and universities operate in different selection environments under different institutional logics. Moreover, as the field developed biotech firms and partner organizations become relational generalists. In addition to learning to manage multiple types of activities across stages of product development, biotech firms developed the capacities necessary to conducting the same kinds of endeavors with different types of partners. Their efforts to develop and maintain network portfolios that include diverse activities and partners accounts for the characteristic structure of the industry-wide network.

We next turn to analyses of innovation in two densely populated biotechnology regions, Boston and the San Francisco Bay area, to address our second question. These two regional communities are highly productive, but one (Boston) is anchored in a network that grew from public sector origins. The other community (SF Bay) is centered

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on a network that emerged from starting points in venture capital (VC) initiatives. The different institutional anchors in these two regional networks result in divergent approaches to innovation. Both clusters are highly successful and network structures are fundamental in both places, but the types of success and the ways in which networks matter vary with the organizational form and associated logics of key participants.

We dramatically shift levels of analysis and go 'microscopic' to examine our next two questions. We first consider the ways in which broad logics (of appropriate skepticism), salient categories (such as academic discipline) and concrete relationships (of collaboration and mentorship) are pulled down into the daily life of a scientific laboratory. The institutional and relational features of academic science shape laboratory life, but they do so imperfectly because they also offer researchers avenues for resistance. Finally, we turn to an analysis of decision making in a high-profile technology licensing office to consider how local action can escape its immediate context to reshape broader categories and relationships. In this instance, situated efforts to resolve contradictory logics at the boundary between academe and the market drive licensing officers to create complicated deals that can entangle participants from different market and technological categories, thus shifting the character of the field.

THE RECURSIVE NATURE OF NETWORKS AND INSTITUTIONS

In their study of the commercialization of the life sciences, Powell and colleagues (2005) offer a co-evolutionary analysis of how fields and networks influence one another. Their starting point is the view that fields emerge when social, technical, or economic changes exert pressures on existing relations, and reconfigure models of action and social structures. In this respect, they follow Bourdieu and Wacquant (1992) in viewing a field as a center of debate in which competing interests negotiate over resources and the interpretation of key rules and conventions. Their study focuses on the interaction of multiple overlapping networks through time by examining how the formation, dissolution, and rewiring of network ties from 1988 to 1999 shaped the opportunity structure of the biomedical field. By linking an evolving network topology and field evolution, Powell et al. demonstrate that social change is not an invariant process that affects all participants equally. Rather, field-level transformations are multi-dimensional phenomena. Organizations feel the reverberations of change in different ways depending on their institutional status and location in the overall network. But the status orders and structures of the field change over time.

The analytical aim of the 2005 paper was to illuminate how patterns of network interaction emerged, took root, and transformed the field, with disparate ramifications for all of the varied participants. The empirical setting was the field of biotechnology, which developed out of university laboratories in the 1970s, saw the founding of dozens of science-based companies in the 1980s, and matured in the 1990s with the release of dozens of novel medicines. The field is notable for both scientific and commercial advances and a diverse cast of organizations ranging from universities, public research organizations, venture capital firms, dedicated biotech firms, and giant multinational pharmaceutical corporations. Because the sources of scientific leadership were widely dispersed and developed rapidly, and the relevant skills and resources needed to produce new medicines were broadly distributed, the participants in the biomedical field have found inter-organizational collaboration essential (Powell, Koput, and Smith-Doerr, 1996). By analyzing the evolving structure of inter-organizational networks, we demonstrated how the larger field and its conventions changed both the meaning of ties and the practice of collaboration.

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In the early years of the industry, from 1975 to the late 1980s, most biotech firms were small companies that relied heavily on external support. No biotech firm had the necessary skills or resources to bring a new medicine to market in the early days, thus they became involved in an elaborate lattice-like network of relationships with universities, hospitals, and large multinational firms. The large corporations, despite well-established internal capabilities, lacked access to the cutting edge of university science. Deficient in a knowledge base in the new field of molecular biology, large firms were drawn to the biotech start-ups that had more capability at basic and translational science. This diverse distribution of technological and organizational resources was a key factor driving early collaborative arrangements in the industry. A number of institutional factors undergirded this collaborative division of labor.

The breakneck pace of technical advance has rendered it difficult for any single organization to remain scientifically abreast on multiple fronts, hence linkages to universities at the forefront of basic science have been necessary. The availability of funding also increased rapidly, as biomedicine became a major force in modern global society. The budget of the U.S. National Institutes of Health, a key funder of basic research, nearly doubled in the 1990s during the Clinton years. Venture capital financing flowed into biotech somewhat irregularly in the 1990s, but over the course of the decade grew markedly. Biotech financing by venture capital has always been somewhat counter-cyclical. When there was great enthusiasm for the internet and telecommunications start-ups, interest in biotech waned. But when the bloom fell off the internet rose, financing for biomedical ventures went on the upswing.

