THE SHADOW OF OTHER PEOPLE: SOCIALIZATION AND SOCIAL COMPARISON IN MARKETING

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Voluminous marketing data record the opinion and behavior of individual customers as they state intentions and make purchases. However, much of what determined the intentions and purchases remains unrecorded. In shadow lies the opinion and behavior of other people — friends, neighbors, colleagues, and others. Those other people are variably connected in the surrounding social network so as to affect what any one individual can do, what he or she feels obligated to do, and what he or she feels inclined to do. Something about the network around two people makes the opinion and behavior of one contagious for the other, an effect familiar in popular metaphors about word-of-mouth advertising, building the buzz, and viral marketing.

This chapter is an overview of the two network mechanisms — socialization and social comparison — that lie beneath the popular metaphors about contagion. I have two goals for the chapter: distinguish the two mechanisms by the network conditions in which they occur, and describe how the mechanisms combine in a predictable way as they generate contagion. Neither mechanism is the whole story at the same time that neither is completely wrong. Socialization turns out to describe the occasional, critical instance of opinion and behavior brokered between groups. Social comparison describes the more frequent instance of interpersonal influence within

groups and indifference beyond the group. The only course of action that is clearly wrong is to ignore either one of the two mechanisms — and that is a course too often taken. I begin with introductions to the network mechanisms and the early research in which they were conceptualized, followed by summary evidence on the way they combine in the actual diffusion of opinion and behavior, which connects back to the two-step flow of information discovered long ago in the influential stream of marketing research from Columbia University's Bureau for Applied Social Research, and connects forward to social capital applications of network theory in contemporary research on competitive advantage. Given the role of this chapter in this book, I put aside network analyses of buyer-seller relations (e.g., Frenzen and Davis, 1990; DiMaggio and Louch, 1998), to focus on the way networks create contagion among potential buyers. Further, to focus on the network mechanisms, I put aside significant differences between contagions such as the risk they pose (e.g., Van den Bulte and Lilien, 2001) or their complexity (e.g., Centola and Macy, 2007). Finally, I focus on contagion at the person-to-person level because that is where the social psychology of the network mechanisms is most intuitive. I hasten to note that such a focus comes at the cost of putting aside most studies of contagion between organizations, which are some of the most sophisticated empirical studies available (Strang and Soule, 1998, for review; also Davis et al. 2008).

SOCIALIZATION MECHANISM, CONNECTIVITY CRITERION

When available data are insufficient to decide on an appropriate judgment or course of action, we can turn to friends and colleagues to discuss the matter and come to a better sense of our own position. As we talk and exchange views, we socialize one another such that we eventually express similar opinions and act in similar ways. The network prediction is that people connected by a strong relationship are likely to share similar opinion and behavior.

How It Works

The connectivity criterion — also discussed as a "cohesion" or "structural cohesion" criterion — comes to contemporary network analysis from an influential series of marketing studies conducted in the 1940s and 1950s at Columbia University. Precedent for the studies came from Muzafer Sherif's (1935, 1936) experiment on social norms among college students at Columbia University.[2] The study was based on a psychophysics experiment using a stimulus selected for its ambiguity. Students were asked to judge the distance moved by a point of light projected from 15 feet away in a dark room. The point of light was stationary, but appeared to move because of random noise in human sight combined with the lack of visible reference points in the dark room (autokinetic effect, Sherif, 1936:91-92).

When students were alone and asked to evaluate the extent to which the point of light moved, evaluations converged toward a standard for each person; less than one inch for some students, over seven inches for others, with 3.3 inches the average across individuals (Sherif, 1936:102-103). As Sherif (1936:97) quotes from participants, the lack of a reference point made the evaluation difficult (e.g., "It was difficult to estimate the distance the light moved because of the lack of visible neighboring objects") so people relied on their prior evaluations as the best available frame of reference (I "compared with previous distance"), which resulted in different individuals converging on different standards.

When Sherif's students made evaluations in groups of three, group standards emerged. Individual evaluations quickly converged to a group standard consistent across the individuals in the group, and the group standard persisted when the subjects returned later to repeat the experiment alone. Zucker (1977) took up the persistence result to show that the arbitrary group standard could be expected to persist for a dramatically longer period of time if evaluations were embedded in a

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[2] Sherif (1936:69-70) cites precedent experiments by Allport (1924:260-285) in which groups had what he termed a "leveling" effect, truncating the distribution of personal opinion and behavior to less extreme evaluations (which reflects a "basic human tendency to temper one's opinions and conduct by deference to the opinion and conduct of others," Allport, 1924:278). For the purposes of this chapter, Sherif's experiment seems to me the key precedent for the influential research from MIT and Columbia University during the 1950s that became the foundation for contemporary network theory on the effects of socialization. See Turner (1990) on Sherif's links to sociology more broadly.

simple organizational routine (from persistence across seven sessions in Sherif's design to persistence beyond 38 sessions if the group standard is embedded in a simple organizational routine, Zucker, 1977:735).

Outside the lab, sources of contagious opinion and behavior were measured with sociometric choice data. Survey respondents were asked to name their friends or the people with whom they discuss things, then asked about the opinions or behavior of the cited people. A body of research emerged in which people connected by a sociometric link were reported to have similar opinions and behaviors. To name a few of the more influential studies (see Rogers, 2003, for broad review), connected people have similar presidential preferences (Lazarsfeld, Berelson and Gaudet, 1944; Berelson, Lazarsfeld and McPhee, 1954), similar student opinion and activity (Festinger, Schachter and Back, 1950), similar consumer preferences (Katz and Lazarsfeld, 1955), and similar professional practices (Coleman, Katz and Menzel, 1957).

Following the precedent of Sherif's study, the survey research focused on ambiguous stimuli, stimuli that had no obvious empirical referent, because ambiguous stimuli were likely to reveal social forces at work. Festinger, Schachter and Back (1950:168-169) gave a working definition often cited in subsequent work:

> If a person driving a car down a street is told by his companion that the street ends in a dead end, this piece of information may be easily checked against physical "reality." He has only to drive on and soon he will find out whether or not the street really does end in this manner. . . . The situation with regard to social opinions and attitudes is quite different, however. There is no such "physical reality" against which to check. If one person offers the opinion to another that if the democratic candidate for president is elected economic ruin may be expected, the second person may agree or not but he cannot definitely check this opinion against "reality." . . . The "reality" which settles the question in the case of social attitudes and opinions is the degree to which others with whom one is in communication are believed to share these same attitudes and opinions.

In subsequent work, Schachter (1959:126) noted that our wide variation in emotions is generated by a narrow range of physiological states occurring in a wide variety of

social situations. Emotion is physiology matched to a situation. There can be ambiguity in identifying the emotion appropriate to a situation. I feel anxious. Is it excitement about the task at hand? Am I afraid? Angry? How should I interpret this feeling? The answer lies in connecting with people who are going through the same experience, which leads to Schachter's results showing that people afraid of an event are drawn to affiliate with people facing the same event (also see Schachter and Singer, 1962). Schachter (1959:129) concludes: ". . . the emotions or feelings, like the opinions and abilities, require social evaluation when the emotion-producing situation is ambiguous or uninterpretable in terms of past experience." Toward the end of the era, Coleman, Katz and Menzel (1966:118-119) offer a similar description of doctors influencing one another's decision to begin prescribing a new antibiotic: "Confronted with the need to make a decision in an ambiguous situation — a situation that does not speak for itself — people turn to each other for cues as to the structure of the situation. When a new drug appears, doctors who are in close interaction with their colleagues will similarly interpret for one another the new stimulus that has presented itself, and will arrive at some shared way of looking at it."

Empirical Evidence

It will be useful to have a simple, concrete example. Figure 1 is a sociogram of a hypothetical organization. Lines indicate close relations. Contagion in this context refers to the spread of opinion and practice between employees. Examples would be getting employees to adopt a new practice in human resources, getting employees to be more frugal with business travel costs, or getting employees to implement an efficiency program such as SixSigma.

——— Figure 1 About Here ———

To predict ego's opinion or behavior under a connectivity criterion, look at the people with whom ego has close relations — the lines in Figure 1. Given variable Y measuring individual responses to an idea or practice spreading through a population, the connectivity criterion says that ego's response can be predicted from the weighted average of responses by ego's discussion partners:

$$y_i^* = \Sigma_j\, w_{ij}\, y_j, \quad i \neq j$$

where y_j measures discussion-partner j's response, y_i^* is the average response by ego's discussion partners, ego i's response y_i is excluded from the average, and network weight w_{ij} is a fraction increasing with the extent to which ego's connection with j is stronger than ego's connection with other people ($\Sigma_j\, w_{ij} = 1$). Alternative definitions of the network weight w_{ij} can be compared for the extent to which ego and her peers make similar evaluations. The more accurate the definition of w_{ij}, the more similar y_i should be to y_i^*.

In much of the above-cited survey research, for example, network weight w_{ij} is set to 1/N for each contact that ego cites as a close discussion partner, and N is the number of people that ego cited, whereupon y_i^* is the average response of ego's discussion partners. With respect to the network displayed in Figure 1, the lines indicate close relationships, socializing discussion occurs in close relations, so similar opinion and behavior is predicted between connected people. The salesmen only discuss their work with the head of sales, so w_{ij} would equal 1.0 for each salesman i's relationship with the head of sales j and zero for everyone else in the network. The marketing staff discuss their work with one another and the head of marketing, so w_{ij} would equal .25 from individual contributor i to each of their four colleagues j in marketing. Across the network, there would be a typical response to a new company policy from the production employees, which could be different from the typical response by employees in the marketing department.

——— Figure 2 About Here ———

Figure 2 contains illustrative evidence. Heinz, Laumann, Nelson, and Salisbury (1993) describe the social system of elite lobbyists active in U.S. Government policy in agriculture, energy, health and labor during the early 1980s. Ronald Reagan had been elected U.S. President. Conservative ideals had popular support. Among the elite lobbyists were a few that Heinz et al. (1993: Chap. 10) describe as notables because of their special prominence as representatives. The 63 notables are the study population here (see Burt, 2009: Figure G3, for more detail on the lobbyist network and evidence of interpersonal influence). The vertical axis in Figure 2 measures lobbyist opinion on national policy. Each lobbyist was asked to express on

a scale from 1 to 5 his or her agreement with eight opinion items concerning government policy. The vertical axis in Figure 2 is the factor-score average of the eight items that Heinz et al. (1993) discuss as lobbyist economic ideology, which ranges from extremely conservative (high score) to welfare-state liberalism (low score). Network data were obtained by asking each lobbyist to look over a roster of other lobbyists and indicate which were close contacts: "Please place a check by the names of people you know well enough to be confident that they would take the trouble to assist you briefly (and without a fee) if you requested it." The horizontal axis of the graph to the left in Figure 2 is the average opinion of a lobbyist's contacts (y_i* in the above equation with w_{ij} equal to one over the number of contacts j cited by lobbyist i). There is strong correlation between a lobbyist's expressed opinion and the average opinion of his close contacts (r = .66). With cross-sectional data as in Figure 2, it is impossible to know whether close relations developed between lobbyists with similar opinion, or similar opinion emerged from discussion between closely connected lobbyists, but there is clearly a correlation between similar opinion and close relations — which is the connectivity criterion for contagion.[3]

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[3]The correlations in Figure 2 are robust to routine controls for individual differences between the lobbyists that would be expected to predict their economic ideology (Burt, 2009:Figure G3), but estimating the correlations between ego's response y_i and the average response of others, y_i*, is a non-trivial statistical exercise. Ego's response is both dependent variable (when ego is the object of contagion) and predictor (when ego is the source of contagion). There is also an endogeneity issue difficult to solve even with good panel data. Did the connection captured by network weight w_{ij} cause, or result from, similar responses by ego and her discussion partners? The first issue is network autocorrelation (e.g., Ord, 1975; Marsden and Friedkin, 1993; Strang and Soule, 1998; Leenders, 2002). The second issue is network endogeneity (Mouw, 2006), nicely discussed by Mansky (1993) as a reflection problem (Did you move your reflection in the mirror or did it move you?). I ignore both issues here for two reasons. First, the issues are well discussed in the above works. Second, no statistical sophistication can correct for a mis-specified model, and my point in this chapter is that the two network mechanisms — socialization and social comparison — combine in a specific way that is not captured by models based on either mechanism alone.

