Embedding Subgroups in a Sociogram: Linking Theory and Image[1]

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By embedding subgroups in a sociogram we generate images of network structure which are consistent with longstanding theoretical descriptions of network structure. Moreover, these images sustain an eclectic array of theoretically based interpretations, thus providing a basis for theoretical integration. We demonstrate the advantages of such images by generating and interpreting two images, one of professional discussions among high school teachers and the other of friendships among the French financial elite. Our findings suggest that this approach has great potential for characterizing and interpreting the structure of various social networks.

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1. The Images of Social Networks in Sociological Theory

One of the strongest and most consistent theoretical images of the structure of social networks is that of interactions concentrated within, but not confined to, cohesive subgroups. Such a description was offered early by Roethlisberger and Dickson (1941) who studied workers who organized themselves into cliques within a bank-wiring room, and has been treated theoretically by Durkheim in *Division of Labor in Society* (1933) and Simmel in *Web of Group Affiliations* (1955), each of whom described the integration of cohesive subgroups into organizations or society through interactions which extend beyond subgroup boundaries. Perhaps Blau (1977) has been the most explicit in his description of society composed of densely interwoven subgroups. This image is also central to recent theoretical advancements, such as primary and secondary structural holes, which Burt (1992) defines using the theoretical image shown in Figure 1, and the image may be inferred from Granovetter's hypothesis regarding strong ties (frequent ties which are concentrated within subgroups) and weak ties (relatively infrequent ties which bridge between subgroups).

Insert Figure 1 about here

Unfortunately, data analysts have not successfully represented the pattern of *observed* interactions among actors in a form that is consistent with theoretical descriptions. Some data analysts have used Multidimensional Scaling (MDS) to represent the pattern of interaction among actors, such as is performed by Krackplot (Krackhardt et. al. 1994). While this approach renders an image of actors located in a few dimensions, it offers no objective basis for identifying those actors who are members of a given subgroup. It is left to the researcher to use heuristic and visual criteria to identify subgroups of actors on a *post-hoc* basis.

Other data analysts have identified blocks of structurally similar actors, and relied on the information contained in the block diagonal matrix as a representation of the pattern of the social network (Anderson et al., 1992; Borgatti and Everett, 1994; Burt, 1982; Doreian et al., 1994; Panning, 1982; Snijders and Nowicki, 1994; Wasserman and Anderson, 1987; White et al. 1976). Although recent adaptations have represented the information using shading instead of the numerical information contained in each cell (Freeman, 1994), the information remains organized in essentially the tabular form of an adjacency matrix instead of a graphical image such as is generated by MDS.

Frank (1996) combined MDS and a special form of block modeling to generate an image of observed social network data that is consistent with the theoretical depiction of interactions concentrated within subgroups. In the next section we will discuss Frank's *stochastic* definition of cohesion which is key to Frank's ability to identify non-overlapping cohesive subgroups. The criterion is also the basis of the two statistical tests Frank uses to evaluate the salience of the recovered subgroups. Once such subgroups have been identified, we extend the traditional MDS by applying it within *and* between subgroups to generate an image of the structure of social network data consistent with theoretical description. In Section 3 we will generate and interpret an image of the structure of professional discussions of teachers in a high school, and in Section

4 we will generate and interpret an image of patterns of friendship among the financial elite in France (Kadushin, 1995). In Section 5 we will discuss the possibilities for the general application of this approach.

2. Identifying Non-overlapping Cohesive Subgroups

Frank (1995) defined a stochastic criterion for identifying cohesive subgroups from a reduced form of the p_1 model (Fienberg and Wasserman, 1981; Fienberg et al. 1985; Frank and Strauss, 1986; Holland and Leinhardt, 1981; Strauss and Ikeda, 1990; Wang and Wong, 1987; Wasserman and Galaskiewicz, 1984; Wasserman & Pattison, 1994). Maximizing Frank's criterion is equivalent to maximizing the odds ratio (AD/CB) of Table 1.

