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Structural Holes versus Network Closure as Social Capital

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This chapter is about two network structures that have been argued to create social capital. The closure argument is that social capital is created by a network of strongly interconnected elements. The structural hole argument is that social capital is created by a network in which people can broker connections between otherwise disconnected segments. I draw from a comprehensive review elsewhere (Burt 2000) to support two points in this chapter: there is replicated empirical evidence on the social capital of structural holes, and the contradiction between network closure and structural holes can be resolved in a more general network model of social capital. Brokerage across structural holes is the source of value added, but closure can be critical to realizing the value buried in structural holes.

SOCIAL CAPITAL METAPHOR

The two arguments are grounded in the same social capital metaphor, so it is useful to begin with the metaphor as a frame of reference. Cast in diverse styles of argument (e.g., Coleman 1990; Bourdieu & Wacquant 1992; Burt 1992; Putnam 1993), social capital is a metaphor about 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 people enjoy higher incomes. Some more quickly become

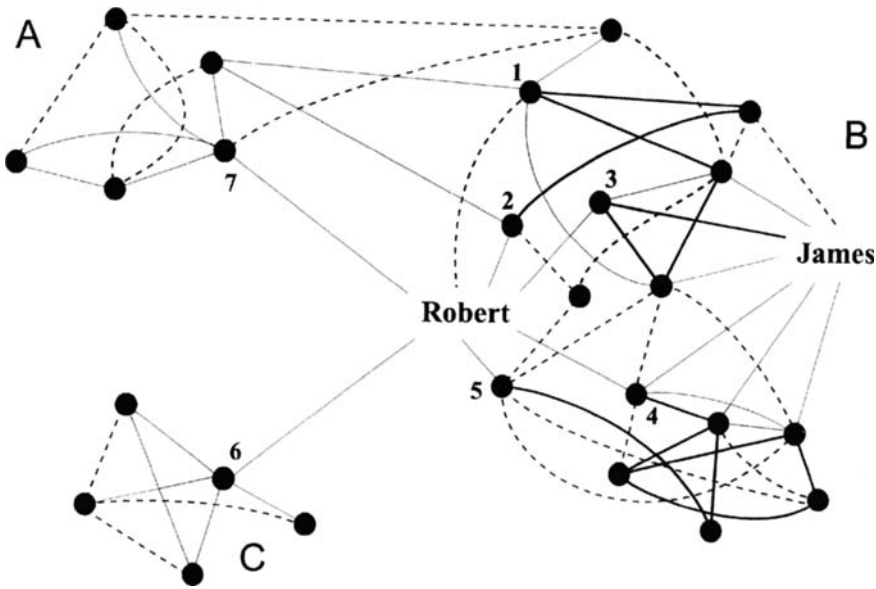
prominent. Some lead more important projects. The interests of some are better served than the interests of others. The human capital explanation of the inequality is that the people who do better are more able individuals; they are more intelligent, more attractive, more articulate, more skilled.

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 in defining social capital as the resources that result from social structure (Bourdieu & Wacquant 1992:119, expanded from Bourdieu 1980): "social capital is the sum of the resources, actual or virtual, that accrue to an individual or group by virtue of possessing a durable network of more or less institutionalized relationships of mutual acquaintance and recognition." Coleman, another often-cited source, defines social capital as a function of social structure producing advantage (Coleman 1990:302; from Coleman 1988:S98): "Social capital is defined by its function. It is not a single entity but a variety of different entities having two characteristics in common: They all consist of some aspect of a social structure, and they facilitate certain actions of individuals who are within the structure. Like other forms of capital, social capital is productive, making possible the achievement of certain ends that would not be attainable in its absence." Putnam (1993: 167) grounds his influential work in Coleman's metaphor, 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 1992:8,45).

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.

