THE NETWORK STRUCTURE OF SOCIAL CAPITAL

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ABSTRACT

This is a review of argument and evidence on the connection between social networks and social capital. My summary points are three: (1) Research and theory will better cumulate across studies if we focus on the network mechanisms responsible for social capital effects rather than trying to integrate across metaphors of social capital loosely tied to distant empirical indicators. (2) There is an impressive diversity of empirical evidence showing that social capital is more a function of brokerage across structural holes than closure within a network, but there are contingency factors. (3) The two leading network mechanisms can be brought together in a productive way within a more general model of social capital. Structural holes are the source of value added, but network closure can be essential to realizing the value buried in the holes.

INTRODUCTION

Social capital is fast becoming a core concept in business, political science, and sociology. An increasing number of research articles and chapters on social capital are appearing (look at the recent publication dates for the references to this chapter), literature reviews have begun to appear (e.g. Nahapiet & Ghoshal, 1998; Portes, 1998; Sandefur & Laumann, 1998; Woolcock, 1998; Foley & Edwards, 1999; Lin, 1999; Adler & Kwon, 2000), books are dedicated to it (e.g. Leenders & Gabbay, 1999; Baker, 2000; Lesser, 2000; Lin, Cook, & Burt, 2001; Lin, forthcoming), and the term in its many uses can be found scattered across the internet (as a business competence, a goal for non-profit organizations, a legal category, and the inevitable subject of university conferences). Portions of the work are little more than loosely-formed opinion about social capital as a metaphor, as is to be expected when such a concept is in the bandwagon stage of diffusion. But what struck me in preparing this review is the variety of research questions on which useful results are being obtained with the concept, and the degree to which more compelling results could be obtained and integrated across studies if attention were focused beneath the social capital metaphor on the specific network mechanisms responsible for social capital. For, as it is developing, social capital is at its core two things: a potent technology and a critical issue. The technology is network analysis. The issue is performance. Social capital promises to yield new insights, and more rigorous and stable models, describing why certain people and organizations perform better than others. In the process, new light is shed on related concerns such as coordination, creativity, discrimination, entrepreneurship, leadership, learning, teamwork, and the like – all topics that will come up in the following pages. I cover diverse sources of evidence, but focus on senior managers and organizations because that is where I have found the highest quality data on the networks that provide social capital.[1] The goal is to determine the network structures that are social capital.

SOCIAL CAPITAL METAPHOR

Figure 1 is an overview of social capital in metaphor and network structure. The figure is a road map through the next few pages, and a reminder that beneath the general agreement about social capital as a metaphor lie a variety of network mechanisms that make contradictory predictions about social capital.

Cast in diverse styles of argument (e.g. Coleman, 1990; Bourdieu & Wacquant, 1992; Burt 1992; Putnam, 1993), social capital is a metaphor about
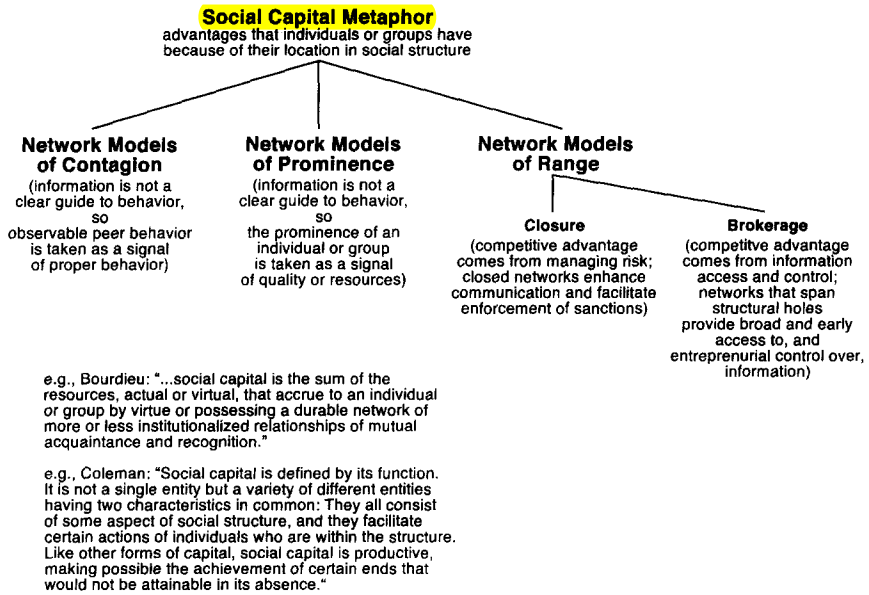
Fig. 1. Social Capital, in Metaphor and Network Structure.

advantage. Society can be viewed as a market in which people exchange all variety of goods and ideas in pursuit of their interests. Certain people, or certain groups of people, do better in the sense of receiving higher returns to their efforts. Some enjoy higher incomes. Some more quickly become prominent. Some lead more important projects. The interests of some are better served than the interests of others. The human capital explanation of the inequality is that the people who do better are more able individuals; they are more intelligent, more attractive, more articulate, more skilled.

Social capital is the contextual complement to human capital. The social capital metaphor is that the people who do better are somehow better connected. Certain people or certain groups are connected to certain others, trusting certain others, obligated to support certain others, dependent on exchange with certain others. Holding a certain position in the structure of these exchanges can be an asset in its own right. That asset is social capital, in essence, a concept of location effects in differentiated markets. For example, Bourdieu is often quoted as in Fig. 1 in defining social capital as the resources that result from social structure (Bourdieu & Wacquant, 1992, p. 119, expanded from Bourdieu, 1980). Coleman, another often-cited source as quoted in Fig. 1,

defines social capital as a function of social structure producing advantage (Coleman, 1990, p. 302; from Coleman 1988, S98). Putnam (1993, p. 167) grounds his influential work in Coleman's argument, preserving the focus on action facilitated by social structure: "Social capital here refers to features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated action." I echo the above with a social capital metaphor to begin my argument about the competitive advantage of structural holes (Burt, 1992, pp. 8, 45).

So there is a point of general agreement from which to begin a discussion of social capital. The cited perspectives on social capital are diverse in origin and style of accompanying evidence, but they agree on a social capital metaphor in which social structure is a kind of capital that can create for certain individuals or groups a competitive advantage in pursuing their ends. Better connected people enjoy higher returns.

NETWORK MECHANISMS

Disagreements begin when the metaphor is made concrete in terms of network mechanisms that define what it means to be 'better connected'. Connections are grounded in the history of a market. Certain people have met frequently. Certain people have sought out specific others. Certain people have completed exchanges with one another. There is at any moment a network, as illustrated in Fig. 2, in which individuals are variably connected to one another as a function of prior contact, exchange, and attendant emotions. Figure 2 is a generic sociogram and density table description of a network. People are dots. Relations are lines. Solid (dashed) lines connect pairs of people who have a strong (weak) relationship.

In theory, the network residue from yesterday should be irrelevant to market behavior tomorrow. I buy from the seller with the most attractive offer. That seller may or may not be the seller I often see at the market, or the seller from whom I bought yesterday. So viewed, the network in Fig. 2 would recur tomorrow only if buyers and sellers come together as they have in the past. The recurrence of the network would have nothing to do with the prior network as a casual factor. Continuity would be a by-product of buyers and sellers seeking one another out as a function of supply and demand.

Networks Affect and Replace Information

Selecting the best exchange, however, requires that I have information on available goods, sellers, buyers, and prices. This is the point at which network

mechanisms enter the analysis. The structure of prior relations among people and organizations in a market can affect, or replace, information.

Replacement happens when market information is so ambiguous that people use network structure as the best available information. Such assumption underlies the network contagion and prominence mechanisms to the left in Fig. 1. For example, transactions could be so complex that available information cannot be used to make a clear choice between sellers, or available information could be ambiguous such that no amount of it can be used to pick the best exchange. White (1981) argues that information is so ambiguous for producers that competition is more accurately modeled as imitation. A market is modeled
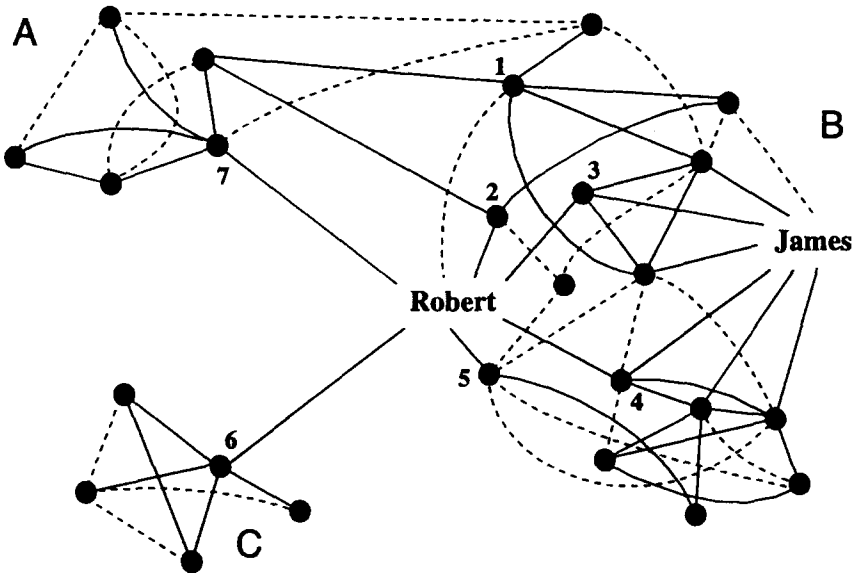
Density Table of Relations Within and Between Groups

.65			Group A (5 people and 8 ties; 5 strong, 3 weak)
.05	.25		Group B (17 people and 41 ties; 27 strong, 14 weak)
.00	.01	.65	Group C (5 people and 8 ties; 5 strong, 3 weak)

Fig. 2. Social Organization.

as a network clique (in other words, a small, cohesive group distinct from an external environment). Price within the clique is determined by producers taking positions relative to other producers on the market schedule. Information quality is also the problem addressed in Podolny's concept of status as market signal (Podolny, 1993; Podolny, Stuart & Hannan, 1997; Benjamin & Podolny, 1999). In his initial paper, Podolny (1993) described how investors not able to get an accurate read on the quality of an investment opportunity look to an investment bank's standing in the social network of other investment banks as a signal of bank quality, with the result that banks higher in status are able to borrow funds at lower cost. More generally, presumptions about the inherent ambiguity of market information underlie social contagion explanations of firms adopting policies in imitation of other firms (e.g. Greve, 1995; Davis & Greve, 1997; see Strang & Soule, 1998, for review; Burt, 1987, on the cohesion and equivalence mechanisms that drive contagion). Zuckerman's (1999) market model is an important new development in that the model goes beyond producer conformity to describe penalties that producers pay for deviating from accepted product categories, and the audience (mediators) that enforce the penalties.

The network contagion and prominence mechanisms describe social capital. Contagion can be an advantage in that social structure ensures the transmission of beliefs and practices more readily between certain people and organizations (a theme in Bourdieu's discussion of cultural capital), and of course, network prominence has long been studied as an advantage for people (e.g. Brass, 1992) and organizations (e.g. Podolny, 1993).

Although contagion and prominence mechanisms can be discussed as social capital, they are more often discussed as other concepts – for example, imitation in institutional theory, or reputation and status in economics and sociology – so I put them aside for this turn-of-the-century review. Future reviewers will not be so lucky. The contagion and prominence mechanisms are not ideas around which current social capital research has accumulated, but they certainly could be, and so are likely to be in future if the social capital metaphor continues to be so popular.

The other two mechanisms in Fig. 1, closure and brokerage, have been the foundation for work on social capital. These two mechanisms do not assume that networks replace information so much as affect the flow of information and what people can do with it.

Both mechanisms begin with the assumption that communication takes time, so prior relationships affect who knows what early. Information can be expected to spread across the people in a market, but it will circulate within groups before it circulates between groups. A generic research finding is that

information circulates more within than between groups – within a work group more than between groups, within a division more than between divisions, within an industry more than between industries. For example, the sociogram in Fig. 2 and the density table at the bottom of the figure show three groups (A, B, C), and the generic pattern of in-group relations stronger than relations between groups (diagonal elements of the density table are higher than the off-diagonals, each cell of the density table is the average of relations between individuals in the row and individuals in the column). The result is that people are not simultaneously aware of opportunities in all groups. Even if information is of high quality, and eventually reaches everyone, the fact that diffusion occurs over an interval of time means that individuals informed early or more broadly have an advantage.

Network Closure as Social Capital

Coleman's (1988, 1990) view of social capital focuses on the risks associated with incomplete information. I will refer to Coleman's view as a closure argument. Networks with closure – that is to say networks in which everyone is connected such that no one can escape the notice of others, which in operational terms usually means a dense network – are argued to be the source of social capital.

Specifically, closure is argued to do two things for people in the closed network. First, it affects access to information (Coleman,1990, p. 310; cf. 1988, p. S104): "An important form of social capital is the potential for information the inheres in social relations . . . . a person who is not greatly interested in current events but who is interested in being informed about important developments can save the time required to read a newspaper if he can get the information he wants from a friend who pays attention to such matters." For example, noting that information quality deteriorates as it moves from one person to the next in a chain of intermediaries, Baker (1984; Baker & Iyer, 1992) argues that markets with networks of more direct connections improve communication between producers, which stabilizes prices, the central finding in Baker's (1984) analysis of a securities exchange.

Second, and this is the benefit more emphasized by Coleman, network closure facilitates sanctions that make it less risky for people in the network to trust one another. Illustrating the trust advantage with rotating-credit associations, Coleman (1988, p. S103; 1990, pp. 306–307; see Biggart, 2000, for a closer look at how such associations operate) notes; "But without a high degree of trustworthiness among the members of the group, the institution could not exist – for a person who receives a payout early in the sequence of meetings

could abscond and leave the others with a loss. For example, one could not imagine a rotating-credit association operating successfully in urban areas marked by a high degree of social disorganization – or, in other words, by a lack of social capital." With respect to norms and effective sanctions, Coleman (1990, pp. 310–311; cf. 1988, p. S104) says; "When an effective norm does exist, it constitutes a powerful, but sometimes fragile, form of social capital . . . . Norms in a community that support and provide effective rewards for high achievement in school greatly facilitate the school's task." Coleman (1988, pp. S107-S108) summarizes; "The consequence of this closure is, as in the case of the wholesale diamond market or in other similar communities, a set of effective sanctions that can monitor and guide behavior. Reputation cannot arise in an open structure, and collective sanctions that would ensure trustworthiness cannot be applied." He continues (Coleman, 1990, p. 318); "The effect of closure can be seen especially well by considering a system involving parents and children. In a community where there is an extensive set of expectations and obligations connecting the adults, each adult can use his drawing account with other adults to help supervise and control his children."

Coleman's closure argument is prominent with respect to social capital, but it is not alone in predicting that dense networks facilitate trust and norms by facilitating effective sanctions. In sociology, Granovetter (1985, 1992, p. 44) argues that the threat of sanctions makes trust more likely between people who have mutual friends (mutual friends being a condition of structural embeddedness): "My mortification at cheating a friend of long standing may be substantial even when undiscovered. It may increase when the friend becomes aware of it. But it may become even more unbearable when our mutual friends uncover the deceit and tell one another." There is an analogous argument in economics (the threat of sanctions creating a reputation effect, e.g. Tullock, 1985; Greif, 1989): Mutual acquaintances observing two people: (a) make behavior between the two people public, which (b) increases the salience of reputation for entry to future relations with the mutual acquaintances, (c) making the two people more careful about the cooperative image they display, which (d) increases the confidence with which each can trust the other to cooperate. This chapter is about social capital, so I focus on Coleman's prediction that network closure creates social capital. I have elsewhere discussed the network structures that facilitate trust, showing that closure's association with distrust and character assassination is as strong as its association with trust (Burt, 1999a; 2001).

The closure prediction, in sum, is that in comparisons between otherwise similar people like James and Robert in Fig. 2, it is James who has more social capital. Strong relations among his contacts are argued to give James more

reliable communication channels, and protect him from exploitation because he and his contacts are more able to act in concert against someone who violates their norms of conduct.

Structural Holes as Social Capital

Participation in, and control of, information diffusion underlies the social capital of structural holes (Burt, 1992). The argument describes social capital as a function of brokerage opportunities, and draws on network concepts that emerged in sociology during the 1970s; most notably Granovetter (1973) on the strength of weak ties, Freeman (1977) on betweenness centrality, Cook & Emerson (1978) on the benefits of having exclusive exchange partners, and Burt (1980) on the structural autonomy created by complex networks. More generally, sociological ideas elaborated by Simmel (1955 [1922]) and Merton (1968 [1957]) on the autonomy generated by conflicting affiliations are mixed in the hole argument with traditional economic ideas of monopoly power and oligopoly to produce network models of competitive advantage.

The weaker connections between groups in Fig. 2 are holes in the social structure of the market. These holes in social structure – or more simply, structural holes – create a competitive advantage for an individual whose relationships span the holes. The structural hole between two groups does not mean that people in the groups are unaware of one another. It only means that the people are focused on their own activities such that they do not attend to the activities of people in the other group. Holes are buffers, like an insulator in an electric circuit. People on either side of a structural hole circulate in different flows of information. Structural holes are thus an opportunity to broker the flow of *information* between people, and *control* the projects that bring together people from opposite sides of the hole.

Structural holes separate nonredundant sources of information, sources that are more additive than overlapping. There are two network indicators of redundancy: cohesion and equivalence. Cohesive contacts (contacts strongly connected to each other) are likely to have similar information and therefore provide redundant information benefits. Structurally equivalent contacts (contacts who link a manager to the same third parties) have the same sources of information and therefore provide redundant information benefits.

Robert and James in Fig. 2 have the same volume of connections, six strong ties and one weak tie, but Robert has something more. James is connected to people within group B, and through them to friends of friends all within group B. James can be expected to be well informed about cluster B activities. Robert is also tied through friends of friends to everyone within group B, but in

addition, his strong relationship with contact 7 is a conduit for information on group A, and his strong relationship with 6 is a conduit for information on group C. His relationship with 7 is for Robert a network bridge in that the relationship is his only direct connection with group A. His relationship with contact 6 meets the graph-theoretic definition of a network bridge. Break that relationship and there is no connection between groups B and C. More generally, Robert is a broker in the network. Network constraint is an index that measures the extent to which a person's contacts are redundant (Burt, 1992). James has a constraint score twice Robert's (30.9 vs. 14.8) and Robert is the least constrained of the people in Fig. 1 (− 1.4 z-score). Network betweenness, proposed by Freeman (1977), is an index that measures the extent to which a person brokers indirect connections between all other people in a network. Robert's betweenness score of 47.0 shows that almost half of indirect connections run through him. His score is the highest score in Fig. 1, well-above average (47.0 is a 4.0 z-score), and much higher than James' 5.2 score, which is below average.