EQUIVALENCE CRITERION,
SOCIAL COMPARISON MECHANISM

Connectivity is one of the two network criteria by which individuals are combined into socially similar kinds of people. The other is equivalence. Two people are equivalent when they have identical patterns of relationships. Equivalent people do not have to have a relationship with one another, though they often do. The equivalence criterion emerged in the 1970s as contemporary network analysis evolved from sociometry, so it was not a consideration in the research just discussed. The connectivity and equivalence criteria are network instances of an ancient distinction: classifications based on similarity within a category versus similarity beyond the category. Is a bug to be classified into a category because the bug looks like other bugs in the category or because it has similar relations with related categories of predators, hosts, and competitors? Should this variable be considered an indicator of concept A because it is correlated with other indicators of the concept (factor analysis, internal consistency), or because it resembles other indicators of A in its correlations with key concepts related to concept A (canonical correlation, construct validity)? With respect to network analysis, the long-standing distinction became explicit with the emergence of structural equivalence in the 1970s, first in Lorrain and White's (1971) theoretical treatment, then in White, Boorman and Brieger's (1976) operational treatment. In fact, research on interpersonal influence between equivalent people was already well established in social psychology, but socialization fit more easily into the sociometric concepts popular after WWII, so the early researchers assumed that socialization was responsible for the network effects observed in the spread of opinion and behavior. Before turning to that fact, let me quickly illustrate overlap and contradiction between the two network criteria for interpersonal influence.

Distinguishing the Equivalence Criterion

The equivalence criterion is illustrated in Figure 3. Structural and role equivalence are illustrated. Two people are structurally equivalent when they have identical relations with the same people. Two people are role equivalent when they have identical relations with the same kinds of people. The two spatial maps in Figure 3

are multidimensional scalings of distances measuring the extent to which the people in Figure 1 are structurally equivalent (map to the left in Figure 3) or role equivalent (map to the right).[4] People are close together to the extent that they are equivalent.

Equivalence and Connectivity Often Make the Same Predictions

When equivalent people have strong relations with each other, equivalence predicts contagion exactly where it is predicted by connectivity. In Figure 1, the three individual contributors in production are connected with one another. In Figure 3, they are right on top of one another as equivalent people. You can see their structural equivalence in the Figure 1 matrix of connections. Look down the rows of columns 8, 9, and 10, which are the columns of relations to the three production staff. Entries are identical across the columns. Persons 8, 9, and 10 are all connected to their supervisor and all connected to one another. The three are all disconnected from everyone else in the organization. Similarly, rows 8, 9, and 10 of the matrix are identical. In sum, persons 8, 9, and 10 are structurally equivalent because they have identical relations to (rows) and from (columns) everyone in the network. Relations are symmetric in Figure 1, so identical rows mean identical columns, but relations are often asymmetric in actual networks (the people that Bob names as close friends need not all name Bob as one of their close friends). Returning to Figures 1 and 3, both connectivity and equivalence predict that persons 8, 9, and 10 are contagious

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[4]The spatial maps in Figure 3 are multidimensional scalings of equivalence distances between the 13 people in Figure 1. Distances in the two-dimensional maps are a good description of raw distances (Kruskal's stress coefficient is near-zero for both maps, .06 for structural equivalence, .01 for role equivalence; Kruskal and Wish, 1978). To compute structural equivalence distances for the spatial map to the left in Figure 3, I traced indirect connections from the direct connections in Figure 1 and used a simple fixed decay weighting to measure the relation z_{jk} from person i to person k (direct connections equal 1.0, two-step connections are .5, three-step connections are .5 squared, four-step connections are .5 cubed, and so on). Structural equivalence between i and j is measured by a distance, call it d_{ij}, which increases as other persons k have different relations with i and j, for example: $d_{ij}^2 = \Sigma_k \, (z_{ik}-z_{jk})^2 + \Sigma_k \, (z_{ki}-z_{kj})^2$, $i \neq k \neq j$. Distance d_{ij} is zero when i and j have identical relations with everyone else in the organization. For details on measuring structural equivalence, see a general introduction to network analysis, such as Wasserman and Faust (1994: Chap. 9), the "gently readable" Scott (2000), or the online text by Hanneman and Riddle (2005: Chaps. 12-13). To compute role equivalence distances for the spatial map to the right in Figure 3, I used the direct connections displayed in Figure 1 and computed Euclidean distances between the triad census describing each person's role in the network. The distance measure was proposed originally by Hummel and Sodeur (1987) in a book only available in German (see Burt, 1990; 2009:Figures 8.10 and G8, for details, literature, and illustration in English).

for one another so they are expected to express similar opinion and display similar behavior. The story just told about the three individual contributors in production also describes the three individual contributors in marketing.

—— Figure 3 About Here ——

The lobbyist network of close contacts discussed with respect to Figure 2 is composed of distinct, cohesive groups that correspond to policy domains (see Burt, 2009:Figure G3, for a sociogram). Lobbyists in each group are similarly close to one another and similarly less close to lobbyists in most other groups. In such a network, equivalence and connectivity make similar predictions. The point is illustrated by the second graph in Figure 2. The vertical axis is a lobbyist's opinion on national economic policy and the horizontal is the average opinion of the lobbyist's structurally equivalent peers.[5] The correlation is strong (r = .73); about the same as the correlation with the average opinion of a lobbyist's close contacts (r = .66). Not surprisingly, the average opinion of close contacts is strongly correlated with the average opinion of structurally equivalent peers (r = .89).

Contradictory Predictions

Network structure among the notable lobbyists was relatively simple. Table 1 shows contagion correlations for more complex networks in which the equivalence criterion contradicts connectivity — and better predicts contagion. The first row of the table refers to the lobbyists in Figure 2.

The second row refers to managers in Galaskiewicz's (1985) study of corporate philanthropy in Minneapolis and St. Paul (with a follow-up survey described in Galaskiewicz, 1997). Galaskiewicz interviewed the manager in charge of his or her company's contribution to local non-profit organizations. The manager was asked to indicate where he or she was personally acquainted with the other managers and was asked for his or her evaluation of local non-profit organizations as potential

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[5]Fractional network weights w_{ij} defining the average opinion y_i^* of lobbyists structurally equivalent to person i were computed from the structural equivalence distances defined in the preceding footnote. People with especially low distance from person i are given especially high weight as a potential source of influence on person i's opinion and behavior (see Burt, 1982:181-184; 2009:Figure 8.8, for details and illustration).

recipients for corporate philanthropy. Relative to the lobbyists, the managers were less likely to reciprocate their citations to contacts (55% versus 69%) and were more often connected indirectly through more than a single intermediary (51% versus 33%). The contagion question was whether managers expressed evaluations similar to their close contacts versus their structurally equivalent peers (see Burt and Galaskiewicz, 1991; Burt, 2009:Figure G2, for details). Table 1 shows that evaluations were more similar between structurally equivalent peers and that the equivalence and connectivity predictors are much less similar among the managers than they were among the lobbyists (correlation of .34 versus .89 for the lobbyists).

—— Table 1 About Here ——

The third row of Table 1 refers to doctors in the classic diffusion study, Medical Innovation, by Coleman, Katz, and Menzel (1957, 1966). Doctors in four Illinois communities were asked to name the doctors with whom they discussed cases and to whom they turned for advice. Prescription records were searched to determine the date at which each doctor had begun prescribing a new antibiotic. The contagion question was whether doctors began prescribing the new drug about the same time as the people with whom they discussed cases or about the same time as their structurally equivalent peers in the community. The study was the first to combine mathematical models with extensive network data and a behavioral measure of adoption. The study is often cited for its evidence of discussion partners beginning to prescribe the new drug at about the same time. Table 1 shows that equivalence better predicts where contagion occurred between the doctors and that connectivity has no predictive value at all. The data are ancient history in terms of contemporary medicine, but the analysis is an exemplar for academic research and practitioners (e.g., Sawai, 1994), and has continuing policy relevance (e.g., Carrin, 1987).[6]

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[6] Summary discussion of the evidence is provided elsewhere (Burt, 2009:Figure G4). Evidence of contagion can be detected among the doctors, but it is fragile given the complex advice and discussion networks (Table 1) and aggressive marketing for a drug whose adoption posed few risks (Van den Bulte and Lilien, 2001:1412-1417). For Coleman, Katz, and Menzel (1966:114-130), doctors central in the discussion network were early adopters and socialized others, but it seems more likely that contagion was between structurally equivalent doctors regardless of direct contact (for more detail on the original Coleman, Katz, and Menzel evidence, see Burt, 1987:1304-1306, 1313n). Either way, adoption was more determined by personal background than colleague behavior. The new drug

Although the communities of lobbyists, managers, and doctors were about the same size (respectively 63, 61, and an average of 66 for the doctors), they were very different social environments. In particular, the manager and doctor networks are in two ways different from the lobbyist network.

They are first of all more complex, which is associated with weaker evidence of contagion. The more complex the network, the less clear the social pressure on opinion and behavior (Burt and Janicik, 1996; Burt, 2009:Figure G7). Complexity increases, and contagion decreases, down the rows in Table 1. The lobbyists were connected by close, symmetric relations and show the strongest evidence of contagion. The doctors were connected by long chains of asymmetric relations and show the weakest evidence of contagion. The doctors often cited discussion partners and advisors who did not reciprocate the citation (24% reciprocated, versus 55% and 69% among the managers and lobbyists respectively) and connections with other doctors in the same community tended to be long and indirect (85% longer than friend of friend, versus 51% and 33% respectively among the managers and lobbyists). The manager network is between the extremes of the doctor and lobbyist networks.

Second, the manager and doctor networks differ from the lobbyist network in that equivalence more often contradicts the contagion predicted by connectivity. A

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spread without the slow-start period typical of early innovation (Burt, 1987:1304-1306), and less variance in adoption dates was predicted by contagion than by characteristics of a doctor's background and practice (respectively, 14% versus 26%, Burt, 2009:Figure G4). Marsden and Podolny (1990) report no event-history evidence of contagion when they impute missing adoption dates from a doctor's personal background (see their appendix, pp. 210-211). The cross-sectional evidence of contagion in Burt (1987) also disappears if missing adoption dates are imputed from a doctor's personal background. Strang and Tuma (1993:633-634) report event-history evidence of contagion by equivalence (multiplying or adding to personal background) and connectivity (additive only), but in both cases, doctor background strongly predicts adoption date. In fact, just holding constant monthly advertising on the new drug in three leading magazines can fully account for the evidence of contagion (Van den Bulte and Lilien, 2001:1426), though there is an endogeneity issue in whether advertising caused or anticipated the generic diffusion curve for the spread of the new antibiotic. Contagion was correlated with aggressive advertising by the first firm into the market (Lederle, no correlation with advertising by other drug companies), and that advertising followed a generic bandwagon curve, increasing during the bandwagon phase, then slowing as diffusion reached saturation (no reason to increase advertising after the bandwagon has passed). Regardless, the above analyses are similar in predicting contagion as a continuous function of equivalence or connectivity. The evidence of contagion conditional on weak equivalence highlighted below in Figure 6 and Figure 7 would not be detected in any of the analyses.

particularly important contradiction occurs when equivalence predicts contagion between people who do not talk to each other. The three salesmen in Figure 1 illustrate the contradiction. The salesmen are structurally equivalent in Figure 3, but disconnected from each other in Figure 1. By structural equivalence, contagion is expected between the salesmen. By connectivity, contagion is expected between each salesman (persons 11, 12, and 13) and the head of sales (person 4). There are several instances of groups like the salesmen among the managers and doctors (Burt, 2009: Figures G3 and G5). These instances involve equivalence contradicting connectivity, but the contagion correlations in Table 1 show that equivalence is the better predictor. Contagion exists between equivalent managers and doctors even in the absence of direct communication.