Two factors stood out in shaping the early structure of the field and the nature of its networks. One is that the different members of the field had varying abilities and competencies. Some of the participants were highly specialized, while others had a hand in multiple activities. For example, universities and public research organizations specialized in basic science and in early stages of drug development. Venture capital firms specialized in financing. Biotechnology companies, and especially large multinationals, tended to have a hand in many more activities. More recently, public research organizations such as universities have greatly broadened their range of endeavors in the biomedical field. The most dramatic finding of this research was that, over time, all participants in the field had to learn to master a wider array of relationships and move from specialist to generalist roles. That move makes the need to navigate multiple potentially competing logics a key feature of the field.

Second, as the field gained coherence and the pattern of reliance on networks solidified, various institutions emerged to facilitate and monitor inter-organizational collaboration. Offices were established on university campuses to promote technology transfer, law firms developed expertise in intellectual property issues, and various angel investors and venture capital firms provided financing, along with management oversight and referrals to a host of related businesses. As these relations thickened and a relational contracting infrastructure grew, the reputation of a participant came to loom large in shaping identities (Powell, 1996).

There are two aspects of this analysis that are highly relevant to our current discussion of network and field evolution. One, notable changes in the nature of the actions pursued by the field's participants accompanied shifts in the field's characteristic practices, logics, and norms. Two, both the cast of participants and the rules of the game changed as new logics of affiliation emerged and spread. We briefly summarize these two co-evolving trends, and refer the reader to the more extensive discussion in the 2005 paper.

In the late 1980s, the most active participants in the emerging biotechnology industry were the dedicated biotech firms, pharmaceutical corporations, and key government agencies such as the National Institutes of

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Health. In these early years, biotech firms lacked the capability to bring novel medicines to market, while large firms trailed in understanding new developments in molecular biology (Gambardella, 1995; Powell and Brantley, 1992; Henderson, Orsenigo and Pisano, 1999). Venture capital activity in biotech was limited, and most small companies supported their research and development activities by selling their lead products to large corporations, which subsequently marketed the medicine and pocketed the lion's share of the revenues (Powell and Brantley, 1996).

A handful of emerging dedicated biotech firms with considerable intellectual property and strong translational research ability were highly sought after as collaborators. This first wave of biotechs founded in the 1970s and early 1980s included Genentech, Centocor, Amgen, Genzyme, Biogen and Chiron, and the most active large corporate partners were firms such as Eastman Kodak, Johnson and Johnson, and Hoffman La Roche. While the commercial logic of young firms selling their lead products to major corporations dominated the landscape of the 1980s, a new set of relationships was quietly emerging.

The National Institutes of Health began forging R&D relationships with new entrants to the industry, and linking university scientists and start-up firms. As the science undergirding biotechnology expanded by leaps and bounds, the intellectual property associated with the science became more codified and legally secure. This, in turn, attracted greater interest from venture capital. By the early 1990s, biotech firms not only had highly prestigious science, evidenced by publications in top-tier journals, but they also had secure legal rights to their intellectual property in the form of patents. The networks of affiliation began to change, in some respects quite dramatically. By the mid 1990s, the most active participants in the field continued to be dedicated biotech firms, but the large pharmaceutical companies were pushed to the sidelines by the entrance of venture capital firms and universities. Moreover, the primary locus of activity shifted from commercialization to research and development and finance.

The industry expanded geographically as well, moving from its early origins in the Bay Area and Boston to San Diego and a handful of other key regions in the United States and Europe (Owen-Smith, Riccaboni, Pammolli, and Powell 2002). Growth in the number of new firms, new partnerships, and new ideas was greatly enhanced by an increase in financial linkages and government research funding. The combination of the growth of private equity markets and national funding for R&D replaced the former reliance on large corporations for support.

The older relationship with giant multinationals for commercialization activity was a very restrictive one. A small handful of firms had the ability to take a drug to late-stage development and a small set of dominant multinationals could manufacture and distribute the drug worldwide. This commercialization arrangement was a downstream activity, involving the sale of a new medical product. One might consider it the last dance in the product life cycle. In contrast, finance is an upstream activity, which fueled research and development, licensing, and subsequent commercialization. Consequently, it enrolled many more participants into the industry network. With the addition of more participants, a wider array of organizational forms joined the field. Diversely anchored, multi-connected networks are much less likely to unravel than are networks that are reliant on a few forms of organization.

Most notably, multiple logics were now at play. Pharmaceuticals began to recognize that they had to learn skills other than development and commercialization in order to compete with university researchers and venture capitalists for access to cutting edge ideas. The network structure of the field continued to expand throughout the 1990s, as both the number of entrants and the number of ties linking incumbents and new entrants expanded greatly. Indeed, in 1998 more than 1100 new ties were forged. All of the

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participants – from federal funding agencies to universities to biotech firms to pharmaceuticals – had begun to engage in a wide array of activities and were no longer specialists. We refer to the ability of participants to participate effectively in multiple kinds of ties with diverse parties as multivocality, a dominant pattern that emerged whereby highly central participants were involved in a diverse array of collaborations with an extensive set of partners of different types (Padgett and Ansell, 1993).