Robert's bridge connections to other groups give him an advantage with respect to information access. He reaches a higher volume of information because he reaches more people indirectly. Further, the diversity of his contacts across the three separate groups means that his higher volume of information contains fewer redundant bits of information. Further still, Robert is positioned at the cross-roads of social organization so he is early to learn about activities in the three groups. He corresponds to the opinion leaders proposed in the early diffusion literature as the individuals responsible for the spread of new ideas and behaviors (Burt, 1999b). More, Robert's more diverse contacts mean that he is more likely to be a candidate discussed for inclusion in new opportunities. These benefits are compounded by the fact that having a network that yields such benefits makes Robert more attractive to other people as a contact in their own networks.

There is also a control advantage. Robert is in a position to bring together otherwise disconnected contacts, which gives him disproportionate say in whose interests are served when the contacts come together. More, the holes between his contacts mean that he can broker communication while displaying different beliefs and identities to each contact (robust action in Padgett & Ansell, 1993; see Brieger, 1995, on the connection with structural holes). Simmel and Merton introduced the sociology of people who derive control benefits from structural holes: The ideal type is the *tertius gaudens* (literally, "the third who benefits," see Burt, 1992, pp. 30–32, for review). More generally, Robert in Fig. 2 is an entrepreneur in the literal sense of the word – a person who adds value by brokering connections between others (Burt, 1992,

pp. 34–36; see also Aldrich, 1999, Chap. 4; Thornton, 1999). There is a tension here, but not the hostility of combatants. It is merely uncertainty. In the swirling mix of preferences characteristic of social networks, where no demands have absolute authority, the *tertius* negotiates for favorable terms. Structural holes are the setting for *tertius* strategies, and information is the substance. Accurate, ambiguous, or distorted information is strategically moved between contacts by the *tertius*. The information and control benefits reinforce one another at any moment in time and cumulate together over time.

Thus, individuals with contact networks rich in structural holes are the individuals who know about, have a hand in, and exercise control over, more rewarding opportunities. The behaviors by which they develop the opportunities are many and varied, but the opportunity itself is at all times defined by a hole in social structure. In terms of the argument, networks rich in the entrepreneurial opportunities of structural holes are entrepreneurial networks, and entrepreneurs are people skilled in building the interpersonal bridges that span structural holes. They monitor information more effectively than bureaucratic control. They move information faster, and to more people, than memos. They are more responsive than a bureaucracy, easily shifting network time and energy from one solution to another (vividly illustrated in networks of drug traffic, Williams, 1998, or health insurance fraud, Tillman & Indergaard, 1999). More in control of their surroundings, brokers individuals like Robert in Fig. 2 can tailor solutions to the specific individuals being coordinated, replacing the boiler-plate solutions of formal bureaucracy. To these benefits of faster, better solutions, add cost reductions; entrepreneurial managers offer inexpensive coordination relative to the bureaucratic alternative. Speeding the process toward equilibrium, individuals with networks rich in structural holes operate somewhere between the force of corporate authority and the dexterity of markets, building bridges between disconnected parts of a market where it is valuable to do so.

In sum, the hole prediction is that in comparisons between otherwise similar people like James and Robert in Fig. 2, it is Robert who has more social capital. His network across structural holes is argued to give him broad, early access to, and entrepreneurial control over, information.

The Social Order of Disequilibrium

The difference between brokerage and closure continues into implying different roles for social capital in broader theories of markets and societies. Exaggerating the difference to clarify the point, closure is about stasis while brokerage is about change. Closure is about advantages that go to people in a

cohesive group. Strategy guided by the closure argument involves locating a group, and closing ranks with like-minded people. In contrast, the hole argument is about advantages that go to people who build bridges across cohesive groups. Strategy guided by brokerage involves locating a position at the edge of two groups, and building relations between dissimilar people. Brokerage must be the more difficult strategy, but the further difference is that brokerage is explicitly about action that cuts across structural holes in the current social structure.

The greater cost of brokerage must be off-set by greater gains. There is abundant evidence of the gains associated with brokerage, some discussed in the next few pages, but the gains can be expected to disappear as more and more people build bridges across the same structural hole. When the first entrepreneurs benefit from synthesizing information across a structural hole, others join them, and the advantage of bridging the hole disappears. If Fig. 2 were an academic market, for example, and Robert produced a useful idea because of Group A technology he discovered from Contact 7, other academics in Robert's line of work can be expected to develop relationships with contacts in Group A (Contacts 1 and 2 in Group B), eventually eliminating the structural hole between Groups A and B.

The rate of decline in value is a question for future research, but the functional form of the decline is probably nonlinear. Imagine X-Y coordinates where Y is the value of building a strong relationship across a structural hole and X is the number of such relations that exist. The value of Y at X equal one would be the value of the first bridge across the hole, the value at X equal two would be the value of the second bridge, and so on. No one knows how Y decreases across increasing X, but it seems likely that the decrease is steeper for the first few bridges than for the last few. Value is certainly eliminated long before everyone eligible to span the hole has done so. Holes are closed by individuals, not populations. To cite a line of academic work familiar to people reading this chapter, the acclaim that Hannan and Freeman (1977) received for synthesizing organization theory from sociology and population biology was much higher than the acclaim accorded subsequent elaborations within the population ecology of organizations.[2]

Value declines with subsequent entrants down to some equilibrium level at which value is marginally higher than the cost of bridging the hole. Regardless of the rate of decline in value, there is no competitive advantage at system equilibrium to a network that spans structural holes because sufficient people have networks across the structural holes so as to eliminate the value of additional people spanning them. Network entrepreneurs have moved the market to equilibrium by eliminating holes in the market where it was valuable

to do so. So viewed, the social capital of structural holes is about a short-run advantage on the path to equilibrium. At equilibrium, the advantage is gone.

That is, unless the system is forever on its way to equilibrium. The short-run advantage of brokerage can become a long-run advantage if social structure is held constant as by culture (e.g. Siamwall, 1978, on Chinese middlemen in the Thai economy; Light & Karageorgis, 1994, on socially excluded ethnicities for whom entrepreneurial activities are the route into society), or technology (e.g. Burt, 1988, 1992, on industry structure-performance differences in the American economy; Burt, 1992, Chap. 6; Bothner, 2000, on structural holes and White's network model of markets as cliques). Or, the short-run advantage of brokerage can be a long-run advantage if information grows quickly out-of-date, as seems to be the case for senior managers (see Mintzberg, 1973; Stinchcombe, 1990, on the short half-life of information in organizations). Such a situation could arise as follows: An industry of managers and organizations moves toward equilibrium. Managers with more social capital have an advantage in identifying and developing the more rewarding opportunities. Technological change and events create new priorities, so the industry begins moving toward a new equilibrium. Again, managers with more social capital have an advantage in identifying and developing the more rewarding opportunities. If the industry is subject to continuing change so that information continues to quickly grow out-of-date, managers with more social capital have a continuous competitive advantage, leaving a residue of association between social capital and performance illustrated by the cross-sectional results discussed in the next few pages.

In short, the hole argument stands apart from closure both in its empirical predictions and in describing a world of change – a world of discovering and developing opportunities to add value by changing social structure with bridges across holes in the structure. The argument, describing competitive advantage on the path to equilibrium, is a story about the social order of disequilibrium.

EVIDENCE

Three kinds of empirical evidence support the argument that social capital is a function of brokerage across structural holes. Lab experiments with small-group exchange networks show that resources accumulate in brokers, people with exclusive exchange relations to otherwise disconnected partners (e.g. Cook & Emerson, 1978; Cook et al., 1983; Markovsky, Willer & Patton, 1988; see Willer, 1999, for review).

Census data on economic transactions have been used to describe how producer profit margins increase with structural holes in networks of

transactions with suppliers and customers. Burt (1983) described the association in 1967 with profits in American manufacturing markets defined at broad and detailed levels of aggregation, and extended the results to include nonmanufacturing through the 1960s and 1970s (Burt, 1988, 1992). Burt, Guilarte, Raider & Yasuda (1999) refined the nonlinear form of the model to more accurately describe the association between performance and market network, and extended the results through the early 1990s. Using profit and network data on markets in other countries, similar results have been found in Germany during the 1970s and 1980s (Ziegler, 1982), Israel in the 1970s (Talmud, 1994), Japan in the 1980s (Yasuda, 1996), and Korea in the 1980s (Jang, 1997).

Third, archival and survey data on interpersonal relations have been used to describe the career advantages of having a contact network rich in structural holes. An early, widely known, study is Granovetter's (1995 [1974]) demonstration that white-collar workers find better jobs faster through weak ties that bridge otherwise disconnected social groups (see Burt, 1992, pp. 25–30, on weak ties across structural holes). Lin worked with several colleagues to present evidence of the importance of ties to distant contacts for obtaining more desirable jobs (e.g. Lin, Ensel & Vaughn, 1981; Lin & Dumin, 1986; Lin, 2001, Forthcoming). Similar empirical results appear in Campbell, Marsden & Hurlbert (1986), Marsden & Hurlbert (1988), Flap & De Graaf (1989), Boxman et al. (1991), Lin & Bian (1991), Wegener (1991), Bian (1994, Chap. 5), and in more recent empirical studies (Leenders & Gabbay, 1999; Lin, Cook & Burt, 2001). Lin (1999, Forthcoming) provides an integrative review of such research through a focus on networks as a resource for status attainment.

Individual and Group

Managers in particular have been a fruitful site for network studies of social capital. I can be brief here pending detailed discussion below ('Evidence from Five Study Populations'). Burt (1992, 1995, 1997a) and Podolny & Baron (1997) present survey evidence from probability samples of managers in two high-technology electronics firms showing that senior managers with networks richer in structural holes are more likely to get promoted early. Mizruchi & Sterns (2000), studying loan officers in a large commercial bank, show that the officers whose networks span structural holes in the firm (in the sense of being less dense and less hierarchical) are more likely to be successful in bringing a deal to closure. Burt, Hogarth & Michaud (2000) present evidence from a French chemical firm of salary increasing with the structural holes in a manager's network, and Burt (1997a, 2000b) presents evidence of more

positive peer evaluations and higher bonus compensation to investment officers with networks richer in structural holes. Mehra, Kilduff & Brass (2000) find that supervisors in a small high-technology company give higher performance evaluations to employees whose networks bridge otherwise disconnected parts of their organization. Working with more limited data, Sparrowe & Popielarz (1995) innovatively reconstruct past networks around managers to estimate the effects of holes in yesterday's network on promotion today (cf. Hansen, 1999, p. 93), Gabbay (1997) shows that promotions occur more quickly for sales people with strong-tie access to structural holes (cf. Meyerson, 1994, on manager income as a function of strong ties), and Gabbay & Zuckerman (1998) show that expectations of promotion are higher for research and development scientists whose networks are richer in spanning structural holes.

Information and control benefits to individuals aggregate to the management teams on which they serve. For example, Rosenthal (1996) studied the performance of quality management teams in several Midwest manufacturing plants as a function of individual team-member networks within and beyond the team. As discussed below, Rosenthal's data show a dramatic association between team performance and the average social capital of individuals on the team. Teams composed of employees with more entrepreneurial networks were more likely to be recognized for their success in improving the quality of plant operations. Hansen (1999) studied new-product teams in one of America's leading electronics and computer firms, a firm segmented by geography and product lines into 41 divisions. The network data are aggregate in that Hansen asked the R&D manager in each division to describe the extent to which people in his or her division had frequent and close working relationships with other divisions. Team performance is measured by the relative speed with which a team moves from initiation (first employee dedicated to the project) to completion (product released to shipment). Faster solutions are to be expected from teams with the social capital of bridge relationships that span the structural holes between divisions, and Hansen found that teams reached completion more quickly when they were in divisions with frequent and close relations to other divisions.[3] Hansen, Podolny & Pfeffer (2000) study the interpersonal networks around the teams. Each team member was asked to name intra-division contacts from whom he or she had regularly sought information and advice, then asked about relations between the contacts. Teams more quickly completing their assigned task contained people with more non-redundant contacts beyond the team (measured by 'advice size' and 'sparseness').

Related results are reported by Krackhardt & Stern (1988) on higher performance in student groups with cross-group friendships, and in numerous

studies of inter-organization networks (also see Leana & Van Buren, 1999, on corporate social capital): Fernandez & Gould (1994) on organizations in broker positions within the national health policy arena being perceived as more influential, Provan & Milward (1995) on higher performing mental health systems that have a hierarchical, rather than a dense, network structure, Geletkanycz & Hambrick (1997) on higher company performance when top managers have boundary-spanning relationships beyond their firm and beyond their industry, Ahuja (1998) on the higher patent output of organizations that hold broker positions in the network of joint ventures or alliances at the top of their industry, Pennings, Lee & Witteloostuijn (1998) on the survival of accounting firms as a function of strong partner ties to client sectors, Stuart & Podolny (1999) on the higher probability of innovation from semiconductor firms that establish alliances with firms outside their own technological area, McEvily & Zaheer (1999) on the greater access to competitive ideas enjoyed by small job manufacturers with more non-redundant sources of advice beyond the firm (and see McEvily & Marcus, 2000, on the lower absorptive capacity of these organizations when their sales network is concentrated in a single customer), Sørensen (1999) on the negative effect on firm growth of redundant networks beyond the firm, Llobrera, Meyer & Nammacher (2000) on the importance of non-redundant networks to the development of Philadelphia's biotechnology district, Koput & Powell (2000) on the higher earnings and survival chances of biotechnology firms with more kinds of activities in alliances with more kinds of partner firms, and Podolny (2000) on the higher probability of early-stage investments surviving to IPO for venture-capital firms with joint-investment networks of otherwise disconnected partners.

Suggestive results come from research in which networks beyond the team are inferred from the demography of the people within the team. Ancona & Caldwell (1992a) provide a study of this type describing 409 individuals from 45 new-product teams in five high-technology companies. Teams were distinguished by managerial ratings of innovation, member reports on the volume of communication outside the team (Ancona & Caldwell, 1992b, distinguish types of communication), functional diversity (members from multiple functions) and tenure diversity (members vary in their length of time with the firm). Structural holes are implicit in the boundaries between corporate divisions and the boundaries between cohorts of employees in that each division or cohort is presumed to have its own unique perspectives, skills, or resources. A team composed of people from diverse corporate functions spans more structural holes in the firm, and so has faster access to more diverse information and more control over the meaning of the information, than a team composed of people from a single function. For tenure diversity, replace the

timing and control advantages of access to more functionally diverse information with the same advantages stemming from access to information that differs between employees long with the firm who are familiar with how things have worked before and newer employees more familiar with procedures and techniques outside the firm.

More innovative solutions are to be expected from teams with the social capital of bridge relationships that span the structural holes between divisions (see 'Creativity and Learning' below for detailed discussion), and Ancona and Caldwell report higher managerial ratings of innovation for teams with more external communication, and more external communication by teams drawn from diverse functions.

Tenure diversity has the opposite effect. Ancona and Caldwell report some benefits of tenure diversity associated with higher evaluations of team performance, but the aggregate direct effect of tenure diversity is lower performance. Presumably, people drawn from widely separate employee cohorts have more difficulty with communication and coordination within the team.

The conflicting results are brought together in a productive way by Reagans & Zuckerman (1999) in their study of performance in 223 corporate R&D units within 29 major American firms in eight industries. They report higher levels of output from units in which scientists were drawn from widely separate employee cohorts (implying that their networks reached diverse perspectives, skills and resources outside the team) *and* there is a dense communication network within the unit. In other words, the negative association between performance and tenure diversity reported by Ancona and Caldwell could have been positive if the density of communication within the team had been held constant. Tenure diversity (or other kinds of diversity, see Williams & O'Reilly, 1998) can be disruptive because of the difficulties associated with communicating and coordinating across different perspectives, but when communication is successful (as implied by a dense communication network within the team), team performance is enhanced by the timing and control advantages of the team having access to more diverse information (as Ancona and Caldwell initially predict, and as predicted by the hole argument).

This is a productive observation because it is consistent with the performance effects of structural holes in market networks. The aggregate profit margin for a market increases with the organization of producers in the market and the disorganization of suppliers and customers (Burt, 1992, pp. 91–97). The market model applied to team performance predicts that high performance teams will be those in which member networks beyond the team span structural holes (giving the team access to diverse perspectives, skills and

resources), and strong relations within the team provide communication and coordination (so the team can take advantage of its access to diverse perspectives, skills and resources; see Fig. 5 below on the joint benefits of network closure and structural holes).

At the same time that group performance is enhanced by the social capital of its members, organization social capital can enhance employee performance. For example, Bielby & Bielby (1999) describe a decade of data on the careers of almost nine thousand film and television writers. Social capital in their study is held by the talent agency that represents a writer. About half of the writers had no representation (52% in 1987, down to 38% in 1992; Bielby & Bielby, 1999, p. 73). A quarter had the traditional representation of an agency that "finds work . . . and in exchange it receives a 10-percent commission from the client's earnings." (Bielby & Bielby, 1999, p. 66). The remaining quarter of the writers were advantaged by having what Bielby & Bielby (1999, pp. 66–67) describe as 'core' representation; representation by an agency that brokers connections between functional areas to propose whole projects in which the writer is a component: "Instead of seeking out projects for their clients, they initiate projects on their own. They negotiate unique arrangements with the talent guilds and cultivate long-term relationships with those who finance, produce, and distribute new projects." Bielby and Bielby (1999, pp. 70, 72) do not have network data, so they reduce social capital to binary distinctions between those who have it and those who do not; nevertheless, they obtain strong evidence of more likely employment and higher compensation for writers affiliated with the agencies that have it (cf. Yair & Maman, 1996, on the social capital of songwriters attributable to their country's network position among other countries; Jacob, Lys & Neale, 1999, on the more accurate company earnings predictions from analysts employed in brokerage houses providing the information advantages of many other analysts and specialists in the company's industry).[4]

Creativity and Learning

The advantages of bridging structural holes emerge from an individual generating constituency for new ideas synthesized from the diverse information clusters to which a network entrepreneur has access. Creativity and learning are thus central to the competitive advantage of structural holes, and so should be observed more often where relationships bridge structural holes.