Table 1
Association Between Common Subgroup Membership and The Realization of Interaction Between Actors

		Interaction Realized		
		No	Yes	
Subgroup Membership	Different	A	B	Possible interactions between actors in *different* subgroups
	Same	C	D	Possible interactions between actors in the *same* subgroup
		Unrealized interactions	Realized interactions	Total possible interactions

The odds ratio of Table 1 has the direct interpretation as the increase in the probability that two actors will interact given that they are members of the same subgroup as opposed to being members of different subgroups. Because the odds ratio is stochastic, with values on the diagonals evaluated relative to the marginals, the odds ratio accommodates variation in the data, and thus allows the researcher to identify non-overlapping, but permeable, subgroup boundaries instead of overlapping subgroups of actors satisfying a fixed criterion (most of the criteria available in UCINET and STRUCTURE are not stochastic, and therefore generate overlapping subgroups --see Frank, 1993, Freeman, 1992, and Kadushin, 1995). Given the stochastic criterion, Frank described a simple hill-climbing algorithm for identifying subgroups by iteratively reassigning actors so as to maximize the odds ratio defined in Table 1.

While the boundaries of the cohesive subgroups may be the key component of the structural representation of the pattern of professional discussions, the placement of actors in subgroups constitutes an incomplete representation of the data. Lost in the simple categorization

of actors into subgroups is the variability of patterns of interactions among actors within each subgroup, and the variability in the extent and nature of interactions in which actors engage with others outside their subgroup. In order to represent this variably we will embed subgroups in a sociogram by applying MDS within each subgroup to obtain the locations of subgroups members relative to one another, and then MDS between subgroups to obtain the locations of subgroups relative to each another, and then combining the information in a single image. In Figure 2 we represent the structure of professional discussions among teachers (ranging from once a month [1] to daily [4]) in a single high school called "Our Hamilton High."

Insert Figure 2 about here

Before using the subgroups as the basis for characterizing the pattern of interactions among these teachers, we need to know the extent to which the interactions are concentrated within the subgroups at a rate that is unlikely to occur by chance alone. That is, we must answer the question: "Are there really subgroups in the data, or have subgroups been imposed on a fluid pattern of interactions?" Following Frank (1996), we determine that the probability that the interactions are concentrated within the subgroups in Figure 2 at a rate that could have occurred by chance alone is less than one in a thousand. Further, we determined that the algorithm was likely to have recovered the "true" subgroup memberships. In simulated data in which the subgroup memberships were known and in which interactions were as concentrated within subgroups as they are in Figure 2, Frank (1995) showed that the algorithm was more than four times as likely to assign two actors who were in the *same* known subgroup to the same observed subgroup as it was to assign two actors in *different* known subgroups to the same observed subgroup. Thus the subgroups of teachers represented in Figure 2 are more than boundaries imposed to facilitate an analysis of a pattern of interactions -- they represent an empirical tendency of teachers to interact within the identified subgroup boundaries.

3. Interpreting the Image of Professional Discussions in "Our Hamilton High"

The image in Figure 2 reveals the basic structure of professional discussions within each subgroup and between the subgroups. For example, subgroup B can be characterized in terms of a central dyad (teachers 20 and 23), two teachers closely associated with the dyad but who do not engage in direct discussions with one another (teachers 17 and 22), and two peripheral members (teachers 6 and 8). Each of the subgroups can be similarly characterized, as can the structure of subgroups, which might be characterized in terms of a central subgroup (C), and three competing factions (A, B, and D). Further, because the metric in the original data is preserved within and between subgroups (see Frank, 1996 for a discussion of how the metric is preserved), sets of distances in the map can be compared. For example, the members of subgroup A are mapped, on average, about 1.68 units apart, reflecting the density of discussions within subgroup A of 2.42, or almost once a week (1.68=[Maximum weight]/[density within subgroup A]=4/[2.42]). The average distance of 1.68 between members of subgroup A can be sensibly compared to the average distance of 2.48 between members of subgroup B who engage in discussions on average

about once a month (2.48=[Maximum weight]/[density within subgroup B]=4/[1.6]). The distances within the boundary of subgroup A also can be compared with the distances between members of different subgroups, such as the 16 units that separate the members of subgroups A and C. Distances in different images also could be compared to the extent that the weights in the original data are measured on comparable scales.

The image in Figure 2 also sustains an analysis of the structure of interactions at many levels and with respect to many different theories precisely because it is consistent with theoretical descriptions of the structure of interactions. The subgroup boundaries embedded in Figure 2 reveal strong and weak ties. Ties which occur within subgroups, such as within subgroup A, are strong. They typically reflect a greater frequency of discussion and typically occur between two actors who engage in discussions with many common others -- the other members of their subgroup. Weak ties between subgroups are typically less frequent, and occur between actors who engage in interaction with few common others because they are members of different subgroups.