TWO NETWORK MECHANISMS

Disagreements begin when social capital as a metaphor is made concrete with network models of what it means to be "better" connected. Connec-



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)

Figure 1. Network around Robert and James.

tions are grounded in the history of a market. Certain people have met frequently. Certain people have sought one another out. Certain people have completed exchanges with one another. There is at any moment a network, as illustrated in Figure 1, in which individuals are variably connected to one another as a function of prior contact, exchange, and attendant emotions. Figure 1 is a generic sociogram and density table description of a network. People are dots. Relationships 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 Figure 1 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.

Selecting the best exchange, however, requires that I have information on available goods, sellers, buyers, and prices. 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 in sociology and social psychology 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 Figure 1 and the density table at the bottom of the figure show three groups (A,B,C), and the generic pattern of ingroup 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.

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 and 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 Figure 1 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 an-

other. 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 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 Figure 1 have the same volume of connections, six strong ties and one weak tie, but Robert has something more. James is tied to people within group B, and through them to friends of friends all within group B, so James is 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 person "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 versus 14.8) and Robert is the least constrained of the people in Figure 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 Figure 1, well above average (47.0 is a 4.0 Z-score), and much higher than James's 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 crossroads of social organization so he is early to learn about activities in the three groups. He corresponds to the "opin-

ion leaders" proposed in the early diffusion literature as the individuals responsible for the spread of new ideas and behaviors (Burt 1999a,b). Moreover, 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 a disproportionate say in whose interests are served when the contacts come together. Moreover, the holes between his contacts mean that he can broker communication while displaying different beliefs and identities to each contact ("robust action" in Padgett and 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"), a person who benefits from brokering the connection between others (see Burt 1992, 30–32, for review). Robert in Figure 1 is an entrepreneur in the literal sense of the word—a person who adds value by brokering the connection between others (Burt 1992, 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 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 the 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; Morselli 2000; or health insurance fraud: Tillman & Indergaard 1999). More in control of their surroundings, brokers like Robert in Figure 1 can tailor

solutions to the specific individuals being coordinated, replacing the boilerplate 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 Figure 1, it is Robert who has more social capital. His network across structural holes give him broad, early access to, and entrepreneurial control over, information.

Network Closure as Social Capital

Coleman's (1988, 1990) view of social capital focuses on the risks associated with being a broker. I will refer to Coleman's view as a closure argument. The key idea is that 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 the source of social capital.

Network closure does two things for people in the closed network. First, it affects access to information (Coleman 1990:310; cf. 1988: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:S103; 1990:306–7; 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 (1990:310–11; cf. 1988: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:S107–8) 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 (1990:318); "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, 1992:44) 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 Figure 1, it is James who has more social capital. Strong relations among his contacts 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.

NETWORK EVIDENCE

Figure 2 contains graphs describing five study populations of managers. I focus on these managers because on them I have detailed and comparable network data. Managers in four of the Figure 2 populations completed network questionnaires in which they were asked to name (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 relation with each contact, and the strength of relations between contacts (see Burt 1992:121–25, 1997b; Burt, Hogarth, & Michaud, 2000, for item wording and scaling).

The horizontal axis of each graph in Figure 2 is a network constraint index, C, that measures social capital. Network constraint measures the extent to which a network is directly or indirectly concentrated in a single contact. Constraint varies with three dimensions of a network: size, density, and hierarchy (see Burt 1992:50ff., 1995, 1998, 2000). Constraint is low in large networks of disconnected contacts. Constraint is high in a small network of contacts who are close to one another (density), or strongly tied to one central contact (hierarchy). The index begins with a measure of the extent to which manager i's network is directly or indirectly invested in his or her relationship with contact j: $c_{ij} = (p_{ij} + \Sigma_q p_{iq}p_{qj})^2$, for $q \neq i,j$, where p_{ij} is the proportion of i's relations invested in contact j. The total in parentheses is the proportion of i's relations that are directly or indirectly invested in connection with contact j. The sum of squared proportions, $_j c_{ij}$, is the network constraint index C. I multiply scores by 100.