Anecdotal evidence can be found in the remarks of prominent creatives. In an often-cited lecture on the influence of commerce on manners, Adam Smith (1766, p. 539) noted that; "When the mind is employed about a variety of

objects it is some how expanded and enlarged." Swedberg (1990, p. 3) begins his book of interviews with leading academics working across the boundary between economics and sociology with John Stuart Mills' (1848, p. 581) opinion: "It is hardly possible to overrate the value . . . of placing human beings in contact with persons dissimilar to themselves, and with modes of thought and action unlike those with which they are familiar . . . . Such communication has always been, and is peculiarly in the present age, one of the primary sources of progress." Moving to more contemporary and practical creatives, Jean-René Fourtou, as CEO of the $17-billion-in-sales French chemical and pharmaceutical company Rhne-Poulenc, observed that top scientists were stimulated to their best ideas by people outside their own discipline. Fourtou emphasized *le vide* – literally, the emptiness; conceptually, what I have discussed as structural holes – as essential to creative work (Stewart, 1996, p. 165): "*Le vide* has a huge function in organizations . . . . Shock comes when different things meet. It's the interface that's interesting . . . . If you don't leave *le vide*, you have no unexpected things, no creation. There are two types of management. You can try to design for everything, or you can leave le vide and say, 'I don't know either; what do you think?'" (cf. Hatch, 1999, on the importance of empty places to the integrated improvisation among jazz musicians playing together, and by analogy to the integrated improvisation of managers working together).

A more explicit network perspective underlies Yair & Maman's (1996) conclusion that certain songwriters had a better chance of winning the Eurovision Song Contest because of their country's network position among other countries. Erickson (1996) innovatively measured network diversity for a cross-section of people in the security industry (guards, not financial analysts) by asking whether they have friends and acquaintances in 19 disparate occupations. The more diverse their non-kin contacts (i.e. the more occupations in which they have friends and acquaintances), the broader their knowledge of diverse cultural genres; sports, art, books, restaurants, and business magazines (see Erickson, 2001, for the method applied to an informal local economy showing that participants with more diverse contact networks enjoy higher earnings). In his panoramic analysis of the history of philosophy, Collins (1998) presents sociograms of the intergenerational social networks among philosophers to illustrate his argument that the philosophers of greatest repute tend to be personal rivals representing conflicting schools of thought for their generation (Collins, 1998, p. 76); "The famous names, and the semi-famous ones as well who hold the stage less long, are those persons situated at just those points where the networks heat up the emotional energy to the highest

pitch. Creativity is the friction of the attention space at the moments when the structural blocks are grinding against one another the hardest."

Detailed network data underlie Giuffe's (1999) analysis of the 159 fine art photographers who received National Endowment for the Arts photography grants (1986–88) or had solo shows in a New York City gallery (1988). Studying the network of gallery affiliations among the photographers from 1981 through 1992, she finds three structurally distinct careers; peripheral careers of photographers who drop in and out of the gallery world, 'long unbroken careers' in a 'tight knit clique' of densely interconnected photographers, and 'long unbroken careers' in 'loose knit networks' of sparsely interconnected photographers. In terms of structural holes, the peripheral photographers had the least social capital, those with a clique career had little, and those with a career in loose knit networks had the most (cf. Sediatis, 1998, esp. pp. 373–374, on the greater flexibility, adaptability, and volume of business in Russian commodity markets created by organizers who had little previous contact with one another). Relative social capital has a statistically significant association with relative success measured by critical attention to a photographer's work. Giuffe counted the number of reviews each of the photographers received over the study decade in the two major trade magazines, *Art News* and *Art in America*. The peripheral photographers received the least attention (one review for every four photographers), photographers with a clique career received slightly more (p. 84 per photographer), and those with a career in a loose-knit network received the most (3.23 per photographer).

Experience seems to be the answer to questions about where, when, or how people learn about brokering connections across structural holes. Evidence comes from experiments with people learning social structures. Using DeSoto's (1960) experimental design for measuring the difficulty of learning a social structure, Freeman (1992, pp. 123–124) asked college students to learn the relations in a small network that contained a structural hole. Errors occurred when students failed to recall a relationship that existed, but the most frequent error was to fill in the structural hole by saying that the two disconnected people were connected. Janicik (1998) used DeSoto's design with older (M.B.A.) students and added a control for the network around each student in his or her most recent or current job. Students in a job where they were exposed to structural holes learned the network significantly faster, in particular because they quickly recognized the structural hole in the network. If Freeman's undergraduates lived in dense friendship networks as is typical of college students, then they would be disadvantaged in learning the hole-containing network that Freeman presented to them. A conclusion from Freeman's and

Janicik's experiments is that experience matters: People experienced with networks that contain structural holes more easily recognize the holes in new networks.

There is related evidence from fieldwork. Gargiulo & Benassi (2000) describe managers in the research consulting unit of a large Italian firm. They measure 'coordination failure' as the extent to which a manager consults with people not relevant to his assigned projects. They show that coordination failures are significantly more likely for managers with small, dense networks (cf. Barker, 1993). Lofstrom (2000) asked 262 key individuals (scientists, physicians, and engineers) how much they learned from their firm's participation in an alliance intended to develop or extend a medical device technology. Individuals with more non-redundant contacts, especially contacts within their own firm, were more likely to report that they had 'learned a great deal' in the alliance. Burt (2000b) describes change in the colleague networks of 345 bankers over a four-year period, focusing on the decay of the relationships, bridges, that span structural holes. The rate of decay is high (nine out of ten disappear from one year to the next), but significantly lower for bankers who have more experience with such relationships. Inasmuch as the bridges are social capital associated with bonus compensation, and bridge relationships are less subject to decay when they involve people more experienced with bridges, the conclusion is that social capital accrues to those who already have it.

There is also indirect evidence at the level of organizations. Granting that technological change can affect social structure (e.g. Barley, 1990, pp. 92–95, provides a clear illustration with network data), social structure has its own effects on an organization's ability to productively manage technological change. Electronics and biotechnology have been favored research sites for studying such network effects, with Walter Powell (e.g. Powell & Brantley, 1992; Powell, Koput & Smith-Doerr, 1996; Powell et al., 1999; Koput & Powell, 2000) and Toby Stuart (Stuart, 1998; Stuart, Hoang & Hybels, 1999; Stuart & Podolny, 1999; Stuart & Robinson, 2000) prominent ports of entry into the work. More generally, Kogut (2000) builds on a series of studies (e.g. Shan, Walker & Kogut, 1994; Kogut & Zander, 1996; Walker, Kogut & Shan, 1997) to propose a network theory of the firm in which value is derived from a firm's ability to create and lay claim to knowledge derived from its membership and participation in networks (cf. Nahapiet & Ghoshal, 1998, on social capital and knowledge; Powell & Smith-Doerr, 1994, on information in the economic sociology of networks, especially with respect to inter-organization networks).

More specifically, accumulating empirical research shows that structural holes are a correlate of organizational learning, often discussed in terms of an organization's ability to learn – what Cohen & Levinthal (1990, p. 128) describe as an organization's absorptive capacity: "the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends." which can be studied in terms of industry factors that facilitate absorption (e.g. Cohen & Levinthal, 1990) and external networks that enhance an organization's absorptive capacity (e.g. Cockburn & Henderson, 1998).

To the extent that the information and control benefits of bridging structural holes enhance organizational learning, the following hypothesis should be true: Organizations with management and collaboration networks that more often bridge structural holes in their surrounding market of technology and practice will learn faster and be more productively creative. This is the hypothesis that Lofstrom (2000) uses to interpret her observation that people in medical-device alliances report more learning when they have a broader network of non-redundant contacts. The hypothesis is related to Ancona & Caldwell's (1992a) report that teams judged more innovative had more external communication with contacts in diverse corporate functions (and see the evidence on group brainstorming in the next section). The hypothesis is explicit in several organization-performance studies cited in the previous section: Ahuja (1998) reports higher patent output for organizations that hold broker positions in the network of joint ventures or alliances at the top of their industry. McEvily & Zaheer (1999) report greater access to competitive ideas for small job manufacturers with more non-redundant sources of advice beyond the firm (and McEvily & Marcus, 2000, show lower absorptive capacity for these organizations when their sales network is concentrated in a single customer). Stuart & Podolny (1999) report a higher probability of innovation from semiconductor firms that establish alliances with firms outside their own technological area. Comparing the biotechnology districts in Minneapolis and Philadelphia, Llobrera, Meyer & Nammacher (2000) attribute the growth and adaptation of Philadelphia's district to its many overlapping but non-redundant networks around organizations in the district. Koput & Powell (2000) report higher earnings and survival chances of biotechnology firms with more kinds of activities in alliances with more kinds of partner firms. Podolny (2000) argues that the information and control advantages of structural holes should be a competitive advantage for venture-capital firms detecting and developing ventures at an early stage of development. He studies panel data on investments from 1981 through 1996 to distinguish venture-capital firms that span structural holes in the sense that they bring together as co-investors other firms that are

not investing together. Under attractively stringent controls for autocorrelation, Podolny (2000, p. 22) finds that: "As a venture capital firm acquires a 'deal-flow' network that is rich in structural holes, the firm makes a greater proportion of its investments in the earlier stages." This, in addition to the earlier cited finding of more early-stage investments surviving to IPO for the venture-capital firms whose co-investment network span structural holes.

Whatever the explanation for these results – bridging structural holes enhances an individual's ability to learn, or more intelligent people learn faster and so better report holes in the social structure around them – there is an association between structural holes and learning. The implication, untested in empirical research, is that the social capital of structural holes cumulates over a career so it is critical to encounter holes early in the career (cf. Sørensen, 2000, on the cumulative effects of social heterogeneity on mobility). Managers with experience of structural holes are more likely to see the holes in a new situation, and so enjoy the enhanced performance associated with spanning the holes, and so be promoted to more senior positions, which broadens their opportunities to add value by brokering connections across structural holes.

Process of Brokering

Complementing the above evidence on brokerage's correlates and conse-quences, there is evidence on the processes by which people create value as they bridge structural holes.

Historical accounts describe processes by which certain brokers became successful. Caro (1982, Chap. 15) provides an often-cited account of Lyndon Johnson's creation of a Washington power base in 1933 from the 'Little Congress', through which he brokered connections between journalists and prominent people in government. Dalzell (1987, Part I) describes brokerage in the creation of an industry. Cotton production in the late 1700s was concentrated in England and consisted of a process in which product moved between separate establishments as it was transformed from raw cotton, to thread, to cloth. The separate establishments reflected the way the industry developed in England. Francis Lowell, looking for a commercial venture, saw during a visit to England the gains to be had if production were integrated across the separate establishments. He drew up plans and assembled what became known a century later as the Boston Associates, a group of investors recruited from family and close friends. With a shared vision of their role in society and reputation keeping their money in the venture over time, the Boston Associates created a thriving American industry with a production process integrated from raw cotton to cloth. DiMaggio (1992, pp. 129–130) describes

Paul Sachs role as broker in establishing the Museum of Modern Art in New York; "Sachs could employ his talents precisely because his strong ties to sectors that had previously been only weakly connected – museums, universities, and finance – placed him at the center of structural holes that were critical to the art world of his time." Padgett & Ansell (1993) describe Cosimo de Medici's use of his contacts with opposing elite family factions to establish his Medicean political party in Renaissance Florence. McGuire & Granovetter (2000) describe Samuel Insull's use of his network of contacts in finance, politics, and technology to shape the electric utility industry at the turn of the century.

Direct observation of brokers offers richer detail. Kotter's (1982) cases illustrate the information and control advantages of an entrepreneurial network in performing the two tasks of successful general managers: reading the organization for needed business policy and knowing what people to bring together to implement the policy. Mintzberg (1973) is similarly rich in case material on the central importance to managers of getting their information live through personal discussions rather than official channels. Adding scope to Macaulay's (1963) intuitions from preliminary interviews with local business-men, Uzzi (1996, 1997) offers selections from fieldwork with producers in the apparel industry illustrating the importance they put in having personal, trusting relationships (termed embedded ties) with key buyers and suppliers rather than having impersonal transactions (termed arm's-length ties, see Appendix; cf. Douthit, 2000, on bridge vs. embedded supervision).

Brainstorming groups are another source of leads into understanding the process of brokerage, specifically as brokerage is associated with creativity. Laboratory and field studies of brainstorming groups show two things: (a) Groups generate fewer, and fewer high-quality, ideas than the same number of people working separately, but (b) people in these studies nevertheless report that groups generate more ideas and as individuals report higher personal performance within groups (e.g. Diehl & Stroebe, 1987; Mullen, Johnson & Salas, 1991, for review; Paulus, Larey & Ortega, 1995, for field illustration in an organization). The connection to social capital is that performance is significantly improved if individuals come to the brainstorming group from heterogeneous backgrounds (Stroebe & Diehl, 1994, pp. 293–297). In other words, the value of group brainstorming is a function of the group facilitating the exchange of ideas across structural holes that separate members in the absence of the group. This is a useful analogy because: (a) it fits with the story emerging about the social capital of groups increasing as a function of network density inside the group combined with bridge relationships spanning structural

holes outside the group (see 'Individual and Group' above), and (b) it means that the brainstorming studies which analyze group process can be used to better understand the process of brokerage. For example, Sutton & Hargadon (1996) and Hargadon & Sutton (1997) describe processes by which a firm, IDEO, uses brainstorming to create product designs, creating a status auction within the firm. The firm's employees work for clients in diverse industries. In the brainstorming sessions, technological solutions from one industry are used to solve client issues in other industries where the solutions are rare or unknown. The firm profits, in other words, from employee bridge relationships through which they broker the flow of technology between industries (cf. Allen & Cohen, 1969, on gatekeepers; Lazega & Pattison, 2001, on network management of the status auction).

Finlay & Coverdill (1999a, 1999b) provide selections from their fieldwork with executive headhunters and managers on brokering connections across the structural holes between organizations and market segments. In contrast to research on the consequences of social capital, Finlay & Coverdill (1999b, p. 1) are interested in the "exercise of social capital – on the actual brokering itself." Headhunters offer advantages to a hiring manager in the form of faster search (headhunter has up-to-date data on suitable candidates; "What people are paying me for is somebody with experience to step in to do something right away."), broader search (headhunter knows attractive candidates happy where they are who wouldn't apply for an advertised job, and can recruit from customer or supplier organizations from which recruitment by the hiring manager could threaten his organization's relationship with the raided customer or supplier), and more successful search (headhunter puts time into selecting candidates suited to the job because their compensation depends on their candidate accepting the job). The complication is that the hiring manager's organization has a human resources staff (HR) responsible for recruiting, so brokerage for the headhunter involves matching candidate with the hiring manager while buffering the manager from HR. The tension is indicated by the headhunter phrase for HR staff, 'weenies', and their characterization by one industry trainer, as people who "didn't have the personality to become morticians" (Finlay & Coverdill, 1999a, p. 20). In other words, bridging structural holes in this case involves a simultaneous process of creating holes. As Finlay & Coverdill (1999a, p. 27) conclude: "When headhunters buffer hiring managers from HR or when they shield a client from a competitor, they open gaps in these relationships that the headhunters themselves then bridge. The success of headhunters, and their attractiveness to employers, rests on this dual function of creating and filing holes."

Entrepreneurship

Conspicuous in its absence is evidence on entrepreneurs, in the colloquial sense of entrepreneurs being people who start a business. Such people are inherently network entrepreneurs in the sense of building bridges across structural holes. As Nohria (1992, p. 243) quotes one of his Route 128 entrepreneurs; "A high-technology venture is like a jig-saw puzzle. Each of the pieces is unique and must fit together perfectly if you want the venture to be a success. So the chase in which everybody is involved – be it the entrepreneur, the venture capitalist, the management candidate or whoever else is in the game – is the search for those perfect 'matches' that will help put the puzzle together." Bringing together separate pieces is the essence of entrepreneurship, whether the venture is one of the high-technology ventures so often analyzed by professors in business schools, or the less capital-intensive ethnic ventures so often analyzed by sociologists. There is no value to the venture if it only connects people already connected. As Stewart (1990, p. 149, deleting quotation marks and citations from original) reports from economic anthropology, entrepreneurs focus on: "those points in an economic system where the discrepancies of evaluation are the greatest, and . . . attempt to construct bridging transactions. Bridging roles are based on the recognition of discrepancies of evaluation, which requires an edge in information about both sides of the bridge. Because this requires an information network, bridgers will commit time, energy, travel, and sociability to develop their personal networks. For many entrepreneurs, their most significant resource is a ramifying personal network."

It is a quick step to hypotheses. Here are three: (1) In a cross-section of individuals, those richer in the social capital of strong ties bridging structural holes are more likely to launch entrepreneurial ventures, and the ventures they launch are more likely to succeed. Early access to a broad diversity of perspectives, skills, and resources: (a) is associated with faster learning to identify the holes in new situations, (b) provides a broad base of referrals to customers, suppliers, alliances and employees, (c) helps the entrepreneur identify promising opportunities with respect to customers, suppliers, alliances, employees, financing, and alternative business models, and (d) increases the probability that the entrepreneur knows which of alternative ways to pitch the venture will most appeal to specific potential customers, suppliers, or other sources of revenue. (2) For the same reasons, entrepreneurs with more social capital are more likely to be able to recover ventures that get into trouble. They are aware of trouble sooner, more flexible in re-shaping the venture to adapt to change, and more able to control the interpretation others give to information about the venture. (3) Entrepreneurs richer in the social capital of strong ties to

exploitable – exploitable meaning that the contacts have no alternatives to working with the entrepreneur – labor (usually relatives, especially children) or emotional support (usually relatives, especially the spouse or life-partner) are more likely to be successful in their venture.