As the cast of participants grew , and as diversity in both organizational form and activity became more important, new logics of affiliation took hold. In the early years, there was a powerful influence of accumulative advantage. Those entrants who had the most visibility attracted the most attention and the greatest sponsorship. In short, the rich got richer in the Mertonian sense (Merton, 1968). As the field grew, homophily became more important, particularly in terms of geographic location as firms located near one another connected. Particular regions of the country became known for their biotech clusters. Through time, a logic of appropriateness developed, in which assumptions about what a biotechnology firm looked like became widely accepted. A new canonical firm excelled in translational science and typically had ties to a research university, a venture capital firm or two, and a large corporate partner. A highly successful firm would add affiliations with a noted research hospital and perhaps a federal agency, such as one of the branches of the National Institutes of Health. But note that each of these affiliations was for a specific type of relationship, the venture capital tie for finance, the university tie for research, the link to the hospital for clinical trials, and the partnership with a large corporation for commercialization.

As the field evolved, the diversity of participants began to reshape the range of activities that the participants undertook. As key participants became relational generalists, the logic of affiliation that we dub combinatorial or multivocal took root and began to diffuse to the field's periphery. Neither money, market power, nor the sheer force of novel ideas dominated the field. Rather organizations with diverse portfolios of well-connected collaborators became the most cohesive, central participants in the field and played the largest role in shaping its evolution. The tight density of the expanding network and the open scientific trajectory combined to enhance the importance of the various participants' reputations. The pattern of cross-cutting collaboration meant partners on one project were often rivals on another. As a result, networks were frequently rewired. Thus participants had to learn how to exit relationships gracefully, so as not to damage their future collaborative prospects. The coevolution of networks and categories in the field created a social structure in which external sources of knowledge and resources became widely differentiated and a preference for diversity and affiliation with multiply connected partners had powerful mobilizing consequences.

INSTITUTIONAL EMBEDDEDNESS SHAPES CATEGORIES AND PRODUCTS

In more recent work we have moved from analyzing the evolution of the macro-network to a more fine-grained study of the two most active biotechnology clusters, the San Francisco Bay Area and the Cambridge/Boston region. The attributes and successes of these clusters are widely studied, and their efforts have been broadly emulated worldwide (Powell, Owen-Smith, and Colyvas, 2007). But interestingly, despite their similarities in scale and reputation, each region emerged through distinctive patterns of collaboration that appear to influence their characteristic processes of discovery and types of innovation. We explored the relationship between the forms of affiliation and the types

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of innovative activity pursued in these regions (Owen-Smith and Powell, 2006).

In the conceptual terms used earlier, our analyses of innovation in Boston and Bay Area biotechnology draw on two core ideas. First, our earlier work demonstrates that the organizational form of the dominant players in a network shapes the character of social capital in a community. Where universities dominate, a logic of discovery that favors openness and information diffusion prevails and membership alone suffices to increase rates of innovation. In contrast, when for-profit organizations are key players in the network and more 'closed,' proprietary logics are at the fore, a central network position is essential (Owen-Smith and Powell, 2004). In addition to shifting the ways that organizations extract benefits from their networks, the different logics associated with partners of disparate form shape strategies for innovation, the kinds of connections firms forge and the markets they seek to serve.

Recall our description of the different types of organizations — including VC firms, government agencies, large multinationals, large public research organizations, and dedicated biotech firms – that comprise this field. These diverse organizational forms were linked by multiple types of affiliations: R&D connections for shared research and development, finance ties reflecting investment, licensing relations that transfer the rights to intellectual property across organizations, and commercialization partnerships that include product development, clinical trials, manufacturing, and sales and marketing.

We find two notable differences between the Bay Area and Boston regional networks. The Bay Area is larger organizationally and geographically, with many more biotech firms, several major universities, including Stanford and the Universities of California (UC) at Berkeley and at San Francisco (UCSF), and numerous venture capital firms. The Boston network, while denser and somewhat smaller, has many more public research organizations, including MIT, Harvard University, Massachusetts General Hospital, Dana Farber Cancer Center, and Brigham and Women's Hospital among others. The Boston area had many fewer venture capital firms in the 1970s and 1980s, and VCs arrive in the Boston region much later (Powell, Koput, Bowie, and Smith-Doerr, 2002). Neither region housed a large multinational pharmaceutical corporation during the period stretching from 1970s through the 1990s. Both clusters have structurally cohesive networks, but they differ in the demography of their organizational types.

We have shown that the Boston network grew from early origins in the public sector, and that public science formed the foundation or anchor for subsequent commercial application (Owen-Smith and Powell, 2004; Porter, Whittington and Powell, 2005). Because the Boston biotechnology community was linked by shared connections to public research organizations early in its evolution, this cluster manifested a more open technological trajectory than a cluster that relied more heavily on industrial R&D. By contrast, the Bay Area was much influenced by the prospecting and matchmaking efforts of venture capitalists, the multidisciplinary science of the UC San Francisco medical school, and the novel efforts at technology transfer at Stanford (Colyvas 2007). The San Francisco Bay Area evolved out of this more commercial and entrepreneurial orientation. Interestingly, both Boston and the San Francisco Bay Area developed from dependence upon a non-biotech organizational form, and these diverse forms, whether they are public science organizations or highly engaged entrepreneurial financiers, helped catalyze the development of the respective clusters.