As a frame of reference, network constraint is 27.9 on average across the 841 observations in Figure 2, with a 10.5 standard deviation. The network around Robert in Figure 1 is less constrained than average (C = 15). Robert would appear to the far left in each Figure 2 graph. The network around James is slightly more constrained than average (C = 31).

Association between performance and network constraint is a critical test for 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 argu-

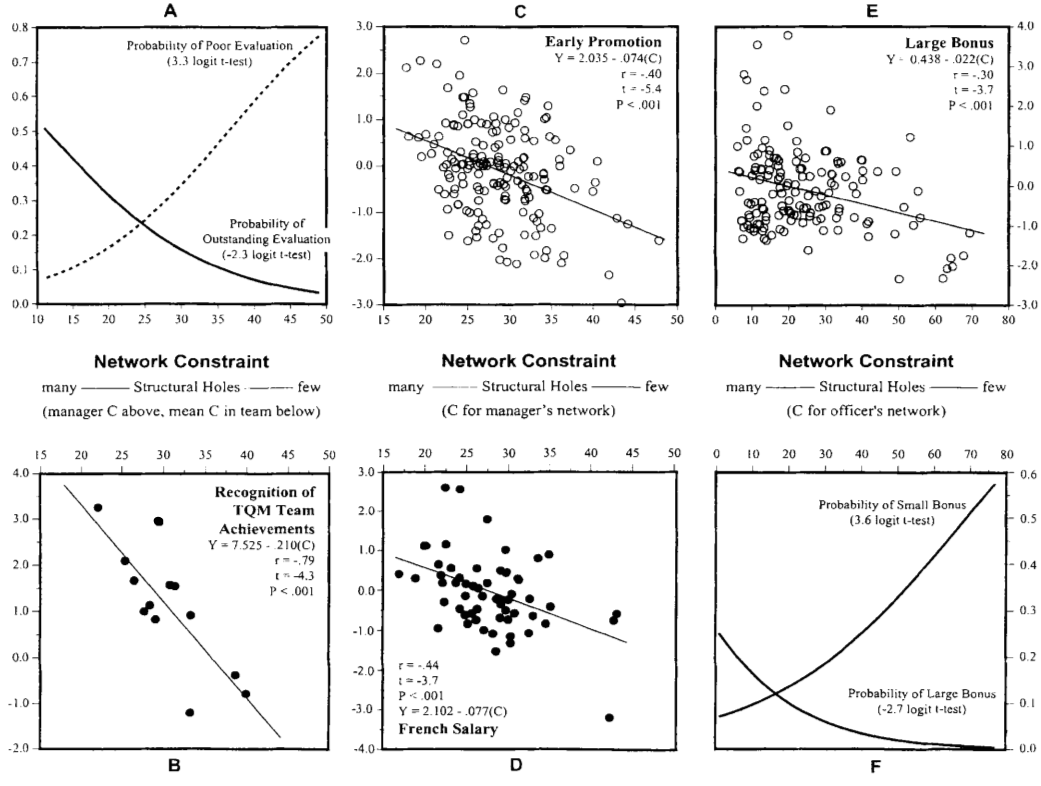


Figure 2. Social capital matters.

ment. *If network closure is the source of social capital, then performance should have a positive association with constraint.*

The vertical axes in Figure 2 measure performance (explained below for each study population). Each graph in Figure 2 shows a strong negative association, supporting the argument that structural holes are the source of social capital.

Performance Evaluations

Graphs A and B show a negative association between network constraint and performance evaluations. Figure 2A 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 Figure 2 are for the women (see Burt 2000:Table 2, for the men). Graph A in Figure 2 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 of evaluation with the middle category as a reference point. 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: 84). Officers with less constrained networks, like Robert, have a significantly higher probability of receiving an outstanding evaluation (-2.3 t-test). The stronger effect is the tendency for officers living in the closeted world of a constrained network to receive a "poor" evaluation (3.3 t-test).