Although entrepreneurship is a promising site for work on the network forms of social capital, empirical research on the role of networks in entrepreneurship has been limited to the most rudimentary of network data (with rare exceptions such as Stuart, Hoang & Hybels', 1999, analysis of prominent affiliations speeding a venture's time to IPO in biotechnology). See Aldrich (1999, Chap. 4) and Thornton (1999) for broad review, Aldrich in particular for intuitions about the changing role of networks over the course of an entrepreneurial venture (Steier and Greenwood, 2000, provide case-study description with respect to structural holes). As Nohria (1992, p. 249) observed in his study of Route 128 entrepreneurs: "search consists of a matching process in which participants first use categories, typifications or classificatory criteria to identify a set of potential participants; second, they use relational criteria (the index of the other's relations) to establish the trustworthiness of the participant; and third, they use emotional criteria (generated in fact-to-face interaction) to decide whether they should pursue the interaction further."

Two examples are sufficient to illustrate the point: Birley (1985) is a pioneering study in the genre. Focusing on businesses created between 1977 and 1982 in the county surrounding the city of South Bend in Indiana, Birley (1985, pp. 107–108) showed that: "the main sources of help in assembling the resources of raw materials, supplies, equipment, space, employees, and orders were the informal contacts of family, friends, and colleagues. The only institution that was mentioned with any regularity was the bank, which was approached towards the end of the process when many of the resources were assembled and the elements of the business set in the entrepreneur's mind." Network data here are ratings of kinds of contacts (Birley, 1985, p. 113): "Available sources of help were listed and respondents were asked to rank the value of that source in assembling the resources of the firm. No rating for a category indicated that as far as the entrepreneur was concerned, no help was received." Similar network data were used in what could be the most authoritative study of networks in entrepreneurship. Brüderl & Preisendörfer (1998) interviewed in 1990 a random sample of 1,700 entrepreneurs who had started five years earlier a business in Upper Bavaria, Germany. The network data were ratings of kinds of contacts (Brüderl & Preisendörfer, 1998, p. 217): "To get an impression about the role of social contacts in the start-up period of new businesses, participants of our study were asked on a scale ranging from 1 (no support) to 5 (full support) whether they received any support from

different kinds of people." With separate measures of active and emotional support from the entrepreneur's spouse, the network data were analyzed as levels of support from two broad categories of people; weak ties (defined as business partners, acquaintances, former employers, or former coworkers), and strong ties (spouse/life-partner, parents, friends, or relatives). Brüderl and Preisendörfer report that entrepreneurs whose business had survived the five years to the survey were more likely than nonsurvivors to give credit to their spouse and strong ties for support.

These two studies are exemplars of the interesting and productive work that has been done on networks and entrepreneurship, but they reveal nothing about the association between network structure and entrepreneurship. The studies do not include data on the variable strengths of an entrepreneur's relations with individual contacts, and the variable strengths of connections between pairs of contacts. Ratings of support from, or acquaintance with, broad categories of contacts leave unknown the network structure variables that measure an entrepreneur's social capital.[5]

So, although entrepreneurship is inherently an exercise in the social capital of structural holes, the topic remains virtually untouched by theory and empirical research on the network forms of social capital. This is an area ripe for study with advances in network theory and analysis. Burt & Raider (2000) provide suggestive evidence. In a representative sample of alumnae from the University of Chicago's Graduate School of Business, they find that the women who became entrepreneurs cited significantly more contacts beyond family and work, and connections with key client contacts in particular were bridge relationships beyond the entrepreneur's immediate circle of contacts.

NETWORK DIMENSIONS OF SOCIAL CAPITAL

My summary conclusion from the preceding section is that the social capital of structural holes can be found in research on diverse substantive questions. The studies reviewed, however, vary dramatically in the depth and precision of their measurement strategies. Broad conclusions are possible – networks across structural holes are clearly a form of social capital – but it is difficult to make exact comparisons across the studies (a problem made worse by population differences correlated with the value of social capital, see 'Contingency Factors' below). So, to draw more precise conclusions, my next step in the review is to present empirical results with comparable network measures in multiple study populations.

I have performance and network data on people in five study populations. Each population was drawn from a medium to large organization, and each has

been the subject of detailed analysis elsewhere. The study populations together contain 841 observations, individual managers in four populations, teams in the fifth population. The network measures to be discussed were computed in all five study populations from survey network data. Managers in four of the populations completed network questionnaires in which they were asked to name (see Fig. 4 below on kinds of relations): (a) people with whom they most often discussed important personal matters, (b) the people with whom they most often spent free time, (c) the person to whom they report in the firm, (d) their most promising subordinate, (e) their most valued contacts in the firm, (f) essential sources of buy-in (g) the contact most important for their continued success in the firm, (h) their most difficult contact, and (i) the people with whom they would discuss moving to a new job in another firm. After naming contacts, respondents were asked about their relationship with each contact, and the strength of relations between contacts (see Burt, 1992, pp. 121–125; 1997b; Burt, Hogarth & Michaud, 2000, for item wording and scaling to measure strength of relations with and between contacts).

Network Constraint

There are many ways to measure social capital. Even a simple count of bridge relationships seems to work; people with more bridges do better (Burt, 2000b). As a summary measure of social capital, I use a network constraint index, C, defined in the Appendix (along with details on some alternative measures). Constraint describes the extent to which a person's network is concentrated in redundant contacts (Burt, 1992, Chap. 2). Constraint is high if contacts are directly connected to one another (dense network) or indirectly connected via a central contact (hierarchical network). As a frame of reference, network constraint scores multiplied by 100 have a mean of 27.9 across the 841 observations in the five study populations, with a 10.5 standard deviation. The network around Robert in Fig. 2 is less constrained than the average (C = 15). The network around James is slightly more constrained than average (C = 31).

Association between performance and network constraint is a summary test between the two leading network mechanisms argued to provide social capital. More constrained networks span fewer structural holes, which means less social capital according to the hole argument. *If networks that span structural holes are the source of social capital, then performance should have a negative association with network constraint.* More constraint means more network closure, and so more social capital according to the closure argument. *If network closure is the source of social capital, then performance should have a positive association with constraint.*

Network Size

More specifically, network constraint varies with three dimensions of a network: size, density, and hierarchy. Network size, N, is the number of contacts in a network. For example, Robert and James in Fig. 2 have 7 contacts each, versus an average size of 14.7 in the five study populations). Other things equal, more contacts mean that a manager is more likely to receive diverse bits of information from contacts and is more able to play their individual demands against one another. With respect to measurement, constraint is lower in larger networks because the proportion of a manager's network time and energy allocated to any one contact on average decreases as the number of contacts increases (− 0.66 correlation between network constraint and size across managers in the five study populations). *If networks that span structural holes are social capital, there should be a positive association between performance and network size.* Numbers of contacts are not a variable in the closure argument, but it seems reasonable to expect that more contacts would be advantageous as long as they do not weaken closure. So, association between performance and network size is not a powerful evidential criterion for testing between the closure and hole arguments.

Network Density

Network density, D, is the average strength of connection between contacts. Density is sometimes discussed as a proportion because in studies limited to dichotomous data (two people are connected or not), the average strength of connection between contacts is also the proportion of contact pairs who are connected. With strong ties in Fig. 2 set to a strength of 100, weak ties to 50, and no tie set to zero, density equals 0.0 for Robert in Fig. 2 since none of his contacts have relations with one another. Density is for 35.7 for James. Applying the same scale to relationships in the five study populations, network density is 36.7 on average.

Density is only one form of network closure, but it is a form often discussed as closure. Contacts in a dense network are in close communication so they can readily enforce sanctions against individuals who violate shared beliefs or norms of behavior. *If network closure is the source of social capital, performance should have a positive association with network density.* At the same time, strong connections between contacts increase the probability that the contacts know the same information, and the direct connections eliminate opportunities to broker information between contacts. Dense networks offer less of the information and control advantage associated with spanning

structural holes. *If networks that span structural holes are the source of social capital, performance should have a negative association with network density.*

Network Hierarchy

Density is a form of closure in which contacts are equally connected. Hierarchy is an alternative form of closure in which a minority of contacts, typically one or two, stand apart as the source of closure. In the extreme case, a network is hierarchical to the extent that it is organized around one contact. For people in job transition, such as M. B. A. students, that one contact is often the spouse. In the organization, hierarchical networks are often built around the boss. Where network constraint measures the extent to which contacts are redundant, network hierarchy, H, measures the extent to which the redundancy can be traced to a single contact in the network. Network constraint increases with density or hierarchy, but density and hierarchy are empirically distinct measures, and fundamentally distinct with respect to social capital (a central point below in 'The Social Capital of Outsiders'). In the five study populations to be described, for example, network constraint has a strong correlation with density (0.71) and with hierarchy (0.56), but the correlation between density and hierarchy is low (0.18, see Burt, 1992, p. 143, for illustrative graph). *As a form of network closure, hierarchy should have a positive association with performance if closure provides social capital.* In contrast, the central contact in a hierarchical network gets the same information available to the manager and cannot be avoided in manager negotiations with each other contact. More, the central contact can be played against the manager by third parties because information available from the manager is equally available from the central contact since manager and central contact reach the same people. In short, the manager whose network is built around a central contact runs a risk of playing Tonto to the central contact's Lone Ranger. *If networks that span structural holes are the source of social capital, performance should have a negative association with network hierarchy.*

Evidence from Five Study Populations

Component effects are separated in Table 1 for aggregate effects in Fig. 3. The vertical axes in Fig. 3 measure performance (explained below for each study population). The horizontal axes are the summary network constraint index C. Robert, with his 15 points of constraint would appear to the far left of each graph. These are the managers expected to do well because they have networks rich in structural holes – and all six graphs in Fig. 3 show the hole prediction of a negative association between performance and network constraint.
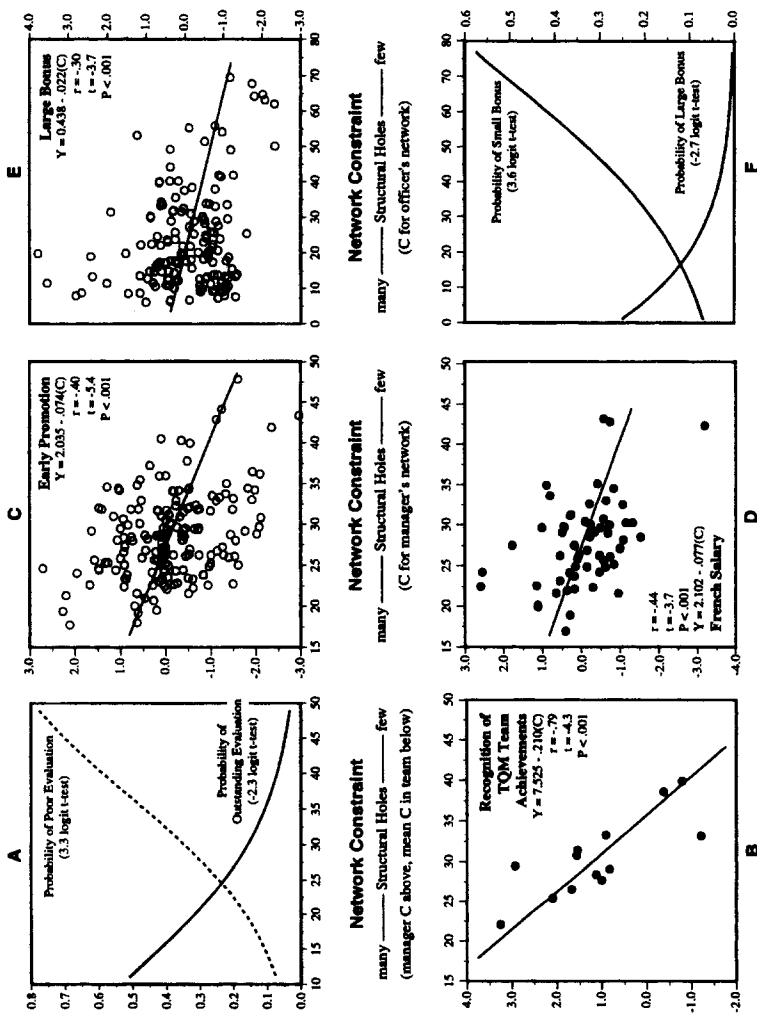
Fig. 3. Social Capital Matters. (More contraint means fewer structural holes, less social capital, and so lower performance [z-score performance except in A and F]).

Performance Evaluations

Graphs A and B describe performance evaluations. Fig. 3A is based on a representative sample of staff officers within the several divisions of a large financial organization in 1996 (Burt, Jannotta & Mahoney, 1998). The dependent variable is job performance evaluation, taken from company personnel records. Employees are evaluated at the end of each year on an A, B, C scale of outstanding to poor with plus and minus used to distinguish higher from lower performances within categories. The evaluations stay with an employee over time to affect future compensation and promotion. Women are the majority of the several hundred employees in the staff function (76% of all officers within the function). Of 160 staff officers who returned network questionnaires, the majority are women (69%). The results in Fig. 3 and Table 1 are for the women. I turn to the men in Table 2. Graph A in Fig. 3 shows how the probability of an 'outstanding' and a 'poor' evaluation changes with network constraint. The graph is based on a logit regression predicting the two extremes with the middle category a reference point.[6] Officers with less constrained networks, like Robert, have a significantly higher probability of receiving an outstanding performance evaluation. The stronger effect is the tendency for officers living in the closeted world of a constrained network to receive an evaluation of 'poor'. The results in the first panel of Table 1 come from predicting the evaluations (A = 3, B = 2, C = 1) holding job rank constant.[7] The aggregate negative association between evaluation and network constraint (− 3.8 t-test in Table 1) is primarily a function of network density. Evaluations have a weak positive correlation with network size, and a weak negative correlation with network hierarchy. The significant effect in the regression equation is the tendency for people with dense networks to receive lower evaluations.

Figure 3B is taken from Rosenthal's (1996) dissertation research on the social capital of teams. I do not have the component measures of size, density, and hierarchy, so there are no corresponding results in Table 1. Troubled by the variable success of total quality management (TQM) teams, and inspired by Ancona & Caldwell's (1992a, 1992b) demonstration that networks beyond the team are associated with team performance, Rosenthal wanted to see whether the structure of external relationships had the effect predicted by the hole argument. She gained access to a midwest manufacturing firm in 1994 that was in the process of using TQM teams to improve quality in all of its functions in its several plants (a total of 165 teams). She observed operations in two plants, then asked the senior manager responsible for quality in each plant to evaluate the performance of each TQM team in his or her plant. Evaluations were standardized within plants, then compared across plants to identify functions in

which team performance most varied. The study population was teams assigned to a function with high success in some plants and low success in other plants. Selecting two functions for study, Rosenthal sent to each employee on the selected teams a network questionnaire and the survey data were used to compute constraint in each person's network within and beyond the team.

The vertical axis in Fig. 3B is the standardized team evaluation, and the horizontal axis is average constraint on people in the team (average was more predictive than minimum C score in team, maximum C score in team, or

Table 1. Social Capital Effect Disaggregated to Component Size, Density, and Hierarchy Effects

	Multile Correlation	Size	Density	Hierarchy
Performance Evaluation				
Job performance evaluations, staff				
function within financial company		0.13	− 0.34	− 0.23
(− 0.34 correlation with constraint				
across 111 senior women in Figure	0.39	0.12	− 0.33	− 0.10
3A, − 3.8 t-test)		(1.0)	(− 3.4)	(− 0.8)
Promotions				
Early promotion, electronics		0.27	− 0.33	− 0.13
manufacturer (− 0.40 correlation with				
constraint across 170 senior men in	0.49	0.27	− 0.43	− 0.23
Figure 3C, − 5.4 t-test)		(3.8)	(− 5.7)	(− 3.0)
Compensation				
Relative salary, chemical and drug		0.42	− 0.41	0.02
manufacturer (− 0.44 correlation with				
constraint across 60 senior	0.51	0.30	− 0.33	0.21
managers in Figure 3D, − 3.7 t-test)		(2.2)	(− 2.3)	(1.7)
Relative bonus, investment officers		0.33	− 0.38	− 0.34
within financial company (− 0.30				
correlation with constraint across	0.43	0.08	− 0.26	− 0.18
147 senior men in Figure 3E,		(1.0)	(− 3.8)	(− 2.5)
− 3.7 t-test)				

Note: Pearson correlations are given in the first row of each panel, standardized regression coefficients in the second (with routine t-tests in parentheses).

variance within team). The association is as predicted by the hole argument, and quite striking (− 0.79 correlation). Teams composed of people whose networks extend beyond the team to span structural holes in the company are significantly more likely to be recognized as successful.[8]

Promotions
Figure 3C describes promotion. The data are taken from a probability sample of senior managers in a large electronics manufacturer in 1989. Performance and network data on these managers have been discussed in detail elsewhere (Burt, 1992, 1995, 1997a, b, 1998). Survey network data were obtained on diverse relationships using the questions described above. Performance and background data on each manager were taken from company personnel records. Company personnel records provided each manager's rank (four levels defined by the firm), date promoted to current rank, date entered the firm, functional area of responsibility (defined by the firm as sales, service, manufacturing, information systems, engineering, marketing, finance, and human resources),and the usual personnel-file variables such as gender, family, income, and so on.

Income in the study population was too closely tied to job rank to measure the relative success of individual managers. Time to rank was a better performance variable (Burt, 1992, pp. 196–197). Whether promoted internally or hired from the outside, people promoted to senior rank in large organizations have several years of experience preceding their promotion. A period of time is expected to pass before people are ready for promotion to senior rank (see Merton, 1984, on socially expected durations). How much time is an empirical question, the answer to which differs between individual managers. Some managers are promoted early. Early promotion is the difference between when a manager was promoted to his current rank and a human capital baseline model predicting the age at which similar managers are promoted to the same rank to do the same work: E(age) minus age. Expected age at promotion E(age), is the average age at which managers with specific personal backgrounds (education, race, gender, and seniority) have been promoted to a specific rank within a specific function (rank, function, and plant location). Expected age at promotion is 12% of the population variance in promotion age, and residuals are distributed in a bell curve around expected promotion age (Burt, 1992, pp. 126–131; 1995). The criterion variable in Fig. 3C and Table 1 is the early promotion variable standardized across all 284 respondents to zero mean and unit variance.