Do these different relational components and logics influence the nature of research and the kinds of medical products that emerged from the companies in these two regions? We explored this question in two ways, by examining the nature of patenting among the participants in the two regions and through a paired comparison of two comparable treatments for multiple sclerosis. In a 2006 study, we found a significant difference

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in the patenting activity of biotech firms in Boston and the Bay Area, with Bay Area firms producing roughly 3,800 U.S. utility patents over the period 1988–1999, while Boston area firms generated 1,376. Bay Area firms appear to be much more prolific patentors. The highly skewed distribution of patents, however, suggests that the difference results from a small number of exceptionally productive Bay Area companies (Owen-Smith and Powell, 2006).

More interestingly, however, are the considerable differences we observe in the citations Boston and Bay Area firms make in their patents. These data suggest that Boston biotechs more routinely engage in exploratory innovative search, which typically yields a few very high impact patents at the expense of numerous innovations with lower than average future effects (Fleming and Sorenson, 2001). In contrast, the dominant Bay Area patenting strategy appears to be a more directed and incremental, 'exploitation' strategy that is what one might expect of companies supported by investor networks that demand demonstrated progress. Companies that pursue exploitative strategies generally develop numerous related improvements on established components of their research trajectories. Exploratory Boston area companies are much more reliant on citations to prior art generated by universities and public research organizations, while Bay Area companies rely more on citations to their own prior art. Indeed, 71 percent of the patent citations by Boston companies are to prior art developed outside at biotech firms.

How might such differences in patenting be reflected in the kinds of products released by the companies? We used the Food and Drug Administration (FOA) approval records to identify the 58 new drugs developed by Boston and Bay Area biotech firms. Fifty-three of these medicines were approved between 1988 and 2004. All of the drugs that appeared on the market prior to 1988 were developed by just two Bay Area firms, Alza and Genentech. These early approvals no doubt reflect the commercialization strategy pursued in the Bay Area region. We find that the Boston-based companies had a stronger focus on orphan drugs intended to treat rare diseases for patients with relatively small markets. In 1983, the Orphan Drug Act was created to speed the development of therapies for rare diseases by offering tax breaks and regulatory assistance to organizations that would develop medicines for small market medical needs. Many Boston-based firms have chosen to focus on orphan drugs, as one might expect of companies that are enmeshed in networks that are dominated by universities and hospitals. In contrast, Bay Area biotech firms have pursued medicines for larger markets in which the potential patient populations run into the millions, and for which there is likely to be stiff product competition. This high-risk, high-reward strategy shows the imprint of the venture capital mindset.

We did a paired comparison of two drugs, Betaseron developed by the Bay Area firm Cetus, which was eventually acquired by Chiron, a Berkeley-based biotech firm, and Avonex, developed by Boston-based Biogen in tandem with Berlex Laboratories, an American subsidiary of the German pharmaceutical firm Schering-Plough. We compared these similar drugs by looking at FDA labeling information and patenting citations to prior art. These two drugs are biologically and chemically comparable. Both are therapies for the same disease, recurring and remitting multiple sclerosis. Betaseron relies on a set of four patents, three initially assigned to Cetus and reassigned to Chiron following the merger of the two firms, as well as one process patent, which was reassigned to Berlex Labs. These four patents cite a small group of prior art patents, and in turn, a larger group of second generation citations. In sum, Betaseron rests on a history of some 55 interlocking patents, almost all of which are based on intellectual property owned by companies.

Avonex, developed by Biogen, is based on a single compound patent, but it reached

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more broadly into the prior art, relying on 155 separate pieces of intellectual property. Not a single piece of the prior art on which Avonex depends is owned by Biogen, suggesting that Biogen developed its market-leading therapeutic drug without the benefit of a thicket of intellectual property rights, and relied instead on a mix of public domain science and its partners' intellectual property. Obviously, internal R&D was critical to the development of both drugs, Biogen's much heavier reliance on public science reflected the local network characteristics of Boston. relied much more heavily on public science, which characterized the local network in Boston, more notably than is the case in the Bay Area. Indeed, among the holders of the patents for the prior art for Avonex are MIT and the Massachusetts General Hospital.

Citation network comparison for similar drugs offers an interesting natural experiment that holds constant technical, clinical, and regulatory features of the innovation process. Even when such factors are quite similar, the patent citation networks underlying these two drugs differ in a manner that reflects the larger institutional environment of the regional innovation system. The Bay Area-based drug relies more heavily on internal R&D and on research efforts of other firms, while the Boston-based therapy draws on a broad cross-section of prior intellectual property owned by a wide range of different types of organizations.