Figure 2B is taken from Rosenthal's (1996) dissertation research on the social capital of teams. Troubled by the variable success of total quality management (TQM) and inspired by Ancona and 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 for TQM teams 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; the survey data were used to compute constraint in each person's network within and beyond the team.

The vertical axis in Figure 2B is the standardized team evaluation, and the horizontal axis is average constraint on people in the team. The association is as predicted by the hole argument, and quite striking (−.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.

Promotions

Figure 2C shows a negative association between promotion and network constraint. 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 1992:196–7). 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 among 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) − age. Expected age at promotion E(age), is the average age at which managers with specific personal backgrounds (education, race, gender, and senior-

ity) 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 1992:126–31; 1995). The criterion variable in Figure 2C is the early promotion variable standardized to zero mean and unit variance.

Figure 2C contains the 170 most senior men responding to the survey (see Burt 1998:14, for the senior women). The negative association between early promotion and constraint is statistically significant (−5.4 t-test). 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).

Compensation

Graphs D, E, and F show negative associations between compensation and network constraint. Figure 2D contains 60 people who were a representative sample of senior managers across functions in a division of a large French chemical and pharmaceuticals company in 1997 (Burt, Hogarth, & Michaud 2000). 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 percent 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 Figure 2D. 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 − 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). The negative association between relative salary and network constraint is statistically significant (−3.7 t-test). 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.

Figure 2E 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 Figure 2E. 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 − E(bonus). I standardized relative bonus across all officers in the study population to zero mean and unit variance (so a score of 1.5, for example, means that an officer's bonus is one and a half standard deviations higher than the bonus typically paid to people at his rank or her rank, age, and seniority). Figure 2E contains a random sample of 147 men analyzed for social capital (see Burt 2000:Table 2, for results on female bankers).

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 social capital theory, has implications for an officer's performance, which in turn should affect his bonus (see Eccles & Crane 1988, Chapter 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, and looked at evaluations by each contact to see how contacts evaluated one another. I then computed network constraint from the network around each officer.

What makes the study population analytically valuable is the time order between the network and performance data. Social capital theory 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 other Figure 2 study populations are cross-sectional and so offer no evidence of causation (see Burt 1992:173–80, for discussion). It is difficult to gather survey network data, wait for the relative success of managers to emerge over time, and 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 Figure 2E 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. The logit results in Figure 2F show that the association is even stronger than implied by the results in Figure 2E. There is a triangular pattern to the data in Figure 2E. 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 .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 Figure 2F 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 smaller than expected from rank and seniority). Network constraint this year significantly decreases the probability of a large bonus next year (−2.7 t-test), but the stronger effect is the increased probability of receiving a low bonus next year (3.6 t-test).

Other Evidence

Across the five study populations in Figure 2, social capital results from brokerage across structural holes, not from network closure. Elsewhere, I review research based on less detailed network data, but research on a broader diversity of substantive questions on a broader diversity of study populations (Burt 2000). The conclusion of the review is the same as here: closed networks—more specifically, networks of densely interconnected contacts—are systematically associated with substandard performance. For individuals and groups, networks that span structural holes are associated with creativity and innovation, positive evaluations, early promotion, high compensation and profits.

RETHINKING COLEMAN'S EVIDENCE

The most authoritative evidence in Coleman's argument for closure as a form of social capital comes from his studies of high-school students. He argues that closure explains why certain students are more likely to drop

out of high school. When the adults in a child's life are more connected with one another, the closure argument predicts trust, norms, and effective sanctions more likely among the adults, which means that the adults can more effectively enforce their interest in having the child complete his or her education.