The predicted social capital effect is evident from the negative association in Fig. 3C between early promotion and network constraint. The results are for the

170 most senior men responding to the survey. Women are a minority (12% of the study population, slightly higher 18% of the 284 survey respondents to ensure that there women appear in all sampling categories). I return to the women below in discussing the social capital of outsiders. In Fig. 3C, men promoted early to their current senior rank tend to have low-constraint networks (left side of the graph), while those promoted late tend to have high-constraint networks (right side of the graph). The regression results in the second panel of Table 1 show that significant contributions from each of the component network variables. Men with large networks were promoted early to their senior rank. Men with dense or hierarchical networks were promoted late.[9]

Compensation

The other graphs describe compensation. Figure 3D contains a representative sample of senior managers across functions in one division of a large French chemical and pharmaceuticals company in 1997 (Burt, Hogarth & Michaud, 2000). All 60 respondent managers are included in Fig. 3D and Table 1. Again, survey network data were obtained on diverse relationships using the questions described above. Performance and background data on managers in the study population were taken from company personnel records. Seventy-two% of the study-population variance in annual salaries can be predicted from a manager's job rank and age (salary slightly more associated with age than seniority). The residual 28% of salary variance defines the performance variable in Fig. 3D and Table 1. Relative salary is based on the difference between a manager's salary and the salary expected of someone in his rank at her age: salary minus E(salary). Associations with other background factors are negligible with rank and age held constant (Burt, Hogarth & Michaud, 2000). Relative salary is standardized across all 85 managers in the study population to zero mean and unit variance (a score of 1.5, for example, means that the manager's salary is one and a half standard deviations higher than the salary typically paid to people in his rank at his age).

    Relative salary has a negative association with network constraint in Fig. 3D. The managers who enjoy salaries higher than expected from their rank and age tend to be managers with networks that span structural holes in the firm. The component results in the third panel of Table 1 show that the aggregate effect is primarily due to network size and density; relative salary increasing with the number of manager's contacts, and decreasing with the density of relations between the contacts. Building a network around a central contact is not as dangerous here as it is in the American firms. The association with network hierarchy is not significantly positive, but it is clearly not significantly negative

as predicted by the hole argument. The component effects in Table 1 are virtually unchanged if I delete the three sample managers who are minorities in the sense that they are not white, married, French men.

Figure 3E contains investment officers in a financial organization in 1993 (Burt, 1997a). The study population includes bankers responsible for client relations, but also includes a large number of administrative and support people who participate in the bonus pool. Performance, background, and network data on the study population are taken from company records. Seventy-three percent of the variance in annual bonus compensation, which varies from zero to millions of dollars, can be predicted from job rank (dummy variables distinguishing ranks defined by the organization), and seniority with the firm (years with the firm, and years in current job). Salary is almost completely predictable from the same variables (95% of salary variance). With rank and seniority held constant, there are no significant bonus differences by officer gender, race, or other background factors on which the firm has data. The residual 27% of bonus variance defines the performance variable in Fig. 3E and Table 1. Relative bonus is based on the difference between the bonus an officer was paid and the bonus typical for someone in his rank, at her age, with his years of seniority at the firm: bonus minus E(bonus). I standardized relative bonus across all officers in the study population to zero mean and unit variance (a score of 1.5, for example, means that an officer's bonus is one and a half standard deviations higher that the bonus typically paid to people at his rank or her rank, age, and seniority). A random sample of officers analyzed for social capital include 147 men in Fig. 3E, and 39 women below in the discussion of outsiders.

The work of this population requires flexible cooperation between colleagues. It is impossible to monitor their cooperation through bureaucratic chains of command because much of their interpersonal behavior is unknown to their immediate supervisor. The firm is typical of the industry in using peer evaluations to monitor employee cooperation. Each year, officers are asked to identify the people with whom they had substantial or frequent business dealings during the year and to indicate how productive it was to work with each person. The firm uses the average of these peer evaluations in bonus and promotion deliberations. The firm does not look beyond the average evaluations. However, there is a network structure in the evaluations that, according to structural hole theory, has implications for an officer's perform-ance, which in turn should affect his bonus (see Eccles & Crane, 1988, Chap. 8). From peer evaluations by the investment officers and colleagues in other divisions of the firm, I identified the people cited as productive contacts by each of the officers, then looked at the evaluations by each contact to see

how contacts evaluated one another. I then computed network constraint, size, density, and hierarchy from the network around each officer.

What makes the study population analytically valuable is the time order between the network and performance data. The hole argument gives a causal role to social structure. Consistent with the argument, I assume the primacy of social structure for theoretical and heuristic purposes. I am limited to assuming the primacy of social structure because the data collected in the four study populations discussed above are cross-sectional and so offer no evidence of causation (see Burt, 1992, pp. 173–180, for discussion). It is difficult to gather survey network data, wait for the relative success of managers to emerge over time, then gather performance data. The network data on the investment officers were obtained in the routine of gathering peer evaluations to affect bonus compensation five months later.

There is a negative association in Fig. 3E between bonus compensation and network constraint (–3.7 t-test). The managers who received bonuses higher than expected from their rank and seniority tend to have networks that span structural holes in the firm (and the effect continues over the next three years, Burt, 2000b). The component results in the fourth panel of Table 1 show that the aggregate effect in Fig. 3E is due primarily to network density and hierarchy. Bonus compensation increases with the number of an officer's contacts, but the association disappears when density and hierarchy are held constant. The significant contributions are the tendency for low bonuses to go to officers with networks of densely connected contacts and to officers who have built their network around a central person.

The logit results in Fig. 3F show that the social capital effect is even stronger than implied by the results in Fig. 3E. There is a triangular pattern to the data in Fig. 3E. On the right side of the graph, officers with the most constrained networks receive low bonuses. On the left, officers receiving larger bonuses than their peers tend to have low-constraint networks, but many officers with equally unconstrained networks receive small bonuses. I attribute this to annual data. The low-constraint networks that span structural holes provide better access to rewarding opportunities, but that is no guarantee of exceptional gains every year. There is a 0.47 partial correlation between bonus in the current year and bonus in the previous year (after rank and seniority are held constant). Even the most productive officers can see a lucrative year followed by a year of routine business. So, the logit results in Fig. 3F more accurately describe the social capital effect for the investment officers. I divided the officers into three bonus categories: large (bonus more than a standard deviation larger than expected from rank and seniority) medium, and small (bonus more than a standard deviation larger than expected from rank and seniority). Network

constraint this year significantly decreases the probability of receiving a large bonus next year, but the stronger effect is the increased probability of receiving a low bonus next year.

Across the Five Study Populations
The illustrative evidence supports two conclusions: First, the social capital of networks that span structural holes matters for manager performance; improving evaluations of the manager's work, the probability of early promotion, and the manager's compensation relative to peers. Second, performance associations with the three component variables vary across the populations, but strongly support structural holes over closure as the source of social capital. Performance is higher for managers with large networks, but the positive association with size is only significant in two of the Table 1 populations. Performance is weaker for managers whose network is built around a central person, but the negative association with hierarchy is only significant in two Table 1 populations, and almost positive in another population. The one consistent association is between dense networks and substandard performance. Network density has a significantly negative association with performance in all of the study populations.

CONTINGENCY FACTORS

The case is not as simple as implied by the evidence thus far. My final step in the review is to describe the contingent value of social capital. A contingency factor is a variable that affects the strength of association between social capital and performance. I review five contingency factors: personality and culture, kinds of relationships, peers and task uncertainty, network closure, and the distinction between insiders versus outsiders. These factors are productive to review because, as I explain, debate over network mechanisms responsible for social capital can be resolved in large part by understanding contingency.

Motivation: Personality and Culture

Brokerage opportunities do not by themselves turn into success, and people are not equally comfortable as brokers between groups. Is the connection between performance and brokerage contingent on being a person who is comfortable working with structural holes?

One response is to assume the motivation issue away. For example, if individuals are rationally self-interested in a micro-economic sense, personal preference about brokering connections is not a contingency factor. To know who succeeds, you only need to know who has the opportunity to succeed.

Or, motivation can be dismissed as a correlate of network structure, and so not necessary to measure once one has a measure of network structure (Burt, 1992, pp. 34–36). For reasons of a clear path to success (a person is more likely to see brokerage opportunities in a large, sparse network), or the personality of the individual who constructed the network (people inclined toward brokering connections between others build large, sparse networks), or the nature of exogenous factors responsible for the structure of the network (persons forced to live in large, sparse networks are more likely to learn about brokering connections between others) – large, sparse networks are more likely to surround a person motivated to be entrepreneurial in the sense of building networks that span structural holes.

Or, the motivation issue can be addressed directly by adding personality or culture to the equation predicting performance. For example, McClelland (1961) argues that the childhood formation of a need to achieve is a personality factor critical to later entrepreneurial behavior, and Weber (1905) makes the culture argument that Protestant beliefs encouraged capitalism by making entrepreneurial behavior righteous.

The little empirical research available on this issue expands, more than revises, the hole argument. Burt, Jannotta & Mahoney (1998) identify personality characteristics associated with structural holes, and the character-istics are consistent with the hole argument. People in networks that span structural holes, like Robert in Fig. 2, claim the personality of an entrepreneurial outsider (vs. conforming and obedient insider), in search of authority (vs. security), thriving on advocacy and change (vs. stability). The association with personality, however, only exists for people in technical and clerical jobs, where contact networks are shaped by personal taste rather than performance. At higher job ranks, where the social capital of structural holes more strongly affects performance, there is no association between personality and structural holes. Regardless of their personal tastes, middle and senior managers seem to adapt to the demands of building networks that span structural holes (see Mehra, Kilduff & Brass, 2000, for an analysis in which the performance effects of network and personality are additive). Burt, Hogarth & Michaud (2000) discuss national culture as a contingency factor in their comparative study of senior managers in a French firm and a similar American firm. The French managers build their networks in ways distinct from the Americans, ways consistent with research documenting the more bureaucratic nature of French business. Where the French are emotionally uncomfortable with bridge relationships to colleagues not close to one another, the Americans are comfortable. Where the French build from long standing personal friendships that rarely span the boundary of the firm, the Americans build from

long-standing work relationships that often span the boundary of the firm. These differences in the etiology of network connections notwithstanding, manager performance in both firms is associated with personal networks that span structural holes (Fig. 3D plots the French managers). The French and American managers build their networks differently, but as predicted by the hole argument, performance is enhanced for both when they build to span structural holes.
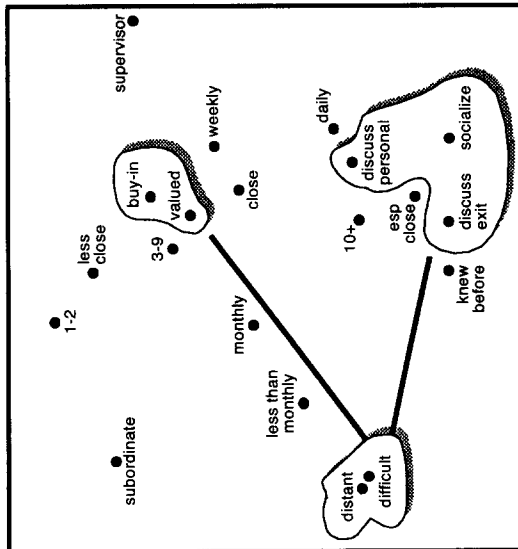
Network Content

The four network variables reviewed (constraint, size, density, hierarchy) are measures of network form in that they describe the strength of relations. Network content is about the substance of relationships, qualities defined by distinctions such as friendship versus business vs. authority.

Content as a contingency factor asks how the value of social capital varies with the kinds of relationships on which it is based. Is brokering connections in a friendship network, for example, viewed as rude or adding value? Is brokering in an authority network adding value or disrupting the chain of command?
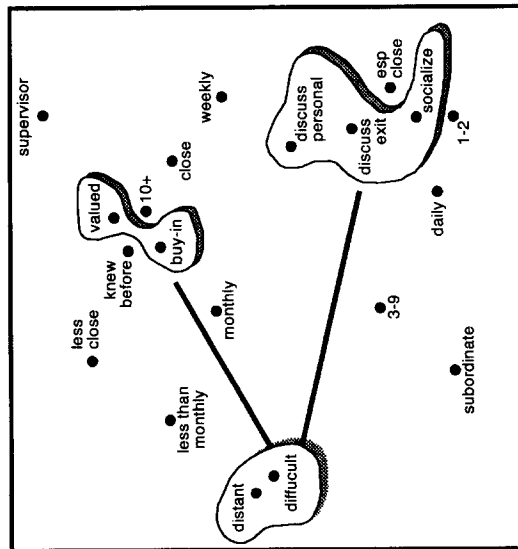
Content in General
It is all too easy for distinctions between kinds of relations to be no more than a semantic distinction in the mind of the observer – what is friendship distinct from business in one study population can be two sides of the same relationships in other study populations – so it makes sense to check that the content distinctions being tested for contingency are meaningful to the population under study.

This is a generic issue in network analysis, for which there are generic solutions (e.g. Romney & D'Andrade, 1964; Burt & Schøtt, 1985; Carley, 1986; Burt, 1990; Krackhardt, 1990). The presumption is that behavioral distinctions precede cognitive distinctions. Two kinds of relations distinguished in a study are in fact the same kind of relationship to the extent that everyone with whom I have the first kind of relationship, I also have the second. The spatial displays, or cognitive maps, in Fig. 4 describe how the American managers from Fig. 3C and the French managers from Fig. 3D distinguish kinds of relationships (see Burt, Hogarth & Michaud, 2000, for discussion of the maps). Each map is a multidimensional scaling of joint probabilities. Kinds of relations are close together to the extent that they tend to reach the same people.[10] For example, the 60 French managers cited a total of 275 colleagues as most valued, 227 as essential sources of buy-in, and 115 as both, defining a

American Managers (in Figure 3C)

supervisor · valued · 10+ · buy-in · close · weekly · knew before · less close · less than monthly · monthly · distant · diffucult · subordinate · 3-9 · daily · 1-2 · discuss personal · discuss exit · esp close · socialize

French Managers (in Figure 3D)

supervisor · weekly · buy-in · valued · 3-9 · less close · 1-2 · daily · discuss personal · close · 10+ · esp close · discuss exit · knew before · monthly · less than monthly · subordinate · distant · difficult · socialize

Key to Kinds of Relationships: "1-2" known for less than three years, "10+" known for ten or more years, "buy-in" contact is an essential source of political support for manager, "close" 2 on a 4-point scale of emotional closeness to manager, "daily" speaks with contact at least once a day, "difficult" contact is manager's most difficult collegue, "discuss exit" manager would discuss moving to another firm with this contact, "discuss personal" manager has disscussed personal matters with contact, "distant" 1 on a 4-point scale of emotional closeness to manager, "esp close" 4 on a 4-point scale of emotional closeness to manager, "knew before" before joining the firm, manager knew this contact, "less close" 3 on a 4-point scale of emotional closeness to manager, "less than monthly" speaks with contact less than once a month, "monthly" speaks with contact at least once a month, "socialize" gets together for informal socializing, "subordinate" most promising of the people supervised by manager, "supervisor" manager's boss, "valued" contact is one of manager's most valued work contacts, "weekly" speaks with contact at least once a week.

Fig. 4. Manager Distinctions Between Kinds of Relationships. (Relations close together reach the same contacts).

joint probability of 0.297 between valued and buy-in. 'Valued' and 'buy-in' are close together in Fig. 4 because the 0.297 joint probability of a contact being cited for buy-in and valued is higher than most other joint probabilities.

The most obvious feature of the maps is their similarity. The three kinds of relations distinct in each map were circled (personal, work, and negative). Personal relations (in the southeast of each map) are to people with whom the manager socializes and discusses personal matters such as leaving for a job with another firm. These are people to whom the manager feels especially close and with whom he speaks daily. Work relations (in the northeast of each map) are to people the manager cites as his most valued contacts at work and essential sources of buy-in for initiatives coming out of his office. These are people to whom the manager feels close, but not especially close, and with whom he speaks once a week or so. Negative relations (to the west of each map) are with people to whom the managers feels emotionally distant, or people cited for having most made it difficult for the manager to carry out his job responsibilities.

The two broad content distinctions illustrated in Fig. 4 are evaluative distinctions between good and bad (east-west in each map), and work distinguished from personal (north-south in each map). These broad distinctions also occur in survey network data on national probability samples, so they are probably reliable content distinctions for social capital research. The evaluative distinction occurs in network data on probability samples of Americans (Marsden & Campbell, 1985; Burt, 1990), as does the distinction between work and personal relationships (Burt, 1990).

The distinction between positive and negative seems an obvious distinction between network contents, but it has not entered social capital research. Virtually all social capital research has been on networks of variably positive relations (exceptions include Labianca, Brass & Gray, 1998; Burt 1999a, 2001; and Labianca & Brass, 2000, on the strategic importance of negative relationships for integrating the concepts of trust and brokerage).

Authority in Particular
Among positive relations, there is mixed evidence of a contingency distinction between personal discussion relationships versus the relations through which corporate authority flows. Podolny & Baron (1997) argue that the value of brokering structural holes is concentrated in networks of personal relationships, such as confiding and socializing in the southeast of the maps in Fig. 4. These are discretionary connections through which managers derive early access to information and shape its distribution within an organization. In contrast, Podolny and Baron argue, performance can suffer from structural holes in the

authority network, as defined by relation such as buy-in and work advice in the northeast of the maps in Fig. 4. These are the channels through which a manager receives normative information about what is proper, and instrumental information on priorities to be pursed. Structural holes in the authority network increases the chances of a manager receiving contradictory information on properties and priorities, which might confuse the manager and so erode performance. With network data on a representative sample of managers in a high-technology engineering and manufacturing company, Podolny and Baron show that large, sparse networks of contacts cited for task advice and strategic information increase the odds of manager promotion. They also show, as predicted by their content distinction, that large, sparse networks of buy-in relations lower the odds of manager promotion.

Similar results exists on the managers in Fig. 3C (Burt, 1997b). Network constraint scores computed from the network of contacts cited as personal ties (socialize, discuss personal matters, discuss exit) have the strong negative association with early promotion predicted by the hole argument and displayed in Fig. 3C (–4.7 t-test). In contrast, constraint scores computed from the network of corporate ties (supervisor and essential sources of buy-in), have no association with early promotion (0.3 t-test). The difference is consistent with Podolny and Baron's argument, though holes in the corporate network do not have a negative association with performance so much as they are independent of performance.

Still, evidence is mixed on the destructive nature of structural holes in the corporate bureaucracy. One issue is that many contacts are cited for both work and personal reasons, which creates an extended network in which managers develop personal relationships with key sources of buy-in. Though replicating the Podolny and Baron content distinction, Burt (1997b) reports the strongest social capital effects with network constraint measured from the combined network of work and personal relationships. Similarly, though Flap, Völker & Bulder (2000) report for their study of two government agencies that material job satisfaction increased with instrumental work ties while satisfaction with the social aspects of a job increased with other contents, 'networks that branch out' enhance satisfaction with both the material and social aspects of a job.