Our comparison demonstrates that the two networks bears a strong institutional footprint. Bay Area firms were faster, more prolific in terms of new product development, and more likely to pursue novel medicines for large markets. In contrast, Boston firms were more deliberative in their commercial strategies and more likely to focus on medicines for identifiable patient populations in need of relief from specific illnesses. We conjecture that the organizational development and innovation processes were significantly influenced by the surrounding institutional environments. Boston is home to MIT, a powerful basic science institution that lacks a medical school, Harvard, a world-class institution rich in basic science with a notable medical school, and numerous leading research-oriented hospitals and health institutes. The upshot of this institutional mix appears to be a corporate focus on expansive science and new treatments for definable patient populations.

In contrast, the biotech community in the Bay Area had its earliest origins in the partnership of Herbert Boyer, the UC San Francisco scientist, and Robert Swanson, a prominent venture capitalist, who joined together to create Genentech, one of the first biotech companies, and long a bellwether of the industry. UCSF is an unusual institution that lacked disciplinary departments in the full range of research programs. The organizational model at UCSF was interdisciplinary, with a cross-functional approach to medicine and an emphasis on translating basic science into clinical applications (Varmus and Wineberg, 1992). Genentech adopted and refined UCSF's interdisciplinary team model, adding the impatience and restlessness of venture capital financiers with their focus on swinging for the fences. Thus, the company has pursued new medical products for illnesses suffered by millions. This contrast of Boston and the Bay Area, the most prolific biotechnology clusters in the world, gives considerable insight into the manner in which the institutional field shapes the formation of networks. Our examinations of two important biotechnology regions demonstrate that logics of action area shaped by growing network structures that influence the habits of mind and the type of products that companies develop.

SEEING THE FIELD IN PERFORMANCE

Linking relationships and categories through situated action requires us to understand how individuals draw on and modify seemingly stable, persistent networks and classifications

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in daily practice. We draw on examples from Owen-Smith's (2001) ethnographic work in a multidisciplinary neuroscience laboratory to explore how scientists draw on existing categories and relationships to make sense of and maneuver within their fields. The particular logics associated with different scientists, technicians, researchers, and students, and the varieties of capital (resources) that can be derived from their positions and relationships have primacy in shaping both identities and opportunities.

In the H-lab[3] – a large, multidisciplinary academic neuroscience group that conducts fundamental research on olfaction in the moth *Manduca sexta* – Owen-Smith found that collective opportunities for skepticism were shaped by relative positions within the laboratory as well as expectations based on the ascribed skill and disciplinary affiliations of participants. In the scientific field, skepticism is a core aspect of the logic by which novel claims are validated.

In an arena where tacit knowledge made direct replication problematic and the multidisciplinary insights needed to pursue the research nevertheless resulted in widely different competencies, public performances of skepticism and resistance became key features of training and knowledge production. Even though public episodes of skepticism were clearly improvisational, they occurred against the backdrop of well-understood (though rarely articulated) norms of appropriateness. Those standards were structured by the relationships (of mentorship, collaboration, and sponsorship), categories (disciplines, methods, audiences), and hierarchies (status) that characterize scientific fields. The stage for particular skeptical performances was thus neither flat nor neutral. Scientists' career trajectories and the fate of new knowledge claims owed much to the skilled performance and reception of skepticism.

Fligstein (2001) identifies social skill with the ability to induce cooperation from others.[4] This view of skill is apparent in individual scientist's abilities to convince skeptical peers of the quality and validity of their findings. Such skilled performances, Owen-Smith's field-work suggests, are differentially enabled by scientists' disciplinary affiliations. Disciplines have different statuses in the academic field and participants draw on broad expectations of disciplinary competence in assessing scientific claims. Discipline is a means to position an individual and his or her claims in a general status hierarchy and a tool for making sense of their competencies. Bio-physicists, for instance, are accorded different degrees and types of leeway in skeptical interactions than chemists or ecologists, even if their claims do not rest explicitly on the particular competencies associated with their discipline. In practice, comparable findings presented by scientists whose disciplines differ can meet with disparate skeptical reactions.

Relationships matter equally as much as disciplinary categories, however. New findings are also evaluated in light of the individuals whose research produced them. Collaboration is a clear example. The vast majority of empirical articles in neuroscience have multiple authors. In the life sciences, authorship apportions credit according to a well-understood formula.[5] Co-authorship has long been understood as a means for scientists to invest established stores of professional credibility in findings and colleagues (Latour and Woolgar, 1976), but in categorically and hierarchically differentiated fields, such investments can be double-edged. Here, relationships serve as important conduits of information and material resources, but they are also key prisms for evaluating new claims under conditions where direct monitoring and replication are implausible or impossible.

Consider a skeptical performance that takes discipline, status, and relationships into account simultaneously (Owen-Smith 2001: 445 fn). In addition to serving as a means to validate findings developed 'locally' in the laboratory, collective skepticism was a means by which members of the laboratory determined which 'external' claims could be trusted and whether findings that contradicted

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their own needed to be taken into account. In one instance, Owen-Smith observed a long discussion of a working paper from outside the H-lab that purported to contradict one of the group's primary findings. The paper generated heated discussions, including one interchange between Beth (a technician in the lab) and Jim, the group's principal investigator. They discussed a paper authored by Blanca, a post-doc in a Scandinavian laboratory, and Bill, that laboratory's principal investigator (PI) and a former student in the H-Lab. In this interaction the categorical implications of Blanca's discipline (she is a chemist) and of her collaborative relationship with Bill loomed large, as does Bill's relative status in the field and the legacy of his time in the H-lab.