Coleman (1988, 1990:590–97) offers three bits of evidence to show that children living within closed networks of adults are less likely to drop out of high school: First, children in families with two parents and few children are less likely to drop out of high school (two parents living together can collaborate more effectively in the supervision of a child than two parents living apart). Second, children who have lived in the same neighborhood all their lives are less likely to drop out of high school (parents, teachers, and other people in the neighborhood are more likely to know one another and collaborate in the supervision of a child than can parents new to the neighborhood). Third, children in Catholic and other religious private schools are less likely to drop out (parent, teachers, and parents of the child's friends at the private schools are more likely—relative to adults in the same roles in a public school—to know one another and collaborate in the supervision of a child).

Two questions: First, is "not dropping out of school" a productive performance criterion for estimating social capital effects? Performance variation around "drop out" is probably driven by factors different from those that determine variation at the other end of the performance continuum, the "stay-in-school-and-do-well" end of the continuum. For example, analyzing data on mathematics achievement from the National Education Longitudinal Study survey of 9,241 students in 898 high schools, Morgan and Sørensen (1999a,b:674) raise questions about the value of network closure: "In contrast to [Coleman's] basic hypotheses, our findings lead us to conclude that the benefits offered by the typical network configurations of horizon-expanding schools outweigh those of norm-enforcing schools." Like Coleman before them, Morgan and Sørensen have limited network data available for their analysis,[1] but their two network variables do measure closure of a kind, so the negative association between math scores and "parents know parents" raises questions for scholars committed to the closure argument.

Second, the accumulating evidence of brokerage as social capital invites speculation about the role that brokerage could be playing in Coleman's evidence. Grant that children are less likely to drop out of school if they have a constrained network in which friends, teachers, and parents are all strongly connected to one another so as to eliminate opportunities for the child to play contacts against one another. Constraint from parents and teachers has positive long-term consequences for children, forcing them to focus on their education. But is this social capital of the child or its parents?

The evidence reviewed in this chapter is about the social capital of the person at the center of the network. The social capital associated with higher performance by adults comes from a network of disconnected contacts. At some point on the way to adulthood, the child shaped by the environment takes responsibility for shaping the environment, and is rewarded in proportion to the value he or she adds to the environment. Constraint, positive for the child, is detrimental to adults, particularly adults charged with managerial tasks at the top of their firm. Moreover, the parental network around their child defines only part of the social-capital effect on educational achievement. The complete story is about effective adult supervision (closure argument) combined with parental ability to wrestle resources out of society to support the child (hole argument). Whatever the effect of closure providing adult control over the child, how much greater is the effect of a parent network that spans structural holes at work such that the parents bring home earlier promotions and higher compensation as illustrated in Figure 2?

A POINT OF INTEGRATION

There remains an important role for closure. It can be critical to realizing the value buried in structural holes.

External and Internal Constraint

Begin with the table in Figure 3. Rows distinguish groups in terms of their 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 a more routine group; a family, a team, a neighborhood, or some broader community such as an industry. Some groups are composed of individuals with many nonredundant contacts beyond the group—as illustrated by the three-person sociograms at the top of the table. People in each of the two groups have a total of six nonredundant contacts beyond the group. With respect to network measurement, nonredundant contacts mean a lack of external constraint on the group. The horizontal axis in Figure 2B, 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 nonredundant 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 Figure 2B, low-performance teams were composed of individuals with redundant contacts beyond the