Douthit's (2000) analysis of direct reports raises a second issue. If structural holes are a problem in the buy-in network around manager, they must be a particularly difficult problem when they separate manager and boss. With network data on samples of staff officers from two financial organizations, one of which includes the senior people in Fig. 3A, Douthit compares supervision in a segregated context of manager and boss sharing no key contacts, to supervision embedded in an integrated context of manager and boss sharing

mutual key contacts. Supervision in the segregated context is a bridge that spans the structural hole between manager and boss. She discusses bridge supervision as the exercise of authority across a structural hole, and argues that bridge supervision should be less productive than embedded supervision. There are two empirical results. In an analogy to segregated networks in Bott's (1957) analysis of conjugal roles, Douthit describes the tendency for bridge supervision to accompany social disintegration between manager and boss in the form of less joint decision-making, less informal discussion of office politics, less personal compatibility. Nevertheless, the disintegration associated with bridge supervision does not affect the association between network constraint and performance evaluations. Interaction between network constraint and bridge supervision is negligible in predicting performance evaluations. Officers with networks that span structural holes are more likely to receive high performance evaluations, whether or not they are working under bridge supervision. In sum, network content can be, but need not be, a contingency factor in the value of brokering structural holes.

Peers and Task Uncertainty

For any individual, there is some number of people – call them peers – who do the same work. A manager could have many peers, a few, or none if no one else is doing the same work.

Contingency Function

The value of social capital varies with the number of peers. More peers, less value. For example, the -0.4 correlation in Fig. 3C between early promotion and network constraint varies between categories of managers; from correlations close to zero for lower-rank managers in engineering (many peers), up to correlations stronger than -0.8 for high-rank managers in sales and service (few peers). More specifically, there is a contingency function in which the magnitude of the correlation between early promotion and network constraint, which indicates the value of social capital, decreases as a power of the number of a manager's peers (Burt, 1997a, p. 385; see Fig. 6 below).

The competition and legitimacy associated with peers can be used to make sense of the negative association between value and peers (Burt, 1997a). Having many peers affects a manager's freedom to define his job, and the firm's response to the manager's definition. First, many peers are a competitive frame of reference. Their aggregate behavior indicates how the manager should perform, and peer competition keeps the manager tuned to peers' job performance (see Burt, 1987, on network conditions for competition and

imitation among peers). Beyond informal pressures to conform, the firm is likely to provide guidelines for jobs held by a large number of employees. Second, legitimacy is established by many people doing the same work. The way in which the job is performed is legitimate not because of content or quality, but because many people perform it that way (e.g. economists in a business school).

The two conditions are reversed for a manager who has few peers: First, there is no competitive frame of reference. There are no peers for informal guidance, and it would be inefficient for the firm to define how a job specific to a few employees should be performed. The manager has to figure out for herself how best to perform the job (see Kohn & Schooler, 1983, on occupational self-direction). Second, legitimacy does not come with the job; it has to be established. With few people doing the work, establishing the legitimacy of a manager's job performance depends on getting others to accept her definition of the job (e.g. sociologists in a business school).

Social capital can be expected to be more valuable to the manager with few peers as described by the contingency function. The information and control benefits of structural holes put a manager in a position to better read the diverse interests in their organization to define needed policy and to know better who can be brought together productively to implement policy. The ability to identify and develop opportunities is essential to the manager evaluating how best to fulfill his or her job responsibilities in a way valued by the firm and the market. Such ability has little value to the manager whose work is defined by corporate convention or the boss.

Task Uncertainty

Peers and task uncertainty are related contingency factors. More peers working on a task means that the task will be less uncertain for the two reasons just discussed: many peers provide a competitive frame of reference for how to do the task, and there are more likely to be established guidelines for a task on which many people work. In other words, managers assigned to more unique tasks face more uncertainty in how to do the tasks. The information and control benefits of social capital can be expected to be more valuable to people working on uncertain tasks for the same reasons that they are more valuable to people whose tasks involve few peers.

Corroborating evidence can be drawn from several research areas, but direct evidence is rare at this time. Gabbay & Zuckerman (1998) describe the greater importance of social capital for anticipated promotions in research groups where individual distinctions are more valued, and Belliveau, O'Reilly & Wade (1996) describe the significance of relative social capital. There is a related

contingency effect in research on the use of social capital by employers to evaluate prospective employees. Employers should check via social capital on candidates for jobs in which performance can be expected to vary with social capital. Marsden & Gorman (2000) show with a national probability sample that informal, social capital, search strategies are more likely to be used to fill vacancies for jobs that require autonomous decision-making. Flap & Boxman (2001) show a similar result even for employers evaluating college graduates applying for their first full-time job. On the other hand, social capital can be a productive criterion for recruitment even where it is irrelevant to job performance. Fernandez, Castilla & Moore (2000) show that personal referrals are a cost-effective strategy to locate employees to answer telephones at a credit-card processing center. Social capital has no value in the job, but the people most likely to survive in such a regulated, wearing job, a job characterized by high turnover, are people with little social capital in their personal lives. Who better to locate people without social capital (prospective employees) than other people without social capital (current employees)?

Moving up to the level of teams, Hansen, Podolny & Pfeffer (2000) report task contingency for new-product teams in a leading electronics and computer firm (also see Hansen, 1999, in note 3). They find that teams composed of people with more non-redundant contacts beyond the team complete their assigned task more quickly – for teams working on a new product for an unfamiliar market or a new product involving unfamiliar technology (termed 'exploration' work following March's, 1991, distinction between exploration versus exploitation). If the team was working on a new product based on a familiar technology for a familiar market, however, the network effect is negligible. In other words, the external network spanning structural holes is more valuable to the teams working on more uncertain tasks. Hansen, Podolny and Pfeffer's task contingency is related to peer contingency to the extent that engineers in routine jobs for which there are many peers and low returns to social capital were more likely to be assigned to the new-product teams working with familiar technologies for familiar markets.

At a still more aggregate level, Podolny (2000, Table 6) describes the contingent value to venture-capital firms of a co-investment network that spans structural holes. Firms with a network rich in structural holes do a large proportion of their investments in ventures at an early stage of development (which is where uncertainty is highest about the market potential of a venture) and the ventures in which they invest are significantly more likely to survive to IPO (4.4 test statistic). However, the association with IPO only exists for their investments in early-stage ventures. Their second-stage investments are no more likely to survive to IPO than the investments of other venture-capital

firms (0.5 test statistic), and their investments in more mature ventures have a still weaker tendency to survive to IPO (–0.9 test statistic). The social capital of bridging structural holes is more of an advantage in more uncertain ventures.

Network Closure

The contingency argument regarding peers and task uncertainty is both structural and ecological. Structural holes among peers allow outsiders to play the peers against one another, which erodes the value of whatever social capital the peers hold (Burt, 1992, pp. 44–45). A manager's ability to develop broker connections across holes is constrained by the presence of one or more peers in a position to undercut or denigrate the manager's proposals. The contingency argument is analogous to ecological arguments describing the competition and legitimacy consequences of an increasing number of organizations in a market (Hannan & Freeman, 1989, pp. 131–141; Burt, 1992, pp. 215ff.; Han, 1993, 1994). I focus on the implications of peer numbers, but the competition and legitimacy mechanisms are familiar from research in organization demography (e.g. Pfeffer, 1983; Haveman & Cohen, 1994). The contingency prediction is that peers erode the value of social capital to the extent that disorganization among peers intensifies competition between the peers and elicits behavioral guidelines from higher authority.

It is a short step from disorganization among peers to disorganization within a group, but it is a step that brings together the closure and hole arguments in a productive way.

Internal and External Networks
Begin with the table in Fig. 5. Rows distinguish groups by external network. Groups can be distinguished on many criteria. I have in mind the two network criteria that define information redundancy (cohesion and structural equivalence) but it is just as well to have in mind more colloquial definitions of group; family, team, neighborhood, ethnicity, or industry. Whatever the definition, some groups have social capital in the sense that its members have many non-redundant contacts beyond the group – as illustrated by the three-person sociograms at the top of the table in Fig. 5. People in each of the two groups have a total of six non-redundant contacts beyond the group.

With respect to network measurement, non-redundant contacts mean a lack of external constraint on the group. The horizontal axis in Fig. 3B, for example, measures the average network constraint on individuals in TQM teams. Low-constraint teams, to the left in the graph, were composed of

employees with many non-redundant contacts beyond their team. In spanning structural holes beyond the team, their networks reached a diverse set of perspectives, skills, or resources. They were the high-performance teams. At the other extreme, to the right in Fig. 3B, low-performance teams were composed of individuals with redundant contacts beyond the team. The sociogram at the bottom of Fig. 5 is an illustration. The group's four contacts beyond the team are interconnected, and so redundant by cohesion. Such a team has access to a single set of perspectives, skills, or resources, and is expected not to see or successfully implement new solutions, as illustrated in Fig. 3B by their poor performance with respect to TQM.

Columns in Fig. 5 distinguish groups in terms of network closure within the group. Structural holes within a group weakens in-group communication and coordination, which weakens group ability to take advantage of brokerage opportunities beyond the group. Closure eliminates structural holes within the team, and so improves communication and coordination within the team. The sociogram to the left of the table in Fig. 5 shows a group with disconnected elements in the group. The two sociograms to the right of the table show groups with all three elements connected. Density or hierarchy can provide network closure, though hierarchy seems to be the more potent form of closure (e.g. Crane, 1972, on the center-periphery structure of invisible colleges; Greif's, 1989, pp. 862–863, observation that the Maghribi traders sanctioned not through their dense network with one another but through "a public appeal to the Jewish communities" in which they were embedded; Provan & Milward, 1995, on higher performing mental health systems that have a hierarchical, rather than a dense, network structure; or Koza & Lewin, 1999, pp. 648–649, on coordination problems that arise if there is only density without hierarchy). A leader with strong relations to all members of the team improves communication and coordination despite coalitions or factions separated by holes within the team.

Performance Surface
The graph at the top of Fig. 5 shows group performance across the cells of the table. Performance here is an undefined mixture of innovation, positive evaluation, early promotion, compensation, and profit. Points A, B, C, and D at the corners of the table in Fig. 5 correspond to the same points in the graph.

Performance is highest at the back of the graph (quadrant A), where network closure within the group is high (one clear leader or a dense network connecting people in the group) and many non-redundant contacts beyond the group (member networks into the surrounding organization are rich in disconnected perspectives, skills, and resources). Performance is lowest at the

front of the graph (quadrant C), where in-group closure is low (members spend their time bickering with one another about what to do and how to proceed) and completely redundant contacts beyond the group (members are limited to similar perspectives, skills, and resources).

Figure 5 is my inference from three bits of evidence in the preceding review. In fact, the Fig. 5 interaction between brokerage and closure is the concept of structural autonomy from which the hole argument emerged (Burt, 1980; 1982; 1992, pp. 38–45).

First, the functional form of the graph comes from research with census data describing the association between industry profits and market structure. The left graph in Fig. 6 plots industry profit margins by network structure within and beyond the industry (Burt et al., 1999, Fig. 3; cf. Burt 1992, p. 95). Industry profit margins decrease with network constraint within an industry (where internal constraint is measured by the extent to which industry output is spread across many independent producers, t-tests for the beta coefficient in Fig. 5 estimated from the market data vary from -9.9 to -4.8; Burt et al., 1999, Table 4) and network constraint beyond the industry (where external constraint is measured by the extent to which producers have few independent suppliers and customers, t-tests for the gamma coefficient in Fig. 5 vary from -9.3 to -4.1; Burt et al., 1999, Table 4).

Analogy with the market structure research is productive in two ways. First, the market results are based on a census of market conditions, so they include data on the performance-network association at extremes not present in most samples of managers. Second, the market results across a broader range of network conditions show a nonlinear form of returns to network structure. The strongest network effects occur with deviations from minimum network constraint. With respect to network structure within a group, in other words, performance should be weakened more by the first significant disconnection in the group than by one more disconnection within an already disorganized group. With respect to external structure, performance should be weakened more by the entry of one strong perspective, or skill, or resource in the surrounding organization than it is by the entry of another external pressure on a group already frozen by external pressures.

A second bit of evidence for the integration is Reagans & Zuckerman's (1999) study of performance in corporate R&D units. As discussed earlier ('Individual and group'), they report higher levels of output from units in which scientists were drawn from diverse employee cohorts (implying that their networks reached diverse perspectives, skills and resources outside the team) and there is a dense communication network within the unit. Tenure diversity (or other kinds of diversity, see Williams & O'Reilly, 1998) can be disruptive
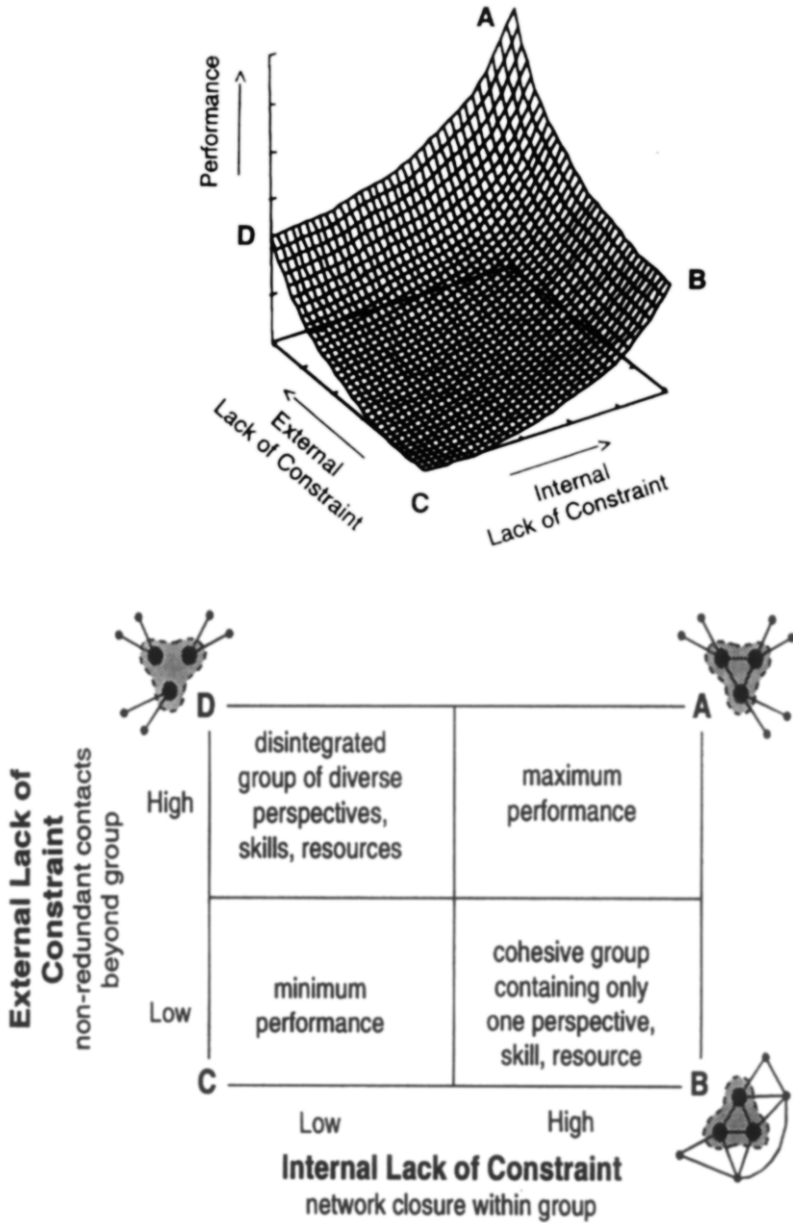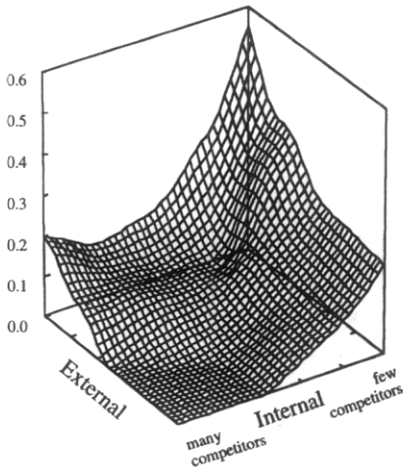
Fig. 5. Group Performance Surface, across Structural Holes and Network Closure.

Industry price-cost margins as a function of internal constraint (one minus concentration ratio within industry) and external constraint (measured by lack of structural holes among the industry suppliers and customers; 509 observations of American markets from 1963 to 1992, Burt et al., 1999: Figure 3).
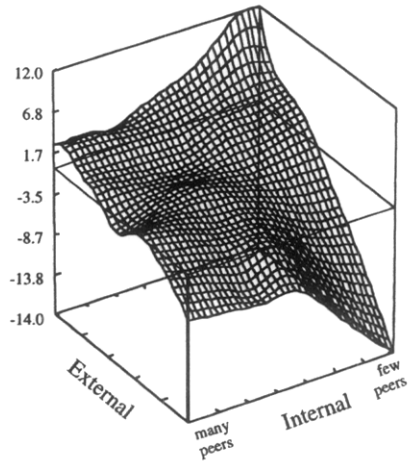
Manager early promotion (years ahead of peers at promotion to current rank) as a function of internal constraint (number of peers) and external constraint (measured by lack of structural holes in the manager contact network; 170 senior male managers in electronics firm, see Figure 4B; Burt, 1997a:Figure 6).

Fig. 6. Performance Surface in Figure 5 Specific to Markets and Managers.

because of the difficulties associated with communicating and coordinating across different perspectives, but when communication is successful (as implied by a dense communication network within the team), team performance is enhanced by the brokerage advantages of the team having access to more diverse information. Reagans and Zuckerman's data are distributed along a segment somewhere between points A and C on the performance surface at the top of Fig. 5.