One could argue that equivalence and connectivity make the same predictions, but connectivity is indirect. Here is the argument: Since all three salesmen are predicted by connectivity to be influenced by their discussions with the head of sales, they should end up expressing similar opinion and behavior — which is the prediction by equivalence. Here is the fly in the ointment: If the similarity between the salesmen results from their similar discussions with the head of sales, then their opinion and behavior similarity to the head of sales should be stronger than their similarity to one another. Their similarity to the head of sales is the direct result of socializing discussion while their similarity with one another is an indirect result of that discussion. In fact, as shown below, similarity between equivalent people exists regardless of direct, indirect, or no connection between the people. Equivalence itself triggers contagion.

Role equivalence makes more obvious the contradiction to connectivity. Structural equivalence is the usual criterion used in contagion studies, but I mention role equivalence because it is an intuitive concept, is easily measured, and it makes more obvious the contradiction between equivalence and connectivity as contagion predictors. Role equivalence is an abstract form of structural equivalence. Two people are role equivalent when they have identical relations with the same kinds of people; not the same individuals, but the same kinds, where kinds are distinguished by network structure. For example, two fathers are role equivalent in having children,

but they are not structurally equivalent because they are not father to the same children. The presidents of two universities cannot be structurally equivalent because they manage different groups, but they can be role equivalent if they manage the same kinds of groups. Returning to the concrete example in Figure 1, the individual contributors in marketing and production are role equivalent across the two functions while structural equivalence occurs only within each function. The spatial map to the left in Figure 3 shows marketing separate from production. The map to the right shows marketing right on top of production. The marketing and production people are role equivalent because they are similar in having relations with people who are strongly connected. Pick any one of the three individual contributors in marketing — persons 5, 6, or 7. Each of their contacts is connected with every other of their contacts. Each of the three marketing people works in a closed network. The same is true in production. Thus, the marketing and production staff are role equivalent across functions in that their surrounding network is completely closed. In contrast, the salesmen — persons 11, 12, and 13 — are not role equivalent to the marketing and production staff. The network of indirect relations through the head of sales that defines a salesman's role in the organization is different from the closed-network direct-contact pattern that defines the role played by staff in marketing and production.

The three local leaders illustrate role equivalence more sharply. In the Figure 1 sociogram and the structural equivalence map to the left in Figure 3, the head of sales is close to the salesmen who report to him, the head of marketing is close to her marketing staff, the head of production is close to his production staff. Role equivalence presents a different picture of the organization. In the role equivalence distances mapped to the right in Figure 3, all three leaders are clustered together in the lower-right of the map, with the heads of marketing and production right on top of one another. That is because the heads of marketing and production play identical roles in their networks: they both manage a group of completely interconnected staff and both have direct contact with the more central person 1. The head of sales also manages a group of three people and has direct contact with the central person, but the three people he manages do not talk with each other, so they are a kind of group

different from the closed networks in marketing and production. Therefore, the head of sales is not role equivalent to the heads of marketing and production in Figure 3.

How it Works: Social Comparison and Relative Deprivation

Socialization cannot explain why equivalent people influence one another in the absence of direct communication. Socialization predicts contagion when people talk to one another so as to shape one another's opinions and behavior. In the absence of direct communication, social comparison makes more sense as the mechanism by which contagion occurs because it is not limited to people who talk to one another.

When confused about an appropriate judgment or course of action, we look around to see what people "like me" are doing. Comparison to people like me provides a benchmark for my own opinion and behavior. Ego needs to be aware of her peers to imagine herself in their position, but no direct communication is necessary. Peer pressure could be stronger with contact and discussion, but neither is required. I do not need to talk to my peers to feel that I am ahead of them or falling behind. I do not need to talk to my peers to feel that I am fortunate to have my higher compensation, or exploited for the relative pittance I receive. Inconsistency draws attention. If I hear, or see, or become aware of someone "like me" making an evaluation that contradicts my own evaluation, I am puzzled. Perhaps my peer has information I do not have, or vice versa. Perhaps the light is different from where he sits. If the contradiction between our evaluations is persistent or too great, perhaps we are not as similar as I thought. "Like me" is it's own motivation. Ego is surprised if a peer, presented with the same stimulus, makes an evaluation obviously different from ego's. Ego feels pressure to explain the difference, moving closer to the other person's evaluation or expecting the other person to move closer to ego's evaluation. When people equivalent in a network use one another as a benchmark for their personal opinions and behavior, they come to express similar opinions and display similar behavior.

The idea that people understand themselves through comparison to others is the concept of relative advantage and deprivation, discussed as reference group theory in sociology (Stouffer et al., 1949; Merton and Rossi, 1957; Merton, 1957;

Stouffer, 1962), social comparison theory in psychology (Festinger, 1954), and the relative income hypothesis in economics (Duesenberry, 1949; Leibenstein, 1950).[7] The concept of relative deprivation emerged just after World War II from research conducted under Samuel Stouffer while he was serving as Director of the Research Branch, Information and Education Division of the U.S. Army (more than 200 questionnaires used to interview more than half a million soldiers). Stouffer et al. (1949:125, italics in original) describe wide differences in soldier attitudes as a preface to introducing the concept: "To help explain such variations in attitude, by education, age, and marital condition, a general concept would be useful. Such a concept may be that of <u>relative deprivation</u> . . . The idea is simple, almost obvious, but its utility comes in reconciling data, especially in later chapters, where its applicability is not at first too apparent. The idea would seem to have a kinship to and, in part, include such well-known sociological concepts as 'social frame of reference,' 'patterns of expectation,' or 'definition of the situation.' Becoming a soldier meant to many men a very real deprivation. But the felt sacrifice was greater for some than for others, <u>depending on their standards of comparison</u>." Research has accumulated on how comparisons are made, with whom, and toward what end (e.g., Hyman and Singer, 1968; Frank, 1985; Shah, 1998; Suls and Wheeler, 2000; Walker and Smith, 2002; Ho and Levesque, 2005; Guimond, 2006; Buunk and Gibbons, 2007).

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[7]Social comparison in psychology is similar in metaphor to reference group theory in sociology, which is not surprising because they developed together during a period of frequent cross-reference between sociology and psychology, the golden age of social psychology (House, 2008; Sewell, 1989; Pooley and Katz, 2008). More specifically, the person who created social comparison theory, Leon Festinger, led the earlier research (Festinger, Schachter, and Back, 1950) so warmly cited in the influential Columbia University research by Lazarsfeld, Katz, Coleman, and colleagues on opinion leaders and diffusion, which together with Stouffer's <u>American Soldier</u>, provided the foundation for Merton's theoretical work in sociology on reference groups — all of which is foundation for network models of social context creating bent preferences (Burt, 2009: Chap. 8). Kindred economic theory emerged at the same time on a separate track. The relative income hypothesis and its component effects have a great deal to say about population implications of social comparison when it occurs, but little to say about the situations in which social comparison is unlikely, so the work has not had much impact on network models (see Burt, 2009: Appendix G, for detailed discussion).

Equivalence Criterion Delimits Influential Social Comparison

Social comparison has been stated in various forms, from metaphor to model. An equivalence criterion for contagion limits social comparison in two ways.

First, comparison occurs within a reference group delimited by equivalence defining the extent to which each of the individuals in the network around ego is a "like me" peer. A comparison metaphor can be based on anything — performance, language, appearance, or something else. The comparison predicted by equivalence is between people who could substitute for one another in their respective relationships. You and I are equivalent peers to the extent that we are expert in the same specialty, our work is popular with the same constituencies, we teach the same courses, and try to place students in the same jobs. People similarly engaged in relations watch one another to see what makes someone "like me" attractive in my relationships. What style of language, lifestyle, clothing, appearance, is attractive for someone like me? The more equivalent two people are in the network around them, the more likely they benchmark against one another, and so the more likely they express similar opinion and display similar behavior.

A second restriction available is that inter-personal comparison has a specific functional form inferred from the functional form of intra-personal evaluations observed in psychophysics. This second point is primarily a theoretical point that awaits more precise empirical research. Putting aside details available elsewhere (Burt, 1982:Chap. 5; 2009: Chap. 8), the key intuition is that ego makes evaluations with respect to her own condition and the condition of her peers in the surrounding network. Marginal interpersonal evaluation is defined by a ratio of what ego has divided by what her peers have. The result is that an individual's preferences can be "bent" by the individual's location in a network. An action can seem wise, attractive, or foolish, depending on the network frame of reference within which the action is evaluated.

The functional form of relative deprivation is illustrated in Figure 4. The graph is taken from Burt (2009:Figure 8.3B), where the model parameters are discussed in detail. For the purposes here, it is sufficient to label the axes and focus on the two defining characteristics of the lines describing relative deprivation. The vertical axis

describes how ego feels about what she has, or an action she is considering. As she feels that what she has is a lot, or an action is very attractive, she is higher on the axis. The horizontal axis refers to people equivalent to ego in the surrounding network. As good things happen for ego's network peers, they move from left to right on the horizontal axis.

—— Figure 4 About Here ——

The lines inside the graph show what happens as good things happen for the peers while ego's situation is fixed. In the absence of peers, ego evaluates her situation with respect to her individual history. Her evaluation is independent of other people, so it is unaffected by good things happening for her peers. Ego's feelings would be described the horizontal dashed line in Figure 4. This is the assumption made when consumer behavior is predicted ignoring the other people in the network around the consumer.

The solid lines in Figure 4 describe ego's misery as peers who were below her, catch up, and surpass her. The heaviest solid line in the graph describes ego with just one peer. Initially ego feels terrific about what she has because it is more than her peers. The solid lines start high to the left in the graph. Ego feels intense loss as peers catch up. Ego suffers no actual loss, but she feels loss. She loses something she felt she had. The severity of the felt loss results from evaluation based on a ratio of ego to peer resources. Whatever ego has feels like a lot when her peers have very little. That inflated feeling of worth, bulging from comparison to less-fortunate peers, evaporates quickly as good things happen for the peers. Highway driving provides a familiar example. You are moving along the highway and a car comes up out of nowhere to pass you. The approaching car makes you feel as though you have slowed. We often see this in our classrooms. Students arrive from jobs in which they were smarter and faster than the people around them. It can be a shock to find oneself surrounded in the classroom by similarly able people. This is the old tension of the frog feeling small when he moves to a large pond.

Illustrative Empirical Evidence

Numerous instances of relative deprivation emerged in The American Soldier and those instances are consistent with the precise predictions now possible with network models of equivalence (Burt, 2009:Chap. 8). Recent research goes further in supporting the more precise predictions. As illustration, consider two studies that illustrate features of the relative deprivation curves in Figure 4.

First, the severe relative deprivation ego feels as peers overtake her (illustrated by the steeply descending lines in Figure 4) is a stronger feeling than relative advantage. This can be discussed as a "network fear" hypothesis in that networks clearly defining peers generate a fear of obviously falling behind peers (Burt, 2009:Figure 8.4). The hypothesis is illustrated by accidents in professional car racing. Bothner, Kang, and Stuart (2007) analyze the probability that a NASCAR driver will experience a car crash during a race as a function of competitors crowding above and below the driver. Under the assumption that "a crash is more likely if a driver attempts risky maneuvers on the track," the incidence of car crashes is an indicator of the pressure a driver feels during a race (Bothner, Kang, and Stuart, 2007:211). That pressure can come from crowding ahead or behind the driver. Drivers earn points according to their finishing position in a race. The season champion is the driver with the most points from races run during the season. Bothner, Kang, and Stuart (2007:219) measure the crowding around a driver in a race by the number of competitors that the driver could surpass in the rankings if the driver did really well in the race (crowding above), and the number that could surpass the driver if they did really well in the race (crowding below). The potential gain from a race depends on crowding above the driver. If the competitors ahead of a driver are far ahead, there is no crowding above, and little potential gain for the driver from pushing hard in this race. But if there is a cluster of competitors just ahead of the driver (crowding above), he has an incentive to make that little bit of extra effort in this race to pass a couple of them, and move ahead in the rankings. The potential loss from a race depends on crowding below the driver. If the competitors behind the driver are way behind, it will be difficult for any of them to move ahead of the driver, whatever their performance in this race. On the other hand, if there is a cluster of

competitors just behind the driver, he is at risk of one or more of them making that little bit of extra effort in this race to pass him, which could move him lower in the rankings. The research question is whether crowding around a driver increases the incidence of a car crash, and if yes, which kind of crowding is more associated with car crashes — crowding ahead of the driver, or crowding behind? Bothner, Kang, and Stuart (2007:225-228) show that crowding in the rankings around a driver before a race does increase the probability that the driver will crash his car during the race, and the effect is entirely from crowding below. Consistent with the network fear hypothesis, drivers are much more pushed to risky maneuvers by the possibility of being overtaken (loss), than they are drawn to risky maneuvers by the possibility of overtaking others (gain).