Beth: You might also want to ask her about her method. Before she came here she worked on really small beetles. That is a really difficult animal. She is an expert with these methods and she has techniques that we do not. Also, she is really good with chemistry. She has a really strong background, stronger than anyone here. So the answer to your implication that she hasn't thought through her controls is that she probably has!

Jim: There's no question about the chemistry, but she is working in Bill's lab and we know that Bill is a little too flamboyant with his methods.

This snippet of conversation is part of a larger, collective skeptical performance that drew on categorically based expectations (e.g. chemists are good at structuring experimental controls), ascribed levels of individual skill (e.g. working with a difficult model animal results in better technique), and past relationships (e.g. evaluations of Bill's scientific competency based on his time in the H-lab), as well as present ones (e.g. Jim's insistence that Blanca's discipline and skill be interpreted in light of her senior co-author). Such performances were disciplined by logics of action native to the broader field (e.g. standards of presentation, means of apportioning credit via authorship), but relied on a mix of local and global standards of appropriateness.

In instances like this one, local action and situated performances bring categories, hierarchies, and relationships together in meaningful efforts to navigate a field. Global features of the field of neuroscience – a multidisciplinary endeavor that plays out on a status-differentiated pitch where collaborations are fundamental to claims-making and evaluation – are apparent in the local interactions of skilled scientists. Convincing one another of the validity (or lack thereof) of particular claims required both careful rhetorical effort and the ability to draw the broader field and its conversations into specific performances.

PERFORMANCES CAN CHANGE FIELDS

Observations in the H-lab clarify some of the ways that categories and relationships get imported into local performances. We also suggest there are (perhaps fewer) instances where situated action can shift the categorical and relational features of fields. We offer a pair of examples drawn from Owen-Smith's field work in a high-profile university technology licensing office (TLO) (Owen-Smith 2005, 2007)[6].

Like the H-lab, the TLO is a university-affiliated workplace situated in a differentiated, hierarchical field. Where work in the H-laboratory is focused on scientific attempts to understand the neuroscience of olfaction, the TLO's goal is to identify, manage and market potentially valuable technologies for 'society's use and benefit while generating unrestricted income for research and education.' The TLO is a boundary-spanning administrative unit, the efforts of which are framed as a service to faculty researchers and industrial partners. The office's staff comprises individuals who

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typically hold bachelor's (and in some cases master's) degrees in technical fields.

Because this office spans the boundary between academe and industry, its work can be understood in light of multiple logics. In most instances, licensing associates can draw on one or more 'appropriate' logics as they make decisions. Because the office opts not to employ legal counsel, the staff has few normatively 'correct' approaches to problems encoded in their training. These features and the prestige of this office make the TLO a fertile site for local action that can reshape broader arrangements.

The TLO is one of the oldest and most accomplished offices of its kind. As a result the office, its staff, and (especially) its director occupy prominent positions in the relatively new field of university technology transfer. Unlike academic life science, the professional field of university technology transfer is still developing. Where skeptical evaluations in the H-lab draw explicitly on the broader landscape of scientific norms, similar collective performances in the TLO are overwhelmingly local and only rarely reach beyond the university (Owen-Smith, 2007). The TLO's highly visible position in the field, combined with its enviable record of success, results in its being widely emulated. Thus, the outcomes of actions taken in the confines of the office often get transferred out into the broader arena where they alter the shape of relationships and help to create or modify emerging categories of professional action.

Much of the daily work of the TLO is informed by routine meetings characterized by improvisational efforts to make sense of, evaluate, and respond to scientific findings couched as 'invention disclosures.' In the TLO, those evaluations take the form of efforts to determine what kind of technological innovation is embedded in a scientific discovery and what sort of market that innovation might reach. Both of these decisions are acts of classification, and once they are made, TLO staff members (singly and, often, collectively) develop a plan for marketing and licensing the invention.[7] Marketing plans typically begin by 'shopping' an invention to potential licensees. Classifying a technology in terms of existing markets and products triggers licensing officers' efforts to search their 'mental rolodexes' for appropriate partners. Prior licensing relationships are highly salient to that process.

Collective licensing discussions in the TLO typically address difficult cases. More straightforward deals are the province of individual staff members. The most common form of difficulty arises as a result of the conflicting logics under which university technology transfer operations function. Recall the TLO's mission, which combines a focus on income generation from licensing and efforts to ensure broad public access to technologies that are often developed with federal R&D funds. This mission puts the TLO and other offices like it squarely at the intersection of business logics that emphasize revenues and academic logics that emphasize open access and the public good. That tension is palpable in discussions about whether federally funded, university-developed technologies should be licensed exclusively or non-exclusively. The former can be particularly lucrative (especially if equity ownership in a start-up company is a condition of the deal), but comes at the expense of access. While they sometimes generate extensive revenues, non-exclusive licenses often forgo a high financial upside to keep a new technology accessible.