A third bit of evidence for the integration comes from the peer contingency just discussed. The value of social capital declines in proportion to the number of managers – peers – doing the same work. Data for the contingency function are plotted in the graph to the right in Fig. 6 so as to make more clear the analogy with the market data. The vertical axis is manager performance measured as early promotion relative to peers so there is no performance variance along the internal constraint axis. The line around the middle of the graph box shows the zero point for early promotion at each level of internal constraint. There is a steep slope to the surface at the back of the graph box (for

managers who have few peers and so are unconstrained by peers). The steep slope is highest for managers with many non-redundant contacts (far corner of the graph box, low external constraint), and lowest for managers with primarily redundant contacts. This corresponds to the line between point A and point B on the team performance surface at the top of Fig. 5. As the number of peers increases, the performance surface becomes more flat – there is less of a difference between managers who are low versus high in external constraint.[11] This corresponds to the line between point D and C on the team performance surface at the top of Fig. 5.

Assume that network closure among peers decreases with their number; closure among many people being more difficult to sustain than closure among a few people. Then the negative association between peers and the value of social capital is a negative association between closure and the value of social capital. The social capital of brokerage across structural holes is more valuable to a group where there is network closure within the group (point A at the back of the graph in Fig. 5). Low closure means poor communication and coordination within a group and such a group can be expected to perform poorly, benefiting least from hole-spanning external networks (point C to D in the graph).

Integrating Research Results

The synthesis of closure and holes as complementary forms of social capital in Fig. 5 is interesting in its own right, but beyond interesting it is powerful as a frame of reference for integrating research results across studies. A study can show exclusive evidence of social capital from network closure or structural holes without calling either argument into question.

For example, Greif (1989) argues that network closure was critical to the success of the medieval Maghribi traders in North Africa. Each trader ran a local business in his own city that depended on sales to distant cities. Network closure among the traders allowed them to coordinate so as to trust one another, and so profitably trade the products of their disparate business activities. The traders individually had networks rich in brokerage opportunities, but they needed closure with one another to take advantage of the opportunities. More generally, in an environment rich in diverse perspectives, skills, and resources, group performance depends on people overcoming their differences to operate as a group. Group performance will vary with in-group closure, not brokerage, because brokerage opportunities beyond the group are high for all groups (this is the Fig. 5 surface from point A to point D).

Rosenthal's (1996) study of TQM teams illustrates the other extreme. People on the teams had been trained to act as a team and there was enthusiasm for

quality management in the firm – so the teams did not differ greatly in their closure. Closure was high in all of them. Therefore, team performance varied as illustrated in Fig. 3B with a team's external network. If a cohesive team can see a good idea, it can act on it. With all teams cohesive, those with numerous non-redundant contacts beyond the team had the advantage of access to a broader diversity of perspectives, skills, and resources. I earlier discussed several recent studies that report high performance from groups with external networks that span structural holes (see 'Individuals and Groups'). With Fig. 5 in mind, these studies tell me not that the closure argument is in error so much as they tell me that closure within business groups is less often problematic than brokerage beyond the group. More generally, the relative performance of cohesive groups will vary with the extent to which a group is composed of people with networks rich in structural holes, not network closure, because closure is high for all of the groups (this is the Fig. 5 surface from point A to point B, illustrated in Fig. 3B).

In short, structural holes and network closure can be brought together in a productive way. The synthesis is only with respect to empirical evidence. The mechanisms remain distinct. Closure describes how dense or hierarchical networks lower the risk associated with transaction and trust, which can be associated with performance. The hole argument describes how structural holes are opportunities to add value with brokerage across the holes, which is associated with performance. The empirical evidence clearly supports the hole argument over closure. The point illustrated in Fig. 5 is that while brokerage across structural holes seems to be the source of added value, closure can be critical to realizing the value buried in the structural holes.

The Social Capital of Outsiders

There is one step further to go with closure as a contingency factor. Closure is essential to the social capital of outsiders, but it is network closure of a specific kind, a kind that indicates borrowed access to structural holes.

Insiders, Outsiders, and Sponsors

There is a delightfully descriptive Yiddish word, *mishpokhe*, that refers to people who are 'one for us'. The word is specifically about extended family, but it is popularly used to refer to people who are one of us. Rosten (1989, p. 338) illustrates with Chase Manhattan Bank's advertising campaign built around the slogan "You have a friend at Chase Manhattan," In a window of the bank next to a Chase Manhattan branch there appeared a sign; "– BUT HERE YOU HAVE MISHPOKHE!"

We are each *mishpokhe* in some settings, outsiders in others. Example outsiders are an economist arguing the merits of his model to an audience of sociologists, an American pitching a deal to a Japanese investor, a woman arguing the merits of a business policy to a sexist male, a baby-faced youngster proposing new theory to a senior scholar, a manager representing her group's interests on a team composed of more senior managers from another group. The list is as infinite as the differences among us.

In the interpersonal politics of competition, *mishpokhe* are twice advantaged as legitimate members of a population. Investors are more likely to believe they understand the motives and probable actions of someone like themselves, which means they feel more confident in predicting the future behavior of *mishpokhe*. Second, it is easier for investors to trust *mishpokhe* because his or her reputation among us will be tarnished if investors are treated poorly. These reasons for preferring insiders are grounds for excluding outsiders, which in American business are disproportionately women.

The well-known solution is for the outsider to speak through an inside sponsor (e.g. Giacalone & Rosenfeld, 1989, on impression management). Every manager needs a sponsor at one time or another. Company leaders don't have time to check into the credibility of everyone making a bid for broader responsibilities. They are looking for fast, reliable cues about managers on whom they do not already have information. A manager deemed suspect for any reason – a new hire, someone just transferred from another country, a new addition to a cohesive group – needs an established insider to provide the cues, sponsoring the manager as a legitimate player to open the mind of a contact not ready to listen seriously to the manager's proposal. The phenomenon is succinctly illustrated by an anecdote that Kilduff & Krackhardt (1994, p. 87) quote from an unattributed source in one of Cialdini's (1989, p. 45) papers on impression management. The financier Baron de Rothschild is asked by an acquaintance for a loan, to which the great man is reputed to have replied: "I won't give you the loan myself; but I will walk arm-in-arm with you across the floor of the Stock Exchange, and you soon shall have willing lenders to spare."

The solution is especially obvious when relations cross corporate or cultural boundaries. It is official in Japan. There are industry-specific directories of people available to help outsiders develop relations with Japanese firms.[12] The people in these directories are usually retired corporate executives who prefer the active life of consulting to life in a window seat. These people do not bring technical skills, they bring connections. Without the proper personal connections, outsiders don't do business in Japan. Corning Glass is a concrete illustration. Corning has a history of joint ventures that give Corning access to

a market where the partner firm is established. Nanda & Bartlett (1990) offer illustrative examples in the United States and Europe, but I particularly enjoy their quote from a Corning executive commenting on the result of Corning's alliance with the Japanese firm Asahi (Nanda & Bartlett, 1990, p. 14): "When our salespeople began calling on the Japanese TV set manufacturers, we felt as if a veil came over them when they dealt with us. Their relationships with their Japanese suppliers ran very deep, while they were very distant with us. Last week, Asahi people escorted me to meeting with the worldwide TV tube manager of a large Japanese company and introduced me properly to him. We had extremely fruitful conversation. I wouldn't have even been able to meet him and discuss issues between us if it were not for the Asahi connection." Japan is merely an extreme case. Stuart, Hoang & Hybels (1999), for example, study the growth of young American biotechnology companies to IPO. Cost, profit, and uncertainty are high in the industry. Prominent investors, or alliances with prominent companies in the industry, can be a competitive advantage in signaling the value of a young company. As expected, companies with prominent associates move more quickly to IPO and earn greater valuations at IPO (see Stuart, 1999, for similar effects on company growth in the semiconductor industry; Gulati, 1998, for broad review).

Hierarchical Networks Indicate Borrowed Social Capital
Sponsorship as a network phenomenon is illustrated in Fig. 7 with two women, Karen and Jane (pseudonyms). To make their network differences more obvious, neither woman is included in the Fig. 7 sociogram of her network. Only the network among each woman's contacts is presented.

Karen and Jane were among the sample senior managers from the electronics manufacturing firm displayed in Fig. 3C. The performance variable was early promotion, on which Jane was doing much better than Karen. The two women held the same rank in the company, but Jane was promoted nine years earlier than other women in her line of work with the same background. Karen was promoted seven years late.

Scores on the network constraint index and component network variables are displayed in the figure. The two women are similarly about average in network constraint, so constraint cannot explain their performance difference. Neither is network size the explanation. Jane's eight contacts are similar to Karen's nine. Network density is also similar for the two women: the average strength of relation between contacts is 36 in both networks.

The difference is hierarchy. Jane's network is more hierarchical than Karen's. Jane's network is more hierarchical because so many of her contacts are connected through Sam (a pseudonym). Sam has especially close ties with

all but two of Jane's contacts, and close ties with the remaining two. More, there would be few relations between contacts if Sam were removed from the network. In contrast, Karen's contacts are connected directly. With respect to
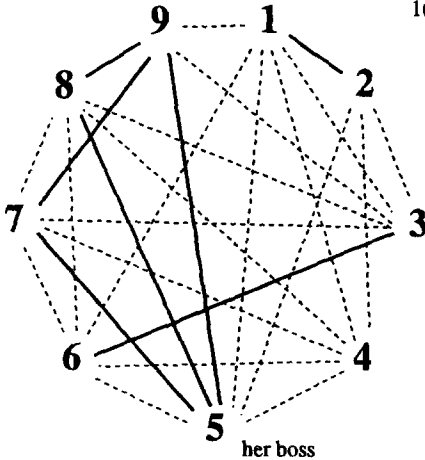
Sam, prior boss
of her boss **1**

her boss

8

2

7

3
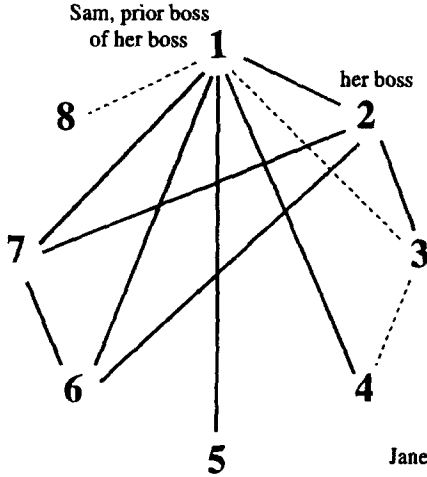
Jane:
Middle Manager
Early Promoted

6

4

5

bold line is especially close,
dashed line is close,
no line is distant or strangers

Jane	Karen	COMPARISON
9	-7	Promotion (years early)
31	34	Constraint (C about same)
8	9	Network Size (N about same)
36	36	Density (D about same)
16	1	Hierarchy (H high vs. low)

9 ······ **1**

8

2

7

3

6

4

5

her boss

Karen:
Middle Manager
Promoted Late

Fig. 7. Illustrative Hierarchy Effect.

hierarchy in the networks of the other sample managers in this study population, Jane's network is two standard deviations above average. Karen's is three standard deviations below average.

I know something about the contacts in each network. From Karen's questionnaire I know that her network is concentrated in her immediate work group. Her boss, contact 5, is the most central contact in her network. He had especially close relations with three of the four other contacts, and close relations with another four. Contacts 3, 4, 6, 7, 8, and 9 are all other people who worked with Karen under her boss.

Relative to Karen, Jane's contacts were more disconnected from one another. Only two of her eight contacts were from her work group; contact 3, and her boss, contact 2. Jane's other contacts were essential sources of buy-in beyond her group (contacts 1, 4, 5, and 6), and people further removed who Jane cited as valuable sources of support and advice. The key to this network is understanding Sam's role in it. Sam was Jane's sponsor in the organization.[13] Jane's boss maintained a strong relation with his prior boss, Sam. On her boss's recommendation, Jane represented her group in a project under Sam's direction. Sam was impressed with Jane and took her under his wing, brokering introductions to other senior managers. Senior managers dealing with Jane felt that they were dealing indirectly with Sam, which greatly simplified Jane's work with them. Jane's situation is a familiar story of sponsorship. The point here is to illustrate the association between performance, sponsorship, and hierarchical networks.

Table 2 contains systematic evidence of the performance-hierarchy association illustrated in Fig. 7. The evidence presented in Fig. 3 and Table 1 was only for insiders. Evidence on other employees, the outsiders, is given in Table 2. For the moment, let me postpone to below the method used to distinguish insiders from outsiders ('Detecting People Deemed Outsiders'). The fourth panel in Table 2 is empty because there were no outsiders in the French study population (all but five managers in the 85 person study population were white, married, French men).

The second panel in Table 2 describes women and entry-rank men in the electronics manufacturer where Karen and Jane worked. Performance, measured by early promotion, is independent of network size and density, but has a strong positive association with network hierarchy (3.2 t-test). Prediction for the 50 senior women alone also yields no performance association with size or density (−1.4 and 1.6 t-tests), but a significant positive association with network hierarchy (2.6 t-test, see Burt, 1998, p. 26, for details).

Women were outsiders in the study population of investment officers. Bonus compensation has the predicted negative association with network constraint

Table 2.   Component Social Capital Effects for Outsiders

	Multile Correlation	Size	Density	Hierarchy
Performance Evaluation				
Job performance evaluations, staff function within financial company (0.20 correlation with constraint		0.02	0.22	0.39
across 49 senior men, 1.1 t-test	0.45	0.01	0.22	0.39
3A, − 3.8 t-test)		(0.0)	(1.6)	(2.9)
Promotions				
Early promotion, electronics manufacturer (0.22 correlation with		− 0.06	0.13	0.30
constraint across 114 women and	0.55	− 0.14	0.17	0.30
entry-rank men, 2.3 t-test)		(− 1.5)	(1.8)	(3.2)
Compensation				
Relative salary, chemical and drug manufacturer (no outsiders)	—	—	—	—
Relative bonus, investment officers within financial company (0.24		− 0.16	− 0.03	0.49
correlation with constraint across 39	0.55	0.06	− 0.24	0.16
senior women, 1.5 t-test)		(0.4)	(− 1.8)	(4.6)

Note: Pearson correlations are given in the first row of each panel, standardized regression coefficients in the second (with routine t-tests in parentheses).

for men (Fig. 3E), and the panel at the bottom of Table 1 showed that density and hierarchy are both significant components in the effect. Men who built dense networks of interconnected colleagues, or who built their network around a sponsor, received a smaller bonus than the average bonus to their peers. Women, in contrast, had to build around a sponsor. The statistically significant association in the panel at the bottom of Table 2 is the strong positive association between bonus and network hierarchy (4.6 t-test).

Men were outsiders in the staff-officer population. Most of the officers were women, for whom performance evaluations have the negative association with network constraint predicted by the hole argument (Fig. 3A), and the first panel in Table 1 showed that the primary component is poor evaluations of women in dense networks. Men, in contrast, have to build around a sponsor. The first panel in Table 2 shows that performance evaluations for the men are

independent of network size and density, but increase significantly with network hierarchy (2.9 t-test).

I interpret the results in Table 2 as evidence of social capital borrowed from a sponsor, a strategic partner, whose network spans structural holes. Beyond the value of having a sponsor, the results in Table 2 show that value depends on the kind of network a sponsor has. Hierarchical, not dense, networks are associated with performance. Think back to Robert and James in Fig. 2 and imagine that each were to sponsor a person newly hired into their group. James introduces the new hire to his contacts, who form the core of the new person's network. The result is a dense network around the new hire. When Robert introduces his new hire around, the result is a hierarchical network. The contacts, previously connected indirectly through their relations with Robert, are now also interconnected through the new hire. From the new hire's perspective, he is sharing his network with one other person also at the center of the network, Robert. More precisely, since the network was Robert's initially, the new hire is working within a network that he borrowed from Robert. Borrowed networks are not all hierarchical. A borrowed network could be either dense (James sponsors the new hire), or hierarchical (Robert sponsors the new hire). Hierarchy results from borrowing a network that spans structural holes (Robert sponsors the new hire; and the higher the hierarchy score, the broader the borrowed network because the hierarchy increases, as I have measured it, with the number of contacts reached through the central contact, see Fig. A1 in the Appendix). Karen and Jane in Fig. 7 illustrate a systematic pattern in their firm of women getting ahead by borrowing the social capital of an insider's network that spans structural holes.

Detecting People Deemed Outsiders
It is one thing to borrow social capital occasionally to succeed in a new venture. It is another to have to borrow social capital if any of your ventures are to succeed. If borrowing social capital is a strategy by which outsiders get access to the benefits of social capital, then a category of people for whom success depends on borrowing social capital is a category of people who have a legitimacy problem (as described with respect to number of peers). *The fact that women fall behind in Karen and Jane's company when they build their own social capital* (indicated by the positive association between performance and network constraint), *and move ahead when they borrow social capital* (indicated by the positive association between performance and network hierarchy independent of density), *implies that women have a legitimacy problem in the company.* There is a two-step rule to distinguishing employees

who are being treated as outsiders in a population (see Burt, 1998, pp. 28–30, for illustrative analysis):

First, Table 2 contains all categories of employees for whom network constraint has a positive association with performance (rather than the negative association predicted by the hole argument). Across the 615 observations in Table 1 on insiders within the five study populations, there is a strong negative association between network constraint and relative performance within each population measured by the z-scores in Fig. 3 (-0.31 correlation, -8.1 t-test). The association is strongly positive for the 226 observations in Table 2 on outsiders within the populations (0.23 correlation, 3.6 t-test).

Second, confirmation of outsider status comes from positive performance associations with network hierarchy in Table 2 independent of network density. In fact, a network rich in direct access to brokerage across structural holes, like Robert's in Fig. 2, is the worst choice for outsiders. Sort the observations from the five study populations into three broad categories of networks (see Fig. 8 below): entrepreneurial networks (C below average within a population, H below average), cliques (C above average, H below average), and hierarchical networks (H above average). For the 615 insiders, performance is significantly above average with entrepreneurial networks, low with cliques and hierarchical networks (mean Fig. 3 performance z-scores of 0.29, -0.17, and -0.22 respectively; 5.9 t-test for the higher performance associated with entrepreneurial networks). Across the 226 outsiders, performance is lowest with entrepreneurial networks, average with a clique, and significantly above average with a hierarchical network (mean performance z-scores of -0.23, -0.06, and 0.29; -2.3 t-test for the low performance associated with entrepreneurial networks). It is clumsy, rude, and ultimately unproductive for outsiders to try without a sponsor to broker connections between insiders.