Second, relative deprivation is an intense, but transitory discomfort. The solid lines flatten out to the right of Figure 4, as ego's peers pass her. This shows how feelings of relative deprivation fade as good things continue to happen for ego's peers. The bold line in Figure 8.3B decreases quickly, then continues with much slower decrease once ego's peers have surpassed her. A bubble of hubris from felt advantage is painfully burst by the success of a lesser peer followed by a rapid diminution of pain from good things continuing to happen for the peer. To continue the highway analogy about being passed by another car, your felt speed is little affected by a passing car after the car is well into the pack ahead of you.

Grinblatt, Keloharju, and Ikäheimo (2008) report illustrative evidence. For residents in a densely populated area of Finland during 1999 through 2001, Grinblatt and his colleagues combine detailed data from tax records and car purchases. They construct measures of car purchases by ego's closest neighbors, and use those measures to predict ego's own car purchase. The research question: How does ego react to the relative deprivation of neighbors coming home in newly purchased cars? Neighbor purchases significantly increase the probability that ego will buy a car, but the effect has a strikingly short duration. The effect is strongest during the two days following neighbor purchases, with a weaker but still substantial effect for a week or two, and no effect thereafter (Grinblatt et al., 2008:744-745). In fact, Grinblatt and his colleagues (2008:750) do not believe that keeping-up-with-the-Joneses envy is a

feasible interpretation of their neighbor effects because the effects are so transitory: "it is difficult to explain how quickly the social influence of those nearest neighbors decays. Envy is a more persistent emotion." On the contrary, envy is a bent preference of short duration (baring the possibility of ego and peer resources somehow held in painful balance for a period of time). The theoretical prediction illustrated in Figure 4 is that the relative deprivation of falling behind the Joneses is a discomfort intense but transitory. That prediction is consistent with the intense, short-lived neighbor effects reported by Grinblatt and his colleagues.

Equivalence Criterion Implicit in Early Research

Network concepts of equivalence were not developed when the early research on social pressure was conducted, but in retrospect, the equivalence criterion can be seen in the research. For example, some methods for detecting cliques of connected people in fact detected categories of structurally equivalent people. MacRae (1960) proposed factor analyzing sociometric choice data to aggregate people into groups. A group defined by factor analysis is a cluster of structurally equivalent people because people are put into the same group (load high on the same factor) to the extent that they have similar relations with other people (Burt, 1982:47-49, 73-89). Further, some people analyzed as strongly connected were structurally equivalent because of the overlap between the connectivity and equivalence criteria. Note the similar spatial distributions by connectivity in Figure 1 and structural equivalence in the map to the left in Figure 3. More generally, people within groups are structurally equivalent in a population of disconnected, cohesive groups (relation pattern is strong ties within group and no ties beyond group). The lobbyists in Figure 2 were such a population. At the same time that evidence of contagion within the groups is evidence supporting the connectivity criterion (left-hand graph in Figure 2), it is often also evidence supporting the equivalence criterion (right-hand graph in Figure 2), but the latter possibility went untested.

Turning from the field to the lab, equivalence was implicit in early experiments. Consider the widely cited experiments by Solomon Asch (1951, 1956) showing that social reality affects evaluations even when social reality contradicts physical reality.

Asch wanted to know whether the contagion evident in Sherif's study with ambiguous stimuli was strong enough to affect evaluations of unambiguous stimuli. Figure 5 is a quick overview of the experiment (using the data in Asch, 1951). The perceptual task was to match line lengths between two cards. An example pair of cards is given in Figure 5. One card contains a single vertical line. The other card contains three lines of different lengths. The task is to match the length of the single line with the same-length line on the three-line card. In Figure 5, the match is with line C. Subjects were asked to make 18 matches. The single lines varied from two to ten inches in length. Lines on the three-line card differed on average by 1.6 inches from shortest to longest (see Asch, 1951:180, for research design).

——— Figure 5 About Here ———

Line length in this experiment is an unambiguous stimulus. When alone as if in a psychophysics experiment, Asch's subjects were accurate in reporting line length. Asch asked a control group of students to go through 12 trials writing down their matches. In 444 matches, the students only made three errors (Asch, 1951:181).

Given the accurate perceptions made by people when alone, it is all the more striking to see the erroneous line lengths people report in a social setting. The left photo in Figure 5 shows seven students sitting around a table facing the experimenter, Asch. Asch sits next to a board on which the two stimulus cards are pasted. All but one of the students are confederates hired by Asch. The second from the last, in Figure 5, is the experiment subject. On the first two trials, the confederates each verbally select the correct match. The subject comfortably goes along with what everyone else is saying. On the third trial, the confederates unanimously select the wrong line; say line B in Figure 5. The subject reaction is illustrated in the middle picture: he cannot believe his eyes. Everyone has picked line B, but we know from the baseline results that the subject sees that line C is the correct match. One can imagine the subject in the third photo in Figure 5 saying to himself, "I must be blind," as he conforms to the majority in announcing that line B is the match. The experiment continues for 18 trials, of which 12 involve the majority making an erroneous match. Every so often, the majority makes a correct match to keep the subject uncertain.

The bar graph in Figure 5 tabulates the results (Asch, 1951:181). One subject conformed to the erroneous majority opinion in 11 of 12 opportunities. Thirteen subjects never conformed (0 conforming choices). In all, subjects conformed to the clearly erroneous majority in 32% of 600 trials, and 74% of 50 subjects conformed at least once. Conformity is less likely with two other people expressing erroneous opinion, and unlikely with a single other person. As Asch (1956: 12) summarized the results: "The unanimously wrong majority produced a marked and significant distortion in the reported estimates." Replications of Asch's experiment show varying levels of conformity, but the experiment continues to show people conforming to the majority (Bond and Smith, 1996).[8]

The results are simultaneously evidence of social comparison between network equivalent people. First, the students are socially similar; they have what Lazarsfeld and Merton (1954) termed homophily (McPherson, Smith-Lovin, and Cook, 2001, provide contemporary review). I know nothing about the social network among the students, but look at the photo in Figure 5. The students are all male. They are all

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[8]It could seem reasonable to go beyond the Sherif-Festinger-Lazarsfeld-Katz-Coleman focus on ambiguous stimuli and argue instead that social reality can dominate physical reality — as illustrated by Asch's subjects reporting perceptions consistent with social reality but clearly inconsistent with physical reality (e.g., see Hardin and Higgins, 1996, for such an argument). There is even evidence of a biological foundation for the Asch results. Berns et al. (2005) report MRI evidence of activity in emotion areas of the brain when subjects contradict the group opinion (versus activity primarily in routine perception areas of the brain when subjects conform to group opinion). The authors offer the results as "the first biological evidence for the involvement of perceptual and emotional processes during social conformity." One reason for staying with the original focus on ambiguous stimuli is confidence. The paragraph quoted in the text from Festinger, Schachter and Back sets up a continuum of stimuli ranging from evaluations that are clearly grounded in empirical fact (as in "this street is a dead-end road") to evaluations that have no clear empirical referent (as in "the economy will suffer if a Democrat is elected"). I am confident that people use other people as a frame of reference for evaluations that have no clear empirical referent, they feel tension contradicting a peer group of unanimous opinion, and they might be affected by other people when making evaluations clearly grounded in empirical fact — but then again they might not. A substantial number of Asch's subjects show the effects of contagion on an evaluation clearly grounded in empirical fact, but some of those subjects did not believe their own reports. They go along with the majority while privately believing what their eyes told them. This public lies versus private truths phenomenon (Kuran, 1998) is illustrated by participant remarks such as (Asch, 1956:32): "When in Rome you do as the Romans," or "I agreed less because they were right than because I wanted to agree with them. It takes a lot of nerve to go in opposition to them." More, subjects are less likely to go along with the majority when the majority is obviously in error (Cohen, 1963:28-29), and subjects are more likely to conform if they have to recall the image of the line rather than having it displayed in front of them when they evaluate its length (Deutsch and Gerard, 1955). In short, physical reality intrudes even into the social reality of complete consensus among peers, or as Asch (1951:189) himself put it: "we find that the majority effect grows stronger as the situation diminishes in clarity."

about the same age. They are the same race. They are all enrolled in courses at the same elite, New England college, familiar with the same courses taught by the same professors. They are all in the college's subject pool for psychology experiments. They likely draw female companions from the same local schools. A subject looks around the room and sees people "like me." One can imagine the photograph looking different for Sherif's experiment in the early 1930s at Columbia University, but homophily must have been similarly high.

A further point to note with respect to structural equivalence is that contagion in Asch's experiment did not require influencer and influencee to talk to one another.[9] In fact, the contagion predicted between structurally equivalent people not talking to one another — such as the salesmen in Figures 1 and 3 — was familiar in social psychology long before Asch's study in 1951, or even Sherif's in 1936. It was the subject of Triplett's (1898) analysis, which is often deemed the first experiment in social psychology (Stube, 2005). Triplett describes men competing in bicycle races, and children competing on the speed with which they can wind a fishing reel. The racing bicyclists and competing children are structurally equivalent — standing in common relation to the rule-making authority, the goal, one another, and spectator elements in the environment. Though not talking with one another, the competitors influence one another. Consistent with the relative deprivation illustrated in Figure 4, Triplett (1898:533) shows that people work faster when they are pitted against a competitor:[10] "the bodily presence of another contestant participating simultaneously in the race serves to liberate latent energy not ordinarily available." In Allport's (1924) influential textbook a generation later, Allport felt the need to explicitly

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[9] I focus on the Asch experiment as an exemplar. Gartrell (2002) offers a broader discussion of the early research on communication and influence in the course of assuming that network connectivity defines the peers with respect to whom ego feels relative deprivation. His chapter is useful in directing research attention to network criteria for ego's selection of peers for social comparison. For the purposes here, however, I put aside Gartrell's assumption that the peers responsible for relative deprivation are defined by connectivity because Gartrell did not consider the structural equivalence implicit in the early research, and did not have the empirical evidence reported here supporting structural equivalence over connectivity as the criterion defining network peers.

[10] Triplett presented his results in graphs and tabulations that were sophisticated for the time, but can leave questions for contemporary scholars about the statistical significance of the oft-cited results (Stube, 2005). It turns out that Triplett's competitor-induced speed improvements stand up to routine statistical scrutiny (Burt, 2009: Appendix G, footnote 7).

separate evidence of social influence into two kinds, one describing influence between people not talking to one another (Triplett is cited as an example), and the other describing influence between people who talk to one another (pages 260-261): "Groups, in turn, may be classified under two heads: co-acting groups and face-to-face groups. In the former the individuals are primarily occupied with some stimulus other than one another. . . . Pupils in a classroom reading a lesson in concert from the blackboard illustrate this type of group. In the face-to-face group, which is necessarily small, the individuals react mainly or entirely to one another. A committee of three or four directors discussing a business project is a group of this sort." Allport (1924) discusses at length the evidence on co-acting groups, and bemoans the lack of research on face-to-face groups ("the face-to-face group has been neglected," page 285). The neglect was corrected in the following decades, although the subsequent studies by Sherif (1936) and Asch (1951) that are today deemed classics in the mid-century research wave that established the connectivity criterion were both instances of influence in co-acting groups. The point for this chapter is that influence between structurally equivalent people who do not talk to one another — a point of contention between connectivity and equivalence criteria defining "like me" — was a phenomenon familiar early in social psychology.