The technologies with the greatest potential value often have the broadest appeal. As a result, university technology managers routinely find themselves adjudicating between more academic and more commercial approaches to their deals. In the TLO, this dilemma is commonly solved by writing 'field-of-use' (FOU) deals that grant exclusive rights to different aspects or uses of a technology to disparate licensees. As the TLO's director noted in an interview (Owen-Smith, 2005: 83):

> Almost everything we do is field-of-use. The positive side of that is that you can get more than one

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> license in different fields. But there is also a negative side. If there is a problem with a patent, or a relationship then you have compounded your difficulties if you have licensed it to multiple entities.

This brief description of a common response to the one of the TLO's primary institutional contradictions implies both the local challenges and the global effects of widespread reliance on this strategy. First, locally, TLO associates who are often ill-prepared to deal with highly technical inventions must partition early-stage technologies into multiple fields of use that can be separately and independently licensed. Such efforts at distinction are often imperfect, and raise subsequent problems. More globally, when FOU licenses convey rights to the same technology to licensees in widely disparate industries, one effect is to make the TLO (and the university that houses it) a network 'short-cut' between firms that might otherwise share no (or at least few) connections or affiliations.

In other words, local decisions in the TLO can yield changes in the relationships and categories of larger fields by bridging otherwise separate licensees. To the extent that imperfect efforts to define fields of use are likely to create later problems, FOU deals may be more likely to deeply entangle different licensees. Consider the example of an invention disclosed by a prominent biochemist. The technology – a compound that interrupts the metabolic processes of a particular bacterium and kills it – has multiple uses.

The bacterium in question produces a sticky plaque that, if found in veins, has been implicated in heart attacks. If the bacterium inhabits a washing machine, however, the plaque results in smelly clothes. The compound, then, can be understood as a component in laundry detergent or as a pharmaceutical aimed at the cardiovascular market. Both are potentially profitable uses but, technically speaking, it is difficult to define separable fields of use because the mode of action of the detergent and the therapy is difficult to distinguish. As a result, efforts to partition this technology to allow for exclusive licensing to a pharmaceutical or biotechnology company, and non-exclusive licensing to manufacturers of laundry detergents may be imperfect. Problems that result from trying to forge this separation may have the unintended effect of creating relationships across industrial categories that otherwise might remain unconnected. Local evaluations of scientific findings in the H-lab draw broader categorical and relational characteristics into situated performances. In contrast, similar efforts in the TLO have some potential to alter the relationships and categories of the larger field. Clearly, efforts in the H-lab could also remake its field by, for instance, making fundamentally novel discoveries about the neuroscience of olfaction. We do not wish to argue performances on some stages can only draw upon their larger contexts while others can alter them. Instead, we wish to suggest that a network-institutional theory sensitive to genesis and, particularly, change should have some way to account for when and why local action shifts larger fields. We believe that attending to the existing stability of a field and to the relative positions of actors within them offers some useful starting points. It matters, for instance, that the H-lab is an important but not dominant player on a large and established field while the TLO is (arguably) one of the dominant players on a relatively young and growing field.

CONCLUSION AND FUTURE DIRECTIONS

We argue that understanding the characteristics and effects of social and economic systems requires simultaneous attention to the categorical and relational features of fields. Institutions and networks are intertwined in canonical theoretical and empirical works in sociology and organizational theory. Perhaps more importantly, master

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concepts in institutional and network theory – fields, logics, embeddedness, and social capital – are shot through with both institutional and relational terminology. Throughout our discussion, we return to the dual relationship between social relationships and social categories that we take to be at the heart of a unified, 'network-institutional' approach to social and economic life.

Networks are essential to fields because they are both the pipes through which resources circulate and the prisms that observers use to make sense of action. Fields, though, are associated with particular logics of action and it is those logics that make networks efficacious by determining which sorts of relationships participants can conceive. More tellingly, the dominant logics in a field define which sorts of connections will have what types of effects for different kinds of partners. In this sense, the relational and structural embeddedness of economic action depends not just on networks but also on the orientations of participants to the fields and logics that render ties sensible and help determine the shape and effects of structures. Social ties and affiliations are not all of a piece. Similar activities and structures may have different implications depending on the institutional character of participants. Even the most purely structural definition of, for instance, social capital must take institutional context into account. Institutions and networks jointly determine when various sorts of capital can be invested, by whom, and with what expectations of returns.

We argue that networks and institutions are co-constitutive. They set the conditions of possibility for each other. At base, we take this co-evolutionary relationship to rest on a key duality between relationships (the building blocks of networks) and categories (the building blocks of institutions). The situated and often improvised performances of highly bounded, but nonetheless purposive, organizational and individual agents breathes life into this duality, and, over time, provides a motor for evolution and change. We expect the link between practical action, networks, and institutions will be particularly apparent (and important) in situations where roles and identities are ambiguous, logics and institutions are conflicting or multiple, and networks span diverse audiences.

We revisited some of our empirical work on biotechnology, scientific collaboration and university technology transfer to examine a few specific implications of our approach. Our discussion highlights four issues where we believe further research can forward a network-institutional theory. We summarize those analytic questions and then suggest some concrete methodological implications for future studies of networks and institutions.