Sponsor Legitimacy

Here are two bits of evidence that corroborate an interpretation of hierarchical networks as borrowed social capital:[14] The first is the source of borrowed social capital. Consider the familiar academic job market. Graduate students who have just completed the requirements for a Ph.D. enter the job market via the networks of their Ph.D. advisor. Murray, Rankin & Magill (1981) show that strong ties more than weak ties lead to better jobs. Legitimacy is an obvious issue here. The valuable strong ties are to sponsoring professors who loan to the student the professor's external network of colleagues. The student whose advisor is limited to strong ties within a clique of interconnected colleagues has less access to the market than the student whose advisor has a network of strong ties to colleagues in diverse institutions and areas (cf. Granovetter's,

1983, p. 211, interpretation of Murray et al.'s, 1981 results). Advisors cannot play the same role in the later promotion to tenure. One expects to see an individual's Ph.D. advisor sponsor the individual for tenure; indeed, the lack of sponsorship is a problem that has to be explained. Letters that make the case come from referees who can appear to be more neutral in evaluating the individual.

The same is true in business promotions in the sense that supervisors are expected to sponsor their subordinates. What the boss says reflects on his or her own work, and competent people usually say positive things about their subordinates. If legitimacy is the issue resolved with a hierarchical network for the women in Karen and Jane's company, then a network anchored on the boss will not resolve the issue as well as a network anchored on a more distant contact. Consistent with this argument, the boss was a poor sponsor: Early promotions were significantly more likely to go to women with hierarchical networks anchored on people outside their immediate work group (Burt, 1992, Chap. 4). Having a sponsor outside the work group adds a corroborating external voice to the boss's sponsorship (as illustrated by Karen in Fig. 7). Effective hierarchical networks were built around a contact sufficiently distant to speak with an authoritative voice of ostensible objectivity.

Illegitimate Men
Second, certain men in Karen and Jane's company rise by borrowing social capital and they have a more obvious legitimacy problem as senior managers. The men are new arrivals to the senior manager population. These entry-rank men are senior managers in the firm, but recent arrivals to senior management so they were outsiders when promoted into their current rank, with their legitimacy suspect as new members of senior management (akin to assistant professors just hired from graduate school). Early promotion to the entry-rank of senior management is associated with having a hierarchical network, indicating borrowed social capital (Burt, 1998, pp. 28–30). The hierarchy effect on early promotion for women, which could indicate a legitimacy problem, also occurs for a kind of man for whom legitimacy is more obviously a problem.

It is important, and probably therapeutic, to emphasize that the insider-outsider distinction is not a gender distinction. It is easy to confuse the two in studies of organizations because women are so often the outsiders (which makes them a substantively rich study population for social capital research). Among the investment officers, it was women who were the outsiders. In the electronics company, it was primarily women who were the outsiders. Seeing these results in my management classes, women often conclude that they

always need a sponsor, and men conclude that they never need a sponsor. Not so. You need a sponsor whenever you try to broker a connection into a group not likely to accept you as a legitimate member of the group. In the electronics company, entry-rank men faced a legitimacy issue along with their female colleagues. Among the predominantly female staff officers, it was the men who faced a legitimacy issue. More generally, we are each insiders, *mishpokhe*, in some settings, outsiders in others. The practical point is that individuals have to decide whether they are insider or outsider in a role, then select a network for the function it serves, rather than selecting a network for the kind of people who have selected it in the past (Burt, 1992, pp. 159–163, 1998, pp. 33–35, on optimum networks).

CONCLUSIONS

In conclusion, the network structure of social capital boils down to the three kinds of networks in Fig. 8. The natural evolution of networks left untended is toward a clique of people known to, and supporting, one another as friends of friends. *Clique networks* are small, dense, non-hierarchical networks associated with leisure activities, the lack of social capital, and poor manager performance. The most consistent empirical finding in this review has been that dense networks are associated with substandard performance. In Table 1, network size and hierarchy sometimes matter as predicted, but network density consistently has a strong negative association with performance as predicted by the hole argument. In Table 2, density has no statistically significant association with performance after network hierarchy, the predictor indicating borrowed access to structural holes, is held constant.

The information and control benefits of structural holes that constitute social capital lie in two directions away from a clique. One direction is to build social capital with a network that spans structural holes as at the top of Fig. 8 (and Robert in Fig. 2). In keeping with the image of a network entrepreneur in the hole argument, I have discussed such networks as *entrepreneurial networks*, though they could just as well be discussed simply as *broker networks*. At their best, these are large, sparse, non-hierarchical networks rich in opportunities to broker connections across structural holes. This is the network structure associated in research on diverse topics with more creativity and innovation, more positive job evaluations, early promotion, and higher earnings.

The alternative is to *borrow* social capital, which creates the hierarchical network in Fig. 8 (and Jane's network in Fig. 7). *Hierarchical networks* are large, sparse networks anchored on a central contact. This is the network structure associated with higher performance by outsiders, that is to say

managers not yet accepted as legitimate members of a population (e.g. women in many populations of senior managers, men who are too young to be taken seriously as members of the population, or men in an organization that is primarily women). Entrepreneurial networks were their worst choice. It is

Network Indices

N = 4
D = 0.0
H = 0.0
C = 25.0

**Entrepreneurial Network: Information & Control**
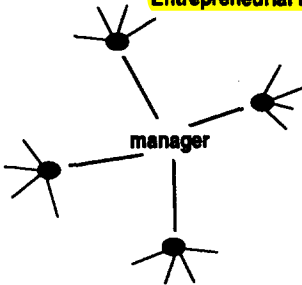
sparse, flat structure

independent relations sustained by manager
(e.g., Robert in Figure 2)

abundant structural holes, low redundancy,
creates information and control benefits

associated with successful managers

N = 4
D = 100.0
H = 0.0
C = 76.6

Clique Network: Security

dense, flat structure

interconnected relations
sustain one another for manager
(e.g., James in Figure 2, Karen in Figure 7)

no structural holes, high redundancy,
creates social support, but
minimal information and control benefits

associated with unsuccessful managers
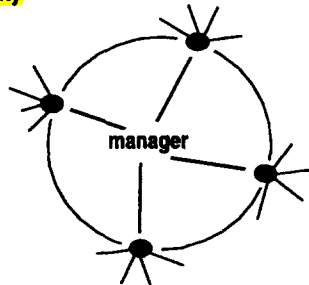
N = 4
D = 50.0
H = 16.8
C = 68.4

Hierarchical Network: Sponsored Access to Information & Control
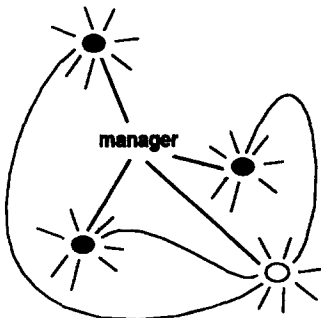
sparse, center-periphery structure

ties sustained jointly by manager and strategic partner
(e.g., Jane in Figure 7)

structural holes borrowed from strategic partner mean
second-hand information and control benefits

associated with successful outsiders
                    (and unsuccessful insiders)

Fig. 8. Three Network Forms of Social Capital.

clumsy, rude, and ultimately unproductive for outsiders to try without a sponsor to broker connections between insiders. Outsiders with entrepreneurial networks received significantly less positive job evaluations, later promotions, and lower compensation. Nevertheless, brokerage is the source of social capital for outsiders as it is for insiders. The difference is that outsiders do not have direct access. They have to borrow from an insider the network through which they broker connections. The central contact in a hierarchical network is, for the manager at the center of the network, positioned to be a sponsor such that a hierarchical network indicates social capital borrowed from the sponsor. The positive association between performance and network hierarchy is a reduced-form coefficient; the result of a strong tie to a sponsor and the entrepreneurial network of the sponsor. The two combine to define a hierarchical network around the manager, and it is access to the sponsor's entrepreneurial network that has the positive effect on performance. Sponsors who had a dense network did not enhance performance. In the end, outsiders are exceptions that prove the rule: social capital is a function of direct or indirect access to brokerage across structural holes.

Two contingency factors stand out in the review for their capacity to integrate ostensibly contradictory research results. One is the distinction between insiders and outsiders. As just described, evidence of social capital can be reversed for insiders and outsiders. The negative association between performance and network constraint for insiders can be positive for outsiders because of the constraint inherent in a hierarchical network. It is only when performance is regressed across the component variables in network constraint – size, density, and hierarchy – that the direct association with hierarchy, and so borrowed social capital, is apparent.

The second contingency factor that stands out is network closure and its correlates, numbers of peers and task uncertainty. The information and control benefits of brokerage is more valuable to people working on more unique tasks, which means tasks on which they have few peers, and so tasks in which there is uncertainty about how to best proceed. This is the point illustrated by the performance surfaces in Fig. 5 and Fig. 6. Performance increases more steeply from point B to A at the back of the graphs (few peers, high task uncertainty) than it does from point C to point D at the front of the graphs (many peers, low task uncertainty). More, the two leading network mechanisms argued to provide social capital, structural holes and network closure, are brought together in a productive way in Fig. 5. Available empirical evidence supports the hole argument over closure, but the performance surface in Fig. 5 shows how differences between study populations can result in research showing exclusive evidence of social capital from network closure or structural holes

without calling either argument into question. Although brokerage across structural holes is the source of added value, closure can be critical to realizing the value buried in the holes.

Having completed the review, I return to the summary conclusion with which I began: What struck me in preparing this review is the variety of research questions on which useful results are being obtained with the concept of social capital, and the degree to which more compelling results could be obtained and integrated across studies if attention were focused beneath the social capital metaphor on the specific network mechanisms responsible for social capital. We have only begun to see the advances possible with this powerful concept.

APPENDIX

The Appendix to this chapter, 'Implications for Research Design', contains four sections: One is about selecting a study population to get rich data on social capital and its effects (focus on places where competitive advantage would result from better access to, and control over, information). The second section is about network measures of social capital. The third is about positional measures (contacts are sorted into kinds, relations between contacts are typically unknown, and social capital is inferred from relations with kinds of contacts). The fourth is a caution about predicting change (social capital is more often a by-product than a goal). The review in this chapter should interest the broad audience of people interested in social capital, but the Appendix will only interest those few planning research on the topic so the Appendix is not included with this already-long chapter. Copies of the Appendix are available from my webpage (http://gsbwww.uchicago.edu/fac/ronald.burt/research).

NOTES

1. For two reasons, focusing on managers probably means more evidence of social capital. First, Carroll & Teo (1996) use survey network data on a probability sample of Americans to show that manager networks (relative to nonmanagers) involve more participation in voluntary associations, more core discussion contacts, a larger proportion of contacts who are colleagues or co-workers, and more contacts who are total strangers to one another. Second, managers have more work autonomy than nonmanagers (Kohn & Schooler, 1983), and social capital is more of an advantage for people who have more autonomy (Burt, 1997a). More evidence of social capital makes professionals and managers a productive research site for studying social capital, but warrants a caution against generalizing to other populations.

2. In fact, the nonlinear decline in value is probably nonmonotonic. There are disadvantages to being the first to propose an innovative product or idea. Subsequent entrants with the same product have an advantage because problems revealed by the first

entrant can be anticipated and eliminated. Whatever the value of bridging a structural hole for the first entrant, value is probably higher for the next few entrants, decreasing for subsequent entrants.

3. The social-capital prediction is only true, however, for teams coordinating poorly documented, personal knowledge across divisions. Where knowledge was unambiguous, teams reached completion more quickly if they didn't have to coordinate at all (in the sense that they were in a division that had infrequent and distant relations to other divisions, 'tie weakness' main effect, Hansen, 1999, p. 102).

4. The implication is that it would be productive to separate two levels of social capital. Distinguish the 'first-order' social capital of a person's personal network (see Barnes, 1969, on the first-order zone of a person's network), from the 'second-order' social capital of the organization, or contacts more generally, with which the person is affiliated (cf. Burt, 1992, pp. 38–44, on primary versus secondary structural holes; Podolny, 1993, on status-enhancing affiliations). The two levels are combined in Bielby & Bielby's (1999, pp. 74–79) analysis: A writer with a contact network that spans structural holes had a competitive advantage in securing and delivering on projects such that (a) his or her earnings would be correlated in adjacent years, and (b) he or she would be more attractive to the 'core' agencies. Therefore, core agencies had more social capital for the reasons given by Bielby & Bielby, and because they could attract writers with more social capital. The task for future research would be to separate the performance effects of an individual's (first-order) social capital from the (second-order) social capital of the organization(s) with which he or she is affiliated.

The task is more difficult than estimating social capital effects within organizations because performance has to be compared across organizations, and organizations differ in performance criteria. Consider professors at major and minor universities. The distinction can be difficult, but universities differ in quality such that a major-minor distinction can be drawn where a major university has more organizational social capital because of its central location in a great many extramural networks of high quality faculty and students (a 'core' university to use Bielby & Bielby's term). Given two professors of equal ability, one at a major, the other at a minor, university, the professor at the major university is more likely to be well compensated (major universities treat their faculty well to attract the most sought-after faculty) and be stimulated to produce important work (able people more often meet and exchange ideas at major universities). This is the performance effect of organizational social capital discussed in the text. However, minor universities can compete for able faculty by offering early promotion to tenure or other senior rank. This is the 'promotion paradox' that Phillips (2000) observes in lawyer promotions to partner (and Phillips & Sørensen, 1999, observe in promotions to manage television stations): The probability of promotion to senior rank is higher in young, small, low-status organizations.

5. Still, approximations can be made from the distribution of contacts across categories typically separate in social structure. This is the intuition behind Lin's (2001) positional measurement of social capital (see Appendix). Renzulli et al. (2000) is a recent illustration in entrepreneurship. They report on the discussion contacts of men and women in the Chapel Hill area of North Carolina who are thinking about starting a business. Renzulli et al. do not have data on relations between contacts, but they know the sector from which each contact was drawn (family, friends, business associates, etc.), so they compute a measure of the extent to which all of a person's contacts come from the same sector. Consistent with the hole argument, Renzulli et al. (2000, Table 4)

report that the people who actually do start a business were more likely to draw their contacts from multiple sectors.

6. Evaluations are adjusted for the four management job ranks defined by the firm because more senior officers are more likely to be evaluated as 'outstanding' (Burt, Jannotta & Mahoney, 1998, p. 84). In Fig. 3A, job rank is a predictor along with network constraint in the logit model. In the first panel of Table 1, the dependent variable is the residual of regressing at the population level the raw 1–2–3 job evaluation variable across job rank for all employees in the staff function (not just the 160 who returned a completed network questionnaire). Job rank describes 5% of the variance in the 1–2–3 evaluation variable. The regression models in Table 1 will be familiar to a wide audience. I get the same results with a logit model predicting from job rank and the network variables a binary variable distinguishing officers who received an 'outstanding' evaluation, or an ordered-logit model predicting the three evaluation categories.

7. See the preceding footnote.

8. The observations in fact fall along two parallel regression lines in the raw data. There is an upper line of teams in which evaluations decrease with increasing network constraint, and there is second line of lower evaluations which decreases with increasing network constraint. Teams on the lower line were significantly more likely to include a quality-control manager. The criterion variable on the vertical axis of Fig. 3B is the raw z-score evaluation adjusted for the presence of a quality-control manager (estimated by regressing raw z-score evaluations of all 67 teams across a dummy variable equal to 1 if a team included a quality-control manager). Rosenthal explains that teams encountering difficulty were assigned a quality-control manager. Difficulty must have resulted from many factors since teams assigned a quality-control manager could not be distinguished with plant variables, or function variables, or variables for the backgrounds of the people assigned to a team.

9. Luthans, Hodgetts & Rosenkrantz (1988) report the promotion-network connection for a sample of American managers in several firms, and Luthans, Welsh & Rosenkrantz (1993) report the connection for a sample of managers in a Russian textile factory. Manager success was measured by the ratio of a manager's rank to his or her years with the firm (which, presuming an internal labor market, measures the speed with which a manager has been promoted across ranks), and networks were measured with an observer's count of the frequency with which a manager was seen (Luthans et al., 1988, Chap.1; Luthans et al., 1993, p. 751): "interacting with outsiders and socializing/politicking during working hours." In both studies, managers were often observed performing the functions of planning, solving problems, monitoring performance, exchanging routine information and processing paperwork, but it was network activity that was most associated with the promotion measure. Figure 3C makes the same point with more precise measures of performance and network structure.

10. The multidimensional scalings are based on Kruskal's (1964) algorithm preserving monotonic distances between points, and the spatial displays are a good summary of the data (0.21 and 0.23 stress coefficients for the French and American maps respectively; 0.91 correlation between logs of the observed and predicted distances between elements in the French map, 0.90 for the American map).

11. Statistical tests show that only the slope of the surface is changing. Average promotion date and average intensity of network constraint are the same for managers with few or many peers. Early promotion and network constraint are equally varied for

managers with few or many peers. What is different across numbers of peers is the extent to which early promotion is correlated with network constraint – strong for managers with few peers, weak for managers with many peers.

12. I am grateful to James E. Schrager for calling my attention to these directories. Professor Schrager's knowledge of them comes from their importance in his work arranging partnerships between American and Japanese firms through his firm, Great Lakes Consulting Group.

13. Sponsor is my word, not Jane's. I telephoned Jane in 1993, four years after the original study, in the course of preparing the graphic in Fig. 7 for a course. I identified Jane and Karen from the sample data distribution because they nicely illustrated the hierarchy association with early promotion, but I wanted more information on Jane to bring her to life for the business students. I explained the nature of the call, and was graciously given a better understanding of Sam's role in her work at the time of the study.

14. There is a third, methodological, bit of corroborating evidence. Freeman's (1977) betweenness index measures the extent to which connections in a network all run through a central person. The measure is independent of network size. When computed for the three hierarchical networks in Fig. A1 in the Appendix, for example, the betweenness index is its maximum of 1.0 because all ties are through the central person. The Coleman-Theil index I use to measure hierarchy increases with network size as illustrated in Fig. A1 in the Appendix. In other words, the index measures the volume of social capital borrowed; hierarchy is lower for a person who borrows a small network rather than a large network. I re-estimated the association with early promotion in Table 2 using a betweenness index of hierarchy and obtained statistically significant, but substantially weaker, hierarchy effects (Burt, 1998, pp. 26–27). The stronger effect with a hierarchy measure that increases with network size corroborates the point that successful women are doing more than just borrowing a network, they are borrowing a network that contains many non-redundant contacts.

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