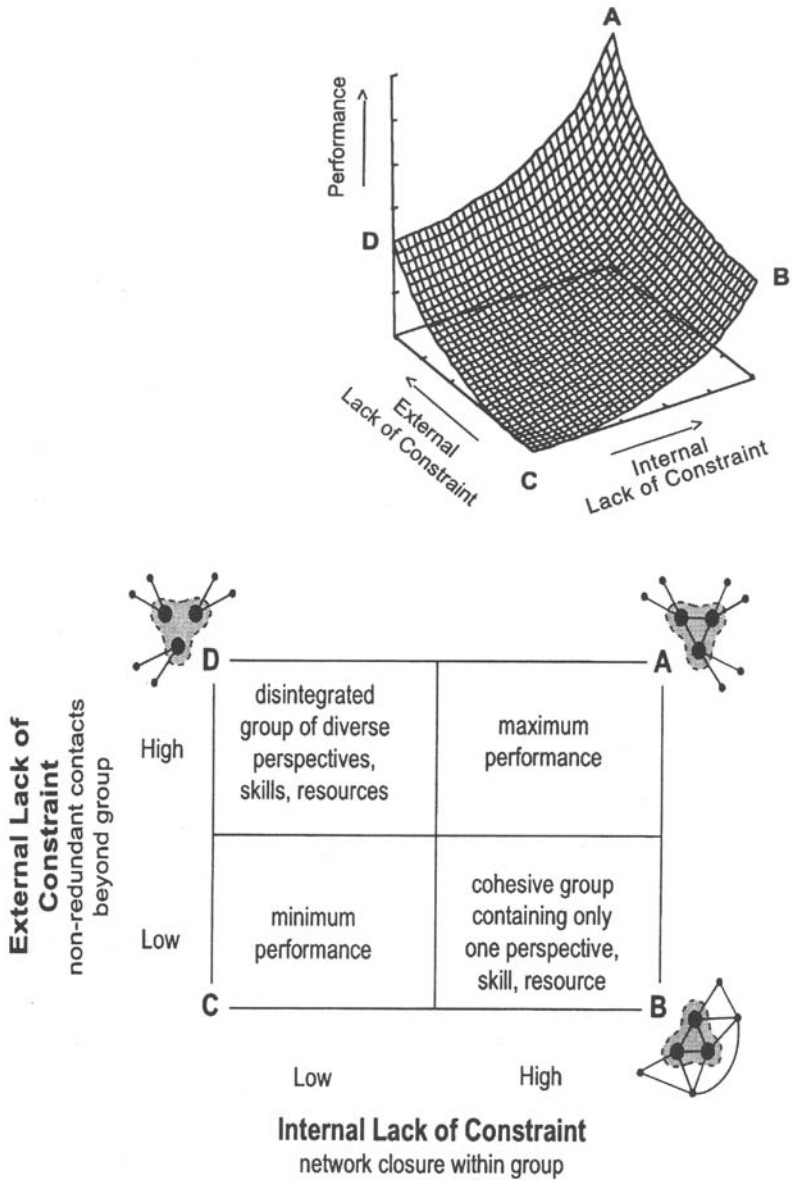


Figure 3. Social capital matters.

team. The sociogram at the bottom of Figure 3 is an illustration. The group's four contacts beyond the team are interconnected, and so are 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 Figure 2B by their poor performance with respect to TQM.

Columns distinguish groups in terms of network closure. Structural holes between people or organizations in a group weakens in-group communication and coordination, which weakens group ability to take advantage of brokerage beyond the group. Closure eliminates structural holes within the team, which improves communication and coordination within the team. The sociogram to the left of the table in Figure 3 shows a group with disconnected elements within it. 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 (Burt 2000). 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 Figure 3 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 Figure 3 correspond to the same points in the graph.

Performance is highest at the back of the graph (quadrant A), where in-group closure is high (one clear leader, or a dense network connecting people in the group) and there are many nonredundant 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 there are few nonredundant contacts beyond the group (members are limited to similar perspectives, skills, and resources).

Figure 3 is my inference from three bits of evidence, all of which are reviewed in detail elsewhere (Burt 2000:Figure 5). In fact, the Figure 3 interaction between brokerage and closure is the concept of structural autonomy from which the hole argument emerged (Burt 1980, 1982, 1992: 38–45).

The first evidential bit comes from research with census data describing the association between industry profit margins and market structure. Industry profit margins increase with closure among industry producers and

increase with the number of nonredundant suppliers and customer markets (Burt 1992, Chapter 3; 2000:Figure 6). Analogy with the market structure research is productive in two ways: 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 and Zuckerman's (1999) 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. 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 brokerage advantages of the team having access to more diverse information. Reagans and Zuckerman's finding is a segment somewhere between points A and C on the performance surface at the top of Figure 3.