First, we contend that studies of evolution and change in social systems must take into account the recursive nature of networks and institutions. Explaining the contemporary character of biotechnology requires attention to the field's history and to the particular tensions that regulatory regimes and market competition create. More importantly, we suggest, such an explanation requires that we attend to the process by which collaborative relationships and network structures alike come to have the implications and effects they do because of their institutional context. As a result, we argue that studies of social dynamics must integrate network and institutional concepts and constructs.

Networks, then, must be understood in the context of institutional arrangements and the institutional embeddedness of networks shapes categories and products. Our examination of innovation in the San Francisco Bay Area and Boston biotechnology regions reinforces the important role network connections play in explaining outcomes. We add to that a recognition that the institutional characteristics of a network alter both the character of what participants produce and the process of production. The features and evolution of social systems, as well as their substantive outcomes, are shaped by the joint pressures of networks and institutions.

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Both of these arguments rest on a belief that participants' strategies and rationalities are shaped by their network-institutional context. We suggest that macro-organizational efforts should attend more closely to behavior. Whether that attention focuses on the practical and situated performances of individuals or on re-integrating a behavioral theory of organizations into network and institutional analyses depends primarily on levels of analysis and topics. We shift focus from the dynamics of industry-wide networks to situated action in bounded organizational settings to emphasize the links between activities on the ground and broader categorical and relational constraints.

We argued that attention should be paid to seeing fields in performances. Individuals and organizations act in contexts structured by relationships, categories, and hierarchies. But such contexts cannot completely determine action and sources of constraint can offer unexpected opportunities to players whose positions and characteristics offer them room to maneuver. If, as we contend, networks and institutions are yoked together by situated action, then studies of local action must take relevant relationships, categories, and logics into account.

We do not wish to suggest, however, that the flow of influence is uni-directional. For networks and institutions to be recursively related through action, the endeavors of participants must have some possibility of influencing their larger social environment. More effort should be put to uncovering the situations and conditions under which local performances shift the structural and institutional features of fields. Because the macro-social world is obdurate, action in some locales must be more likely to effect change than efforts in others. More attention should be paid, then, to the relational and categorical sources of innovation in fields. Even within locations that are situated to effect shifts in their wider contexts, not all actions or participants are equally likely to have a broader influence. As a result, we suggest that more studies should focus on the conditions under which particular practices and innovations diffuse or fail by making rules and practices themselves the unit of analysis.

Finally, our sketch of a network-institutional approach to social organization carries methodological implications. We note that studies at multiple levels of analysis – ranging from practices, to activities, organizations, dyads, collectives, structures and fields – are necessary. More importantly, temporality and dynamics are at the center of our analyses. Seeing the interplay of networks and institutions, we contend, requires more than cross-sectional explanations of variation. Instead, efforts to track change in the categorical and relational features of social worlds over time are needed. Finally, we include a call for comparison. Each of the studies we discuss attends either to locally fluid behaviors or to change over time in a single field. Variations in networks and institutions, which can all too easily be treated as ubiquitous and invariant characteristics of social realms, may be more apparent when we adopt a lens that emphasizes comparative dynamics.

NOTES

1 Obviously, there are several notable exceptions, where more explicit conceptual connections are offered. See Mizruchi, Stearns and Marquis, 2006; Strang and Meyer, 1994; Zuckerman, 1999; Zuckerman,Kim, Unkawa, and von Rittman, 2003; Powell, White, Koput, and Owen-Smith, 2005.

2 In this regard, see the chapters on the micro-level roots of institutional theory in this volume (Powell & Colyvas, Chapter 10 and Barley, Chapter 20), as well as Barley and Tolbert (1997); Hallett and Ventresca (2006).

3 In order to maintain confidentiality we refer to the H-Lab and its occupants using pseudonyms.

4 In this regard, see also Callon (1986) and Latour (1987) whose formulations of actor-network theory emphasize the differential abilities of individuals to enroll disparate allies and maintain the stability of diverse constellations of relationships. This sense of skill was also at play in the H-lab where scientists whose 'golden hands' routinely yielded particularly compelling experimental data were accorded greater deference than their less dexterous colleagues.

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5 The first author is usually a junior scientist responsible for the bulk of the 'bench' work that supports a particular claim. The last author is typically a senior scientist who 'owns' the lab in which the work occurred and may have played a significant role in designing experiments and framing questions. Other authors are typically arrayed alphabetically or in a fashion that places the least important participant nearest the center of a long list. While they are rarely explicitly articulated, such authorship rules represent another characteristic logic that lets participants evaluate claims and scientists by attending to researchers' relative positions in author-lists and to the strength of a finding's association with high-profile scientists.

6 All names are pseudonyms.

7 A license is a deal that transfers the right to use an invention or material that is protected by some form of intellectual property from the property's owner (in the case a university) to a licensee (most often a firm) that hopes to develop it. Licenses can convey exclusive rights, non-exclusive rights, or some limited form of exclusivity.

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