HOW THE MECHANISMS COMBINE

The summary results in Table 1 assume that contagion is a continuous function of one or the other network criterion. In fact, the two criteria combine in a systematic way. There is more here than a multiple regression model in which the two criteria are tested for their relative contribution to contagion. Rather, the two criteria interact, each affecting the other's effect.

Discovering Near-Peers

The interaction is illustrated in Figure 6 (from Burt and Uchiyama, 1989). The data are taken from Coleman, Katz, and Menzel's (1966) Medical Innovation. The unit of

analysis is a pair of doctors practicing in the same city. The vertical axis indicates the months that pass between the first doctor's adoption until the second doctor's adoption. The minimum is zero, indicating two doctors who adopted in the same month.

——— Figure 6 About Here ———

The solid line in Figure 6 describes contagion by structural equivalence. Doctor pairs range from nonequivalent at the left in the graph, to strongly equivalent at the right. The solid line is high for nonequivalent doctors, showing that about six months passed between their adoptions. The solid line declines almost linearly as the network weight for structural equivalence increases. Structurally equivalent doctors tended to begin prescribing the new antibiotic at about the same time.

Now connectivity: The dashed line describes the interval between adoptions by pairs of doctors in which one cited the other as an advisor or discussion partner. Across much of the horizontal axis, the dashed line adds nothing to the solid line. Nonequivalent doctors are separated by about six months whether or not they talked together. Above a certain level of structural equivalence (network weights greater than about .2 in Figure 6), the dashed line runs parallel to the solid line showing that equivalent doctors adopted soon after one another, whether or not they discussed cases together.

The point of the graph is the big gap between the dashed and solid lines at low levels of equivalence. A pair of doctors for whom the equivalence network weight is .1, for example, were separated in their adoptions by 5.79 months on average, but were a month and a half closer together if they discussed cases (4.19 month average interval between adoptions for the dashed line over network weights equal to .1). In short, connectivity contributes to contagion in combination with equivalence. At low levels of equivalence, connectivity makes a big difference.

Z-Graphs

The same pattern occurs among the managers and lobbyists. Contagion evidence within and across the three populations is summarized in Figure 7. The horizontal axes distinguish levels of connection. The strongest connection measured is two

people citing each other as colleagues with whom they discuss their work. The next lower level is when only one person cites the other. The next lower level is when the two people have no direct contact, but they discuss their work with colleagues who know one another such that there is <u>some</u> chain of intermediaries through whom information could travel between the two people. The lowest level of connection is when the two people discuss their work with disconnected colleagues such that there is <u>no</u> chain of intermediaries in the observed network through whom information could travel between the two people.

——— Figure 7 About Here ———

The vertical axes in Figure 7 measure contagion. Pairs of people low on the vertical axis made similar responses on whatever variable was tested for contagion in their population. Pairs of people high on the vertical axes made widely different responses. In Figure 7D, for example, the vertical axis is months between doctor adoptions as in Figure 6. In the Figure 7A graph summarizing the three populations, the vertical axis is a z-score measure of opinion or behavior within each community. The score for a pair of <u>Medical Innovation</u> doctors, for example, is the (z-score) difference between the dates when the doctors began prescribing the new drug. One doctor began prescribing the new drug in month A and the other began in month B. The time between their adoptions (|A-B|), minus the average difference for other pairs of doctors in their community, divided by its standard deviation is a z-score measure of the extent to which the adoption difference between the two doctors was larger than the average in their community (high on the vertical axis), or smaller than the average (low on the vertical axis). The score for two managers is the z-score difference in their evaluations of local non-profit organizations. The score for two lobbyists is the z-score difference between their respective opinions about national economic policy.

Figure 7 shows a Z-pattern within and across the three study populations. The pattern is based on the three qualitative levels of structural equivalence distinguished in Figure 6: clear-peers, near-peers, and not-peers.

Not-Peers: Contact Is Insufficient

Not-peers are pairs of people for whom the equivalence network weight is within rounding error of zero. Not-peers have networks as different as any in their community. The dashed lines across the top of the Z-patterns in Figure 7 show no evidence of contagion between not-peers, regardless of connection. On average, nonequivalent people are further far apart on the contagion variable than the average pair of people in a community (.29 mean z-score). Their difference remains if the nonequivalent people have a chain of indirect connections through whom they could communicate (.20 mean z-score), or one of them cites the other as a discussion partner (.23 mean z-score). There is no mean reported in Figure 7 for mutual citations on the dashed line because the mutual strength of connection did not occur between nonequivalent people.

Clear-Peers: Contact is Superfluous

At the other extreme, clear-peers are pairs of people for whom equivalence is high and contagion is likely even when the two people are not connected. Most people in the three populations have a small number of these close comparison points. I selected a threshold of network weights three or more standard deviations greater than zero. The cut-off I use here has no theoretical foundation. It is based on comparing the three study populations to find a level of equivalence after which contagion is likely and direct contact irrelevant. Among the Medical Innovation doctors, the interval of the horizontal axis marked clear-peer in Figure 6 contains pairs of doctors who sought advice from the same colleagues, discussed cases with the same colleagues, and were themselves sought out by the same colleagues for advice and discussion.

The bold lines across the bottom of the Z-patterns in Figure 7 show consistent evidence of contagion between clear-peers, regardless of connection between the people. The bold lines show that structurally equivalent people who talked to one another directly were similar in their opinions and adoption dates, but no more similar

than structurally equivalent people who had no direct connection with one another.[11] Contact is superfluous to alignment between structurally equivalent people. Social comparisons between equivalent people make them alert to one another such that they become similar whether or not they talk together. This point is implicit in early research conclusions about evidence recognized thirty years later to be evidence of contagion by equivalence. Merton (1949:465-466) concludes that: "One gains the impression that although a relatively few people — the top influentials — exert influence upon people on all levels of the influence-structure, there occurs a secondary tendency for people to be otherwise most influenced by their peers in that structure. . . . people in each influence stratum are more likely to be influenced by their peers in this structure than are people in the other strata." Katz and Lazarsfeld (1955:331) conclude that: "The flow of influence in this arena tends — as it does in every arena — to remain within the boundaries of each status level, but when it does cross status lines, there is no indication that the direction of flow is any more from high to low than it is from low to high."

Near-Peers, Brokers, and Opinion Leaders

The results in Table 1 and Figure 7 show that equivalence often predicts contagion where connectivity predicts contagion and where equivalence contradicts connectivity, equivalence is the better predictor. But near-peers are the most numerous pairs in the three study populations (8,999 of 13,662 dyads in Figure 7A, or 66%, are near peers), and contagion is for them clearly a function of connectivity. Near-peers are people neither equivalent nor clearly nonequivalent. The interval of the horizontal axis marked near-peer in Figure 6 contains pairs of doctors who had similar relations with some colleagues, but also had advisors and discussion partners that the other did not. Near-peers need not be aware of their weak-equivalence until

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[11] Average z-scores are well below zero for structurally equivalent people at each level of connection (-.51, -.32, -.43, and -.50 for the four points on the horizontal bold line at the bottom of Figure 7A). There is no statistically significant trend across the points (0.4 t-test adjusted for clustering between relations involving the same person) and the mean of .47 for the people in direct contact is not significantly higher than the mean of .38 for the people with no direct contact to one another (1.4 t-test adjusted for clustering between relations involving the same person). The clustering adjustment was applied using the CLUSTER option in STATA.

they talk to one another and discover what they have in common. For example, sociologists and economists move in different academic circles, but conversations between a sociologist and economist at the same university can reveal to each the many people they know, admire, or disdain in common.

The upward-sloping thin lines in Figure 7 show contagion between near-peers dependent on contact. The stronger the connection between near-peers, the more likely the contagion. To the lower-left in Figure 7A, mutual-citation near-peers are similar in opinion and behavior (-.38 mean z-score difference on contagion variables). To the upper-right in Figure 7A, differences between disconnected near-peers are as wide as the differences between completely nonequivalent people (.22 mean z-score difference). The association between contagion and connection varies across the populations (managers the lowest, doctors the highest), but all three populations show contagion between near-peers more likely with stronger connection.

Once identified, the near-peers for whom personal connection is so influential are quickly recognized. They are the opinion leaders and cosmopolitans described by Katz, Lazarsfeld, and Merton in the early marketing research from Columbia University's Bureau of Applied Social Research. One of the Bureau's early projects was a study of the 1940 presidential election, later published as The People's Choice. As so often quoted thereafter (Lazarsfeld, Berelson and Gaudet, 1944: 151), the researchers were surprised to find almost no direct media effect on voters, instead finding ". . . that ideas often flow from radio and print to opinion leaders and from these to the less active sections of the population." The role of opinion leaders in innovation diffusion was elaborated in Merton's (1949) contrast between cosmopolitan versus local leaders, and studied in subsequent Bureau projects, most notably Katz and Lazarsfeld (1955) on opinion leaders in consumer purchases. The two-step flow — a process of information moving from the media to opinion leaders, and influence moving from opinion leaders to their followers — became a guiding theme for diffusion and marketing research (Katz and Lazarsfeld, 1955: 309ff; Rogers, 2003: 285). Figure 7 shows that the familiar two-step flow of communication is a compound of the two network mechanisms; ideas enter a group through socializing discussion between weakly-equivalent, near-peers on the edge of the

group, then adoptions spread within the group through social comparisons between strongly-equivalent, clear-peers.

In other words, opinion leaders are more precisely opinion brokers who transmit information across the boundaries between status groups. These need not be leaders with superior authority, nor leaders in the sense of others wanting to imitate them. Defining opinion leaders by function (people whose conversations make new ideas and behaviors contagious) and structural location (people communicating with, and weakly-equivalent to, the individuals they influence) removes the vertical distinction implicit in the contrast between opinion leaders and followers. Opinion leaders are not people at the top so much as people at the edge, not leaders within groups so much as brokers between groups. They are in some ways structurally similar to the people they influence, but in one important way distinct; they have strong connections to other groups. They are what Merton (1949) described as cosmopolitans (see Rogers, 2003:293-294, for a similar conclusion, and Rogers', 2003:336ff, discussion of change agents as linkers). They are what we today study as network brokers, or connectors, who derive competitive advantage from spanning the structural holes between groups in markets and organizations (see Burt, 1999; 2005, for review; Burt, 2009:Table G1, for analysis showing that the near-peers between whom contagion occurs in Figure 7 tend to be brokers in their surrounding network).

CLOSING

This chapter is aimed at students and colleagues in marketing who are interested in a quick introduction to the two network mechanisms — socialization and social comparison — by which ideas and behaviors become contagious in a population. This seemed useful given the growing interest in social network analysis, but the chapter is also written to show that the growing interest is less a novelty than a renewed attack on foundational marketing puzzles with new tools. Marketing advocates for social network analysis can seem defensive as if introducing

something novel and risky. Van den Bulte and Wuyts (2007) open their book, <u>Social Networks in Marketing</u>, with the chapter "Why should marketers care about social networks?" A compelling argument is offered using contemporary facts illustrating that we live in a world increasingly based on social networks. The facts are certainly true; the turn of the century saw substantial progress in a rapid and ongoing transition from bureaucratic authority to network reputation as the mechanism governing coordination. There is another argument to be made based on intellectual history. Much of what the world knows about network effects originated in marketing and consumer research conducted during the golden age of social psychology at places like Columbia University's Bureau for Applied Social Research. Recognition of these conceptual and research foundations is particularly timely as increasingly easy access to thin data on consumers as individuals facilitates an ignorance of the social. In shadow lies the opinion and behavior of other people — friends, neighbors, colleagues, and others. Those other people are variably connected in the surrounding social network so as to affect what any one individual can do, what he or she feels obligated to do, and what he or she feels inclined to do. Something about the network around two people makes the opinion and behavior of one contagious for the other, an effect familiar in popular metaphors about word-of-mouth advertising, building the buzz, and viral marketing. My goals in this chapter were to distinguish the socialization and social comparison mechanisms by the network conditions in which they occur, and describe how the mechanisms combine in a predictable way as they generate contagion. Neither mechanism is the whole story at the same time that neither is completely wrong. Socialization turns out to describe the occasional, critical instance of opinion and behavior brokered between groups. Social comparison describes the more frequent instance of interpersonal influence within groups and indifference beyond the group. The only course of action that is clearly wrong is to ignore either one of the two mechanisms. As Van den Bulte and Wuyts (2007:77) so rightly conclude their book: "There is ample evidence that the pattern of ties among people and among organizations matter."