A third bit of evidence for the integration comes from the contingent value of social capital to managers (Burt 1997a, 2000:Figure 6). Social capital is most valuable to managers who hold relatively unique jobs (such as CEO, divisional vice-president, or people managing ventures of a kind new to their organization). These are people who have the most to gain from the information and control benefits of social capital. The contingency argument is that numerous peers define a competitive frame of reference against which any one manager's performance can be calibrated, so managers doing similar work come to resemble one another in their efforts. Burt (1997a, 2000:Figure 6) shows a nonlinear decline in the value of social capital in proportion to the number of managers—peers—doing the same work. Assume that network closure among peers decreases with the number of peers; network 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 again more valuable to a group where there is network closure within the group—point A at the back of the graph in Figure 3. Along the axis from point C to D in the graph, low closure means poor communication and coordination within a group and such a group can be expected to perform poorly, benefiting from external networks only in the richest diversity of perspectives, skills, and resources.

Frame of Reference for Integrating Research Results

Figure 3 can be a useful 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 abundant for everyone (this is the Figure 3 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 Figure 2B 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 nonredundant contacts beyond the team had the advantage of access to a broader diversity of perspectives, skills, and resources. Several recent studies report high performance from groups with external networks that span structural holes (see Burt 2000 for review): Geletkanycz and 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, and Witteloostuijn (1998) on the survival of accounting firms as a function of strong partner ties to client sectors; Stuart and Podolny (1999) on the higher probability of innovation from semiconductor firms that establish alliances with firms outside their own technological area; McEvily and Zaheer (1999) on the greater access to competitive ideas enjoyed by small job manufacturers with more nonredundant sources of advice beyond the firm; Sørensen (1999) on the negative effect on firm growth of redundant networks beyond the firm; Hansen, Podolny, and Pfeffer (2000) on computer new-product teams completing their task more quickly when the team is composed of people with more nonredundant contacts beyond the team; Baum, Calabrese, and Silverman (2000) on the faster revenue growth and more patents granted to biotechnology companies that have multiple kinds of alliance partners at start-up; Koput and 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. With Figure 3 in mind, these studies tell me not that the closure argument is in error so much as 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 Figure 3 surface from point A to point B, illustrated in Figure 2B).

In short, structural holes and network closure can be brought together in a productive way. The integration 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 reviewed supports the hole argument over closure. However, my summary conclusion illustrated in Figure 3 is that while brokerage across structural holes is the source of added value, closure can be critical to realizing the value buried in the structural holes.

NOTE

1. For example, the "density of student friendship networks" to which they refer in their conclusion is not a network density measure; it is a count of a

student's closest friends named in an interview with the student's parent (0 to 5, "friends in school" variable in Morgan and Sørensen, 1999a:666–67). "Friends in school" is an indicator of intergenerational network closure, and, consistent with the closure argument, has a positive association with a student's gain in math scores to 12th grade (primarily for students averaged across schools: Morgan and Sørensen, 1999a:669, 1999b:698; Carbonaro 1999:684–85). The "density of parental networks" in Morgan and Sørensen's conclusion is also a count. It is the number of the named close friends for whom the interviewed parent claims to know one or both of the friend's parents ("parents know parents" variable). "Parents know parents" is another measure of intergenerational network closure, but in contradiction to the closure argument, has a negative association with a student's gain in math scores (again primarily for students averaged across schools, Morgan and Sørensen, 1999a:669, 1999b:698). Inferences are complicated by the fact that "friends in school" is of course strongly correlated (.58) with "parents know parents." More consequential, Morgan and Sørensen's network variables are enumerations by the parent, not the student. The student need not agree with the parent's selection of best friends, and the student's network can extend well beyond the view of his or her parents (recall that these are high school students; see Hirschi 1972 on the significance for delinquent behavior of a boy's friends unknown to his father).

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