References

Allport, Floyd Henry (1924). Social Psychology. New York: Houghton Mifflin.

Asch, Solomon E. (1951). "Effects of group pressure upon the modification and distortion of judgments." Pp. 177-190 in Groups, Leadership and Men, edited by Harold Guetzkow. Pittsburgh, PA: Carnegie Press.

Asch, Solomon E. (1956). "Studies of independence and conformity: a minority of one against a unanimous majority." Psychological Monographs 70 (whole no. 416).

Berelson, Bernard R., Paul F. Lazarsfeld, and William N. McPhee (1954). Voting. Chicago: University of Chicago Press.

Berns, Gregory S., Jonathan Chappelow, Caroline F. Zink, Giuseppe Pagnoni, Megan E. Martin-Skurski, and Jim Richards (2005). "Neurobiological correlates of social conformity and independence during mental rotation." Biological Psychiatry 58: 245-253.

Bond, Rod and Peter B. Smith (1996). "Culture and conformity: a meta-analysis of studies using Asch's (1952b, 1956) line judgment task." Psychological Bulletin 119: 111-137.

Bothner, Matthew S., Jeong-han Kang, and Toby E. Stuart (2007). "Competitive crowding and risk taking in a tournament: evidence from NASCAR racing." Administrative Science Quarterly 52: 208-247.

Burt, Ronald S. (1982). Toward a Structural Theory of Action. Academic Press: New York.

Burt, Ronald S. (1987). "Social contagion and innovation, cohesion versus structural equivalence." American Journal of Sociology 92: 1287-1335.

Burt, Ronald S. (1990). "Detecting role equivalence." Social Networks 12: 83-97.

Burt, Ronald S. (1999). "The social capital of opinion leaders." Annals 566: 37-54.

Burt, Ronald S. (2005). Brokerage and Closure. Oxford: Oxford University Press.

Burt, Ronald S. (2009). Neighbor Networks. Oxford: Oxford University Press.

Burt, Ronald S. and Gregory A. Janicik (1996). "Social contagion and social structure." Pp. 32-49 in Networks in Marketing, edited by Dawn Iacobucci. Newbury Park, CA: Sage.

Buunk, Abraham P. and Frederick X. Gibbons (2007). "Social comparison: the end of a theory and the emergence of a field." Organizational Behavior and Human Decision Processes 102: 3-21.

Carrin, Guy (1987). "Drug prescribing — a discussion of its variability and (ir)rationality." Health Policy 7: 73-94.

Centola, D. and Michael Macy (2007). "Complex contagions and the weakness of long ties." American Journal of Sociology 113: 702-734.

Cohen, Bernard P. (1963). Conflict and Conformity. Cambridge, MA: MIT Press.

Coleman, James S., Elihu Katz, and Herbert Menzel (1957). "The diffusion of an innovation among physicians." Sociometry 20: 253-270.

Coleman, James S., Elihu Katz, and Herbert Menzel (1966). Medical Innovation. New York: Bobbs-Merrill.

Davis, Gerald F., Calvin Morrill, Hayagreeva Rao, and Sarah A. Soule (2008). "Introduction: social movements in organizations and markets." Administrative Science Quarterly 53: 389-394.

Deutsch, Morton and Harold B. Gerard (1955). "A study of normative and informational social influences upon individual judgment." Journal of Abnormal and Social Psychology 51: 629-636.

DiMaggio, Paul and Hugh Louch (1998). "Socially embedded consumer transactions: for what kinds of purchases do people most often use networks?" American Sociological Review 63: 619-637.

Duesenberry, James S. (1949). Income, Saving, and the Theory of Consumer Behavior. Cambridge, MA: Harvard University Press.

Festinger, Leon (1954). "A theory of social comparison processes." Human Relations 7: 117-140.

Festinger, Leon, Stanley Schachter, and Kurt W. Back (1950). Social Pressures in Informal Groups. Stanford, CA: Stanford University Press.

Frank, Robert H. (1985). Choosing the Right Pond. Oxford: Oxford University Press.

Frenzen, Jonathan K. and Harry L. Davis (1990). "Purchasing behavior in embedded markets." Journal of Consumer Research 17: 1-12.

Galaskiewicz, Joseph (1985). Social Organization of an Urban Grants Economy. New York: Academic Press.

Galaskiewicz, Joseph (1997). "An urban grants economy revisited: corporate charitable contributions in the Twin Cities, 1979-81, 1987-89." Administrative Science Quarterly 42: 445-471.

Galaskiewicz, Joseph and Ronald S. Burt (1991). "Interorganization contagion in corporate philanthropy." Administrative Science Quarterly 36: 88-105.

Gartrell, C. David (2002) "The embeddedness of social comparison." Pp. 164-184 in Relative Deprivation, edited by Iain Walker and Heather J. Smith. Cambridge: Cambridge University Press.

Guimond, Serge (ed.) (2002). Social Comparison and Social Psychology. Cambridge: Cambridge University Press.

Grinblatt, Mark, Matti Keloharju, and Seppo Ikäheimo (2008). "Social influence and consumption: evidence from the automobile purchases of neighbors." Review of Economics and Statistics 90: 735-753.

Hanneman, Robert A. and Mark Riddle (2005). Introduction to Social Network Methods. Riverside, CA: University of California, Riverside. Online textbook available at http://faculty.ucr.edu/~hanneman.

Hardin, Curtis D. and E. Tory Higgins (1996). "Shared reality: how social verification makes the subjective objective." Pp. 28-77 in Handbook of Motivation and Cognition, Volume 3, edited by Richard M. Sorrentino and E. Tory Higgins. New York: Guilford.

Heinz, John P., Edward O. Laumann, Robert L. Nelson, and Robert H. Salisbury (1993). The Hollow Core. Cambridge, MA: Harvard University Press.

Ho, Violet T. and Laurie L. Levesque (2005). "With a little help from my friends (and substitutes): social referents and influence in psychological contract fulfillment." Organization Science 16: 275-289.

House, James S. (2008). "Social psychology, social science, and economics: twentieth century progress and problems, twenty-first century prospects." Social Psychology Quarterly 71: 232-256.

Hummell, Hans and Wolfgang Sodeur (1987). "Strukturbeschreibung von positionen in sozialen beziehungsnetzen," Pp. 177-202 in Techniken der Empirischen Sozialforschung: 1, Methoden der Netzwerkanalyse, edited by Franz U. Pappi. Munich: Oldenbourg.

Hyman, Herbert and Eleanor Singer (eds.) (1968). Readings in Reference Group Theory. New York: Free Press.

Katz, Elihu and Paul F. Lazarsfeld (1955). Personal Influence. New York: Free Press.

Kruskal, Joseph B. and Myron Wish (1978). Multidimensional Scaling. Nebury Park, CA: Sage.

Kuran, Timur (1998). Private Truths, Public Lies. Cambridge, MA: Harvard University Press.

Lazarsfeld, Paul F., Bernard Berelson, and Hazel Gaudet (1944). The People's Choice. New York: Duell, Sloan and Pearce.

Lazarsfeld, Paul F. and Robert K. Merton (1954). "Friendship as a social process: a substantive and methodological analysis." Pp. 18-66 in Freedom and Control in Modern Society, edited by Morroe Berger, Theodore Abel and Charles H. Page. New York: Van Nostrand.

Leenders, Roger Th. A. J. (2002). "Modeling social influence through network autocorrelation: constructing the weight matrix." Social Networks 24:21-47.

Leibenstein, Harvey (1950). "Bandwagon, snob, and Veblen effects in the theory of consumers' demand." Quarterly Journal of Economics 64: 183-207.

Lorrain, Francois P. and Harrison C. White (1971). "Structural equivalence of individuals in social networks." Journal of Mathematical Sociology 1: 49-80.

MacRae, Duncan Jr. (1960). "Direct factor analysis of sociometric data." Sociometry 23: 360-371.

Manski, Charles F. (1993). "Identification of endogenous social effects: the reflection problem." Review of Economic Studies 60: 531-542.

Marsden, Peter V. and Noah E. Friedkin (1993). "Network studies of social influence." Sociological Methods and Research 22: 127-151.

Marsden, Peter V. and Joel M. Podolny (1990). "Dynamic analysis of network diffusion processes." Pp. 197-214 in Social Networks through Time, edited by Jeroen Weesie and Henk Flap. Utrecht, Netherlands: ISOR.

McPherson, Miller, Lynn Smith-Lovin, and James M. Cook (2001). "Birds of a feather: homophily in social networks." Annual Review of Sociology 27: 415-444.

Merton, Robert K. (1968) [1949]. "Patterns of influence: local and cosmopolitan influentials." Pp. 441-474 in Social Theory and Social Structure, edited by Robert K. Merton. New York: Free Press.

Merton, Robert K. (1968) [1957]. "Continuities in the theory of reference groups and social structure." Pp. 335-440 in Social Theory and Social Structure, edited by Robert K. Merton. New York: Free Press.

Merton, Robert K. and Alice S. Rossi (1968) [1957]. "Contributions to the theory of reference group behavior." Pp. 279-334 in Social Theory and Social Structure, edited by Robert K. Merton. New York: Free Press.

Monge, Peter R. and Noshir Contractor (2003). Theories of Communication Networks. New York: Oxford University Press.

Mouw, Ted (2006). "Estimating the causal effect of social capital: a review of recent research." Annual Review of Sociology 32: 79-102.

Ord, Keith (1975). "Estimation methods for models of spatial interaction." Journal of the American Statistical Association 70: 120-126.

Orzechowicz, David (2008). "Privileged emotion managers: the case of actors." Social Psychology Quarterly 71:143-156.

Pooley, Jefferson and Elihu Katz (2008). "Further notes on why American sociology abandoned mass communication research." Journal of Communication 58: 767-786.

Rao, Hayagreeva, Henrich R. Greve, and Gerald F. Davis (2001). "Fool's gold: social proof in the initiation and abandonment of coverage by Wall Street analysts." Administrative Science Quarterly 46: 502-526.

Rogers, Everett (2003) [1962]. Diffusion of Innovations. New York: Free Press.

Sawai, K. (1994). "A study on how Coleman's book on diffusion of new drugs has been cited in subsequent published articles." Library and Information Science 32: 105-122.

Schachter, Stanley (1959). The Psychology of Affiliation. Stanford, CA: Stanford University Press.

Schachter, Stanley and Jerome E. Singer (1962). "Cognitive, social, and physiological determinants of emotional state." Psychological Review 69: 379-399.

Scott, John P. (2000). Social Network Analysis. Newbury Park, CA: Sage.

Sewell, William H. (1989). "Some reflections on the golden age of interdisciplinary social psychology." Social Psychology Quarterly 52: 88-97.

Shah, Priti Pradhan (1998). "Who are employees' social referents? Using a network perspective to determine referent others." Academy of Management Journal 41: 249-268.

Sherif, Muzafer (1935). "A study of some factors in perception." Archives of Psychology, No. 187.

Sherif, Muzafer (1936). The Psychology of Social Norms. New York: Harper & Brothers.

Stouffer, Samuel A. (1962). "The concept of relative deprivation." Pp 13-38 in Social Research to Test Ideas, edited by Samuel A. Stouffer. New York: Free Press.

Stouffer, Samuel A., Edward A. Suchman, Leland C. DeVinney, Shirley A. Star, and Robin M. Williams Jr. (1949). The American Soldier: Adjustment During Army Life. Princeton, NJ: Princeton University Press.

Strang, David and Nancy Brandon Tuma (1993). "Spatial and temporal heterogeneity in diffusion." American Journal of Sociology 99: 614-639.

Strang, David and Sarah A. Soule (1998). "Diffusion in organizations and social movements: from hybrid corn to poison pills." Annual Review of Sociology 24:265-290.

Stube, Michael J. (2005). "What did Triplett really find? A contemporary analysis of the first experiment in social psychology." American Journal of Psychology 118:271-286.

Suls, Jerry and Ladd Wheeler (eds.) (2000). Handbook of Social Comparison. Boston, MA: Kluwer Academic/Plenum.

Triplett, Norman (1898). "The dynamogenic factors in pacemaking and competition." American Journal of Psychology 9: 507-533.

Turner, Ralph H. (1990). "Some contributions of Muzafer Sherif to Sociology." Social Psychology Quarterly 53: 283-291.

Van den Bulte, Christophe and Gary L. Lilien (2001). "Medical Innovation revisited: social contagion versus marketing effort." American Journal of Sociology 106: 1409-1435.

Van den Bulte, Christophe and Stefan Wuyts (2007). Social Networks and Marketing. Cambridge, MA: Marketing Science Institute.

Walker, Iain and Heather J. Smith (eds.) (2002). Relative Deprivation. Cambridge: Cambridge University Press.

Wasserman, Stanley and Katherine Faust (1994). Social Network Analysis. Cambridge: Cambridge University Press.

White, Harrison C., Scott A. Boorman, and Ronald L. Breiger (1976). "Social structure from multiple networks, I. blockmodels of roles and positions." American Journal of Sociology 81: 730-780.

Zucker, Lynne G. (1977). "The role of institutionalization in cultural persistence." American Sociological Review 42: 726-743.

Figure 1

Discussion Network in a Hypothetical Organization

(Connectivity criterion predicts similarity between people connected by a line.)

Figure 2

Economic Opinions of Notable American Lobbyists Relative to the Social Opinion Around Them

(Higher scores indicate more conservative opinion. Data are from Heinz, Laumann, Nelson, and Salisbury, 1993.)
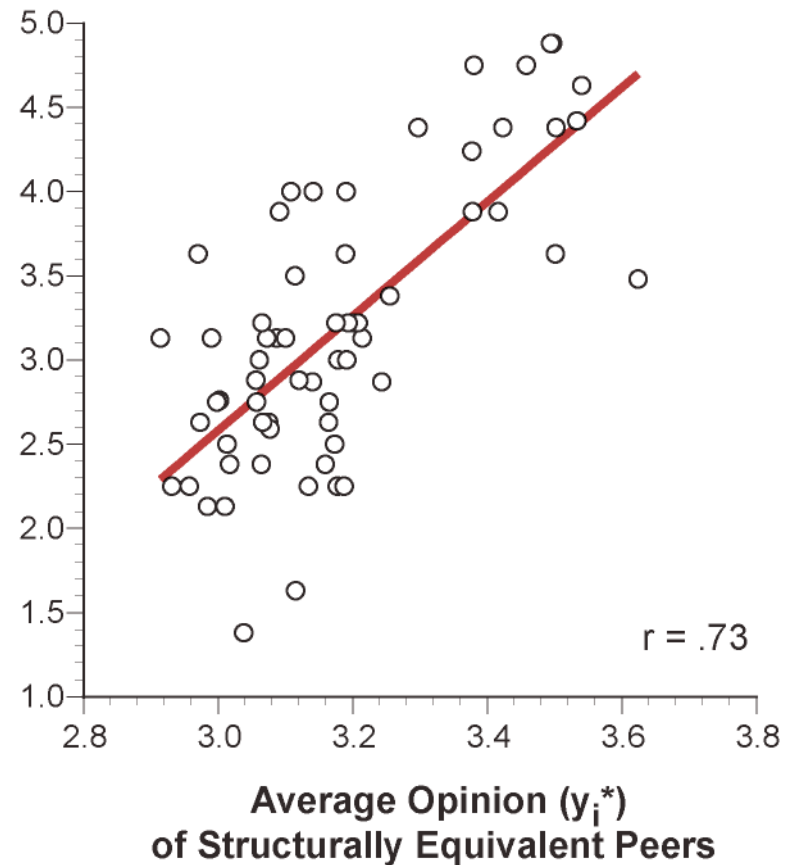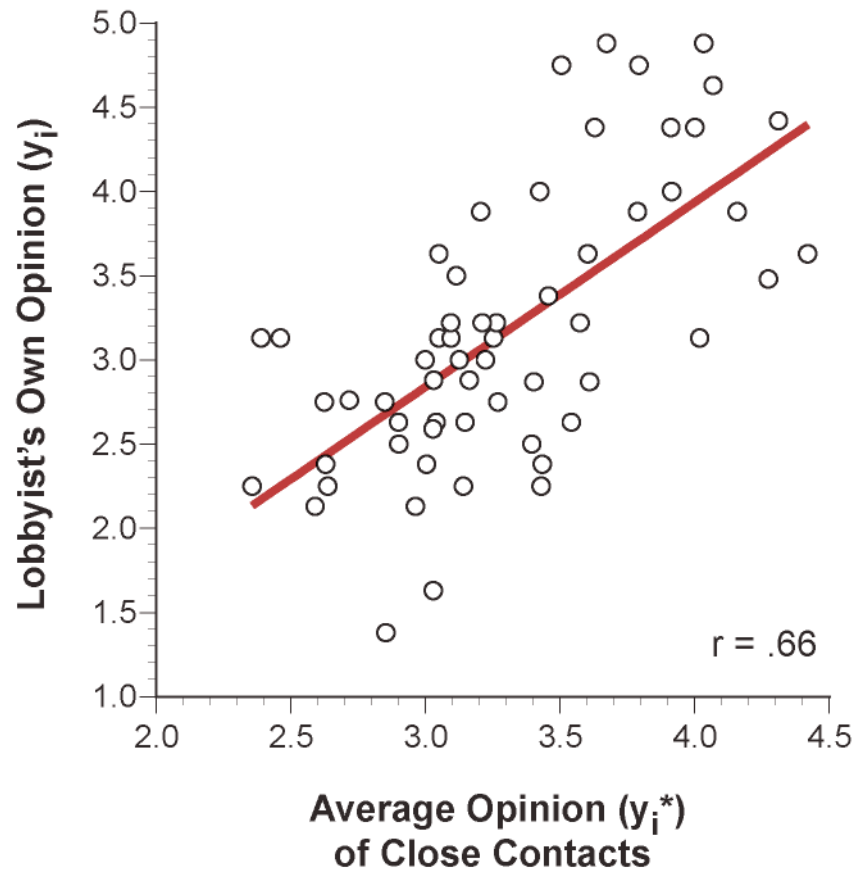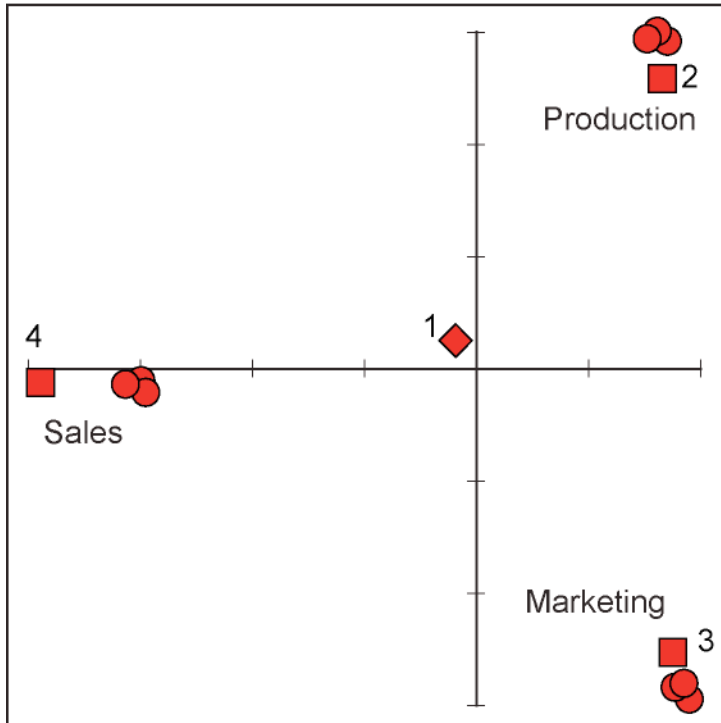
Figure 3

Equivalence Criteria Applied to Figure 1 Network

(Equivalence criterion predicts similarity between people close together. Multidimensional scaling, footnote 4.)
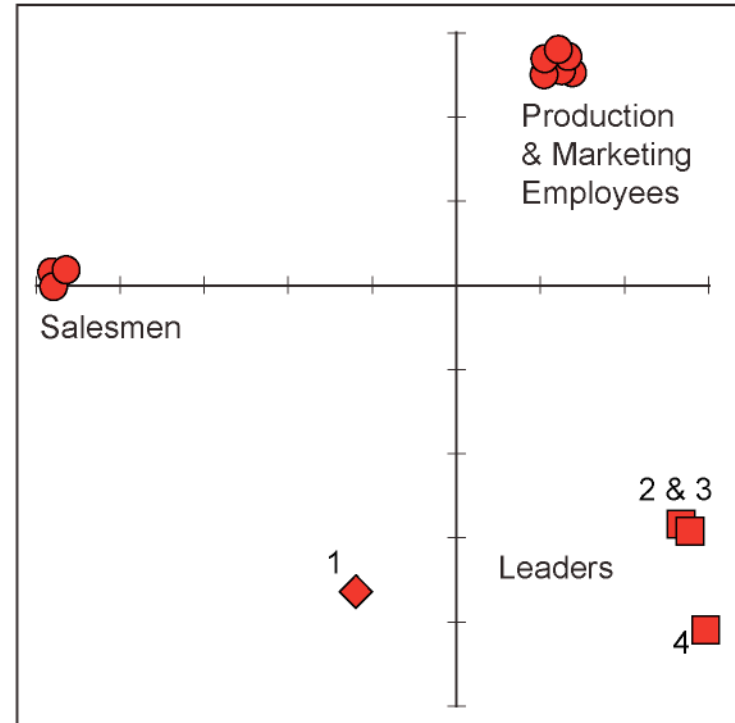
Table 1

Network Structure and Contagion
in Three Study Populations

	Reciprocal Connections	Percent of Population beyond Friends of Friends	Contagion Measure	Correlation for Contagion by Connectivity Criterion	Correlation for Contagion by Equivalence Criterion	Correlation between Connectivity vs Equivalence Predictors
Lobbyists (Figure 2)	69%	33%	Similar Economic Ideology	.66	.73	.89
Managers	55%	51%	Similar Opinions of Other Organizations	.22	.54	.34
Doctors	24%	85%	Similar Dates for Prescribing New Drug	-.01	.35	.31

Figure 4

**Ego's Felt Loss
as Peers Catch Up**

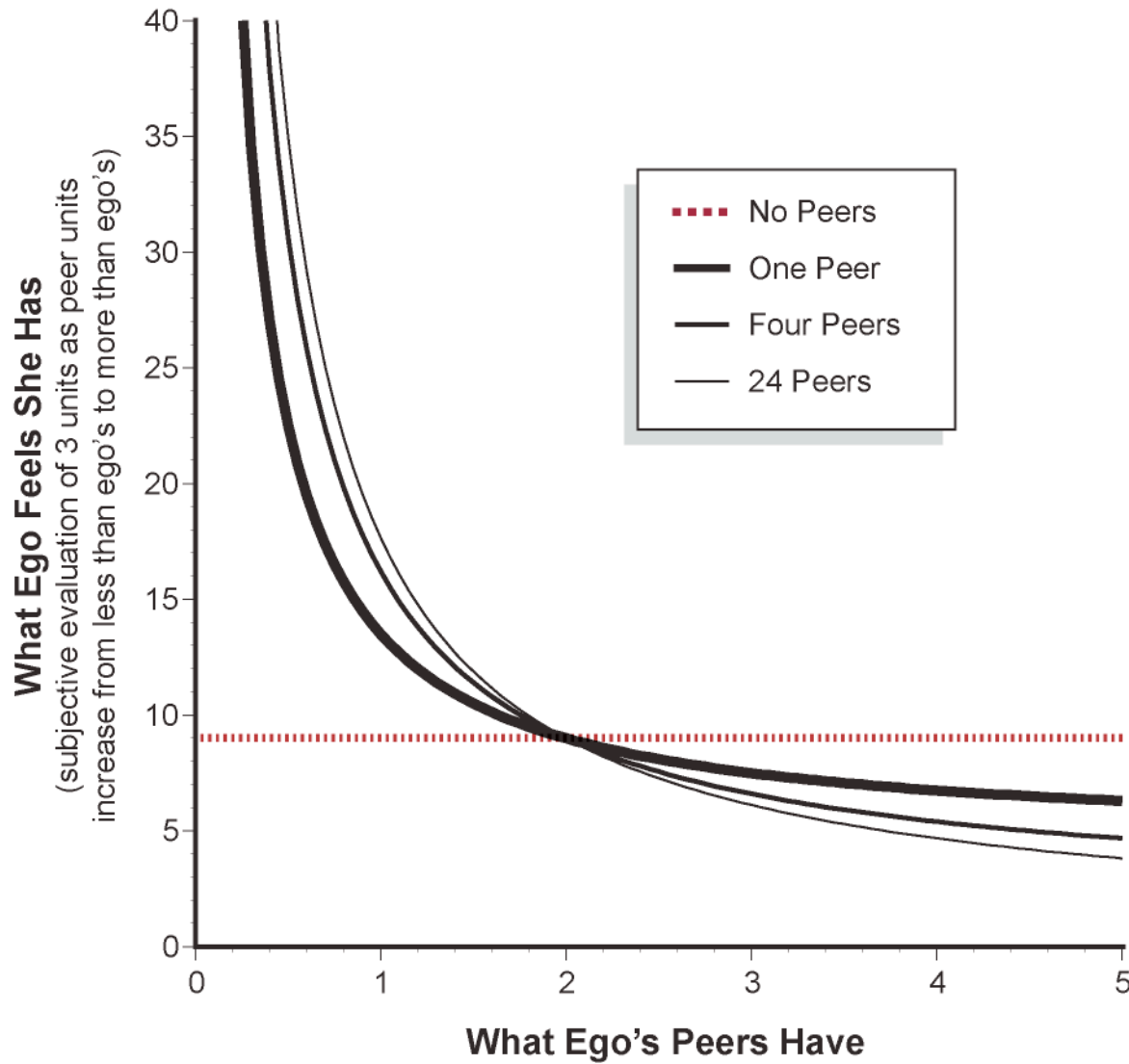(Model parameters are given in footnote X.)

Figure 5. The 1951 Asch Experiment

12 trials for each of 50 subjects (college students, with 6 confederates pictured above)

74% conform at least once (37/50)

Conformity on 32% of trials (192/600)

Variations:

99% accurate when subject is alone.

3% conformity with 1 confederate present.

13% conformity with 2 confederates present.

33% conformity with 3 confederates present.

35% conformity with 4 confederates present.
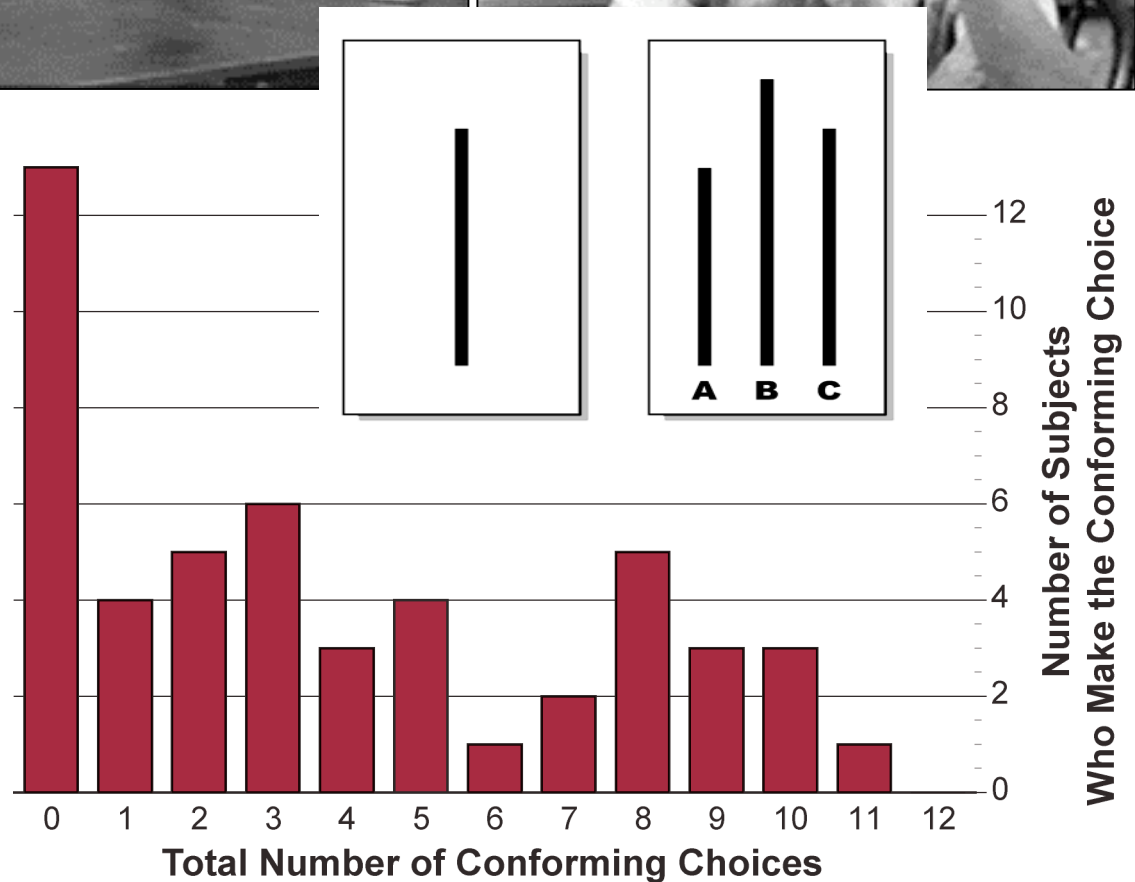
32% conformity with 8 confederates present.

Number of Subjects Who Make the Conforming Choice

Total Number of Conforming Choices

Figure 6

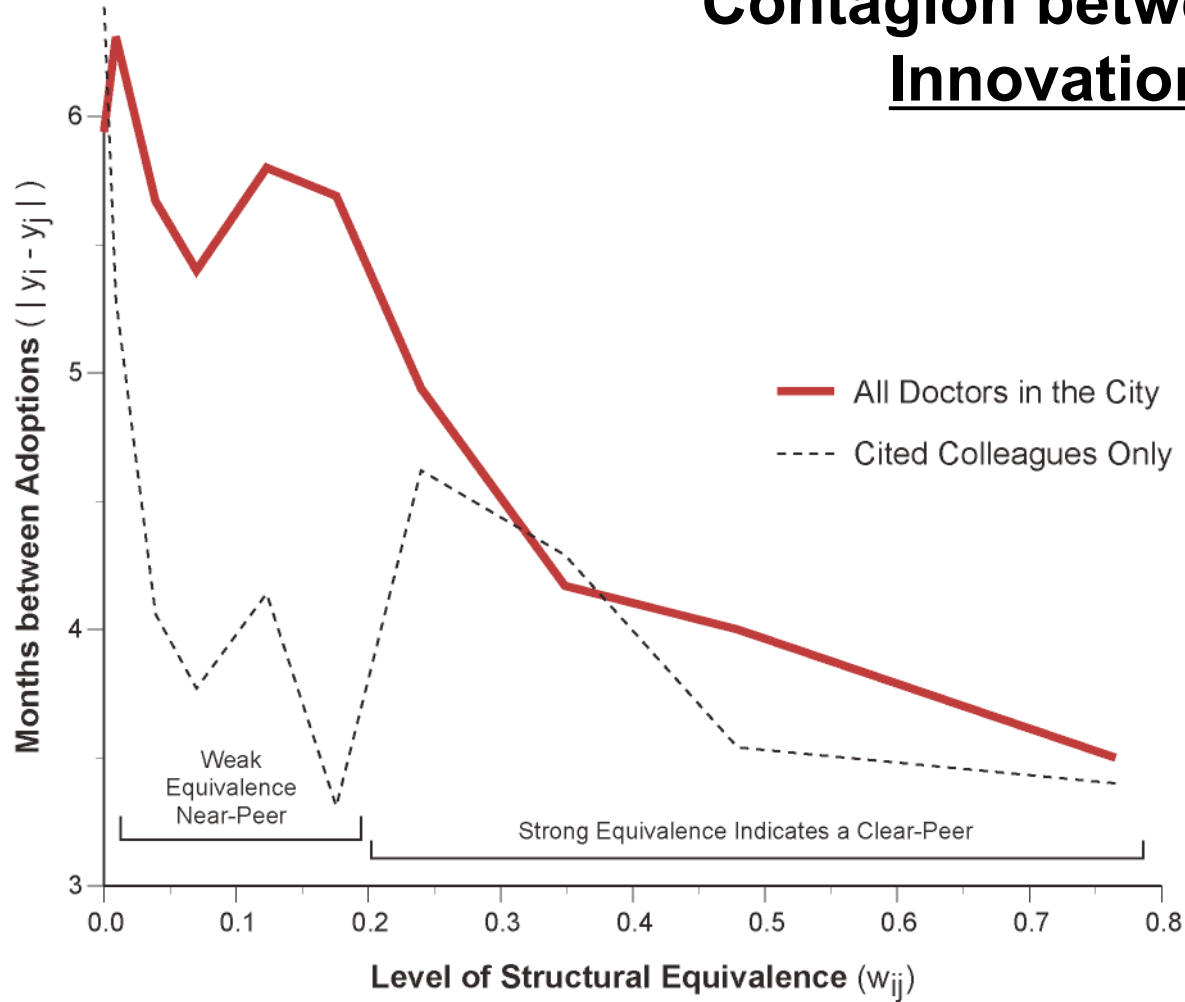**Detail on Network Conditions for Contagion between the <u>Medical Innovation</u> Doctors**

Figure 7. Summary Network Conditions for Contagion

A. All Three Populations

most different

most similar

Average Z-Score Difference across the Study Populations

Not-Peers (n = 3,617)

Near-Peers (n = 8,999)

Clear-Peers (n = 1,046)

B. Managers

Average Disagreement between Officer Evaluations

Not-Peers (n = 443)

Near-Peers (n = 2,545)

Clear-Peers (n = 552)

C. Lobbyists

Average Difference between Lobbyist Ideologies

Not-Peers (n = 94)

Near-Peers (n = 3,463)

Clear-Peers (n = 349)

Mutual Citation — Asymmetric Citation — Indirect Connection — No Connection

Strength of Connection

D. Doctors

Average Number of Months between Physician Adoptions

Not-Peers (n = 3,080)

Near-Peers (n = 2,991)

Clear-Peers (n = 145)

Mutual Citation — Asymmetric Citation — Indirect Connection — No Connection

Strength of Connection