The subgroup boundaries embedded within the image in Figure 2 also reveal structural holes within and between subgroups (Burt, 1992) For example, within subgroup C, the limited amount of direct discussion between teachers 14 and 15 in the upper right and teachers 4 and 16 in the lower left constitutes a structural hole within the subgroup (only one of the four possible interactions occurs). This hole is filled primarily by teachers 5, 10, and 19, each of whom engage in direct discussion with three of the four disconnected teachers. In Burt's language, the action of teachers 5, 10, and 19 would be less constrained than that of teachers 4,14,15, and 16. There also are structural holes between teachers in different subgroups. For example, teachers 1 and 2 are the only members of subgroup A who engage in discussions with the teachers in subgroup B. Without these bridging teachers there would be a hole between subgroup A and subgroup B.

The identification of structural holes in a graphical image such as Figure 2 can be generalized to define the positions of actors in terms of their location in the image (Freeman, 1992). For example, in Figure 2, teachers 20 and 23 occupy similarly central positions in subgroup B, and teachers 6 and 8 occupy similarly peripheral positions in subgroup B. Further, comparisons of positions *across* subgroups operationalize recent redefinitions of structural similarity in which two actors occupy a similar position if the actors *to whom they are related* occupy structurally similar positions. Faust (1988) refers to this as general equivalence and Borgatti and Everett (1994) characterize such relationships in terms of structural isomorphisms. Using Faust's term, teachers 20 and 23 who are central to subgroup B may be characterized as generally equivalent with teachers 21 and ** who are central to subgroup D. General equivalence also may be defined relative to between subgroup discussions; teacher 13 in subgroup D, who bridges between teachers in subgroups A and B, might be characterized as generally equivalent with teacher 3 in subgroup C who does the same. Therefore teachers 13 and 3 may occupy similar positions, even though there are no direct and few indirect interactions (through a single intermediary) between them. The similarity is through the common subgroup memberships of those with whom they engage in discussions outside of their own subgroup.

In general, the internal structures of an organization, including the structure of interaction, will affect the way in which the entire organization responds to external influences (Katz and Kahn, 1966; Pfeffer and Salancik, 1978), and this holds true for the teachers'

responses to the students in "Our Hamilton High." The student population attending "Our Hamilton High" has become increasingly disadvantaged over the years, as poor families have moved to the district from a nearby city and as the children of the more established wealthier families have aged. The teachers have responded in various ways to this exogenous change. Some who had difficulty adapting to the change sought early retirement. Others altered their mode of interaction with the students, befriending the students whom they felt were in the most need. But a core of teachers in the school have responded by becoming "moral agents," inculcating students into a specific set of values emphasizing citizenship and responsibility. These teachers pursue their goal by keeping firm control of the classroom and leading by example. We used the ranks of the teacher's measures on moral agency as measured by responses to survey items (reliability=.74, see Frank, 1995, for a description of the items), as a basis for the teacher identification numbers in Figure 2. The lower the ID number, the more the teacher emphasized moral agency.

Unfortunately we did not obtain longitudinal data to adequately observe processes of influence among all faculty in "Our Hamilton High." But because this is often the case for those who study the social networks of organizations, statistical techniques have been developed for estimating the parameters in models which are based on hypothesized processes of influence, even though the data are only cross-sectional (e.g., Doreian, 1981; Friedkin and Marsden, 1994). Similarly, a map of interactions can be interpreted with respect to a *hypothetical* cycle of influence that occurs repeatedly and continuously. If we assume the pattern of professional discussions to be relatively stable (which it is likely to be given that most of the teachers have been in the school for more than 15 years and have settled into a pattern of discussion with a fixed set of colleagues), we can use the information indicating frequency of professional discussions to construct a hypothetical pattern of influence in the school. We begin describing the process with the core of emphasis on moral agency, the members of subgroup A (teachers 1, 2, 7, and 9). Moral agency is cultivated within subgroup A as the teachers in subgroup A engage in discussions with one another on a near daily basis. Then one of the teachers in subgroup A engages in discussions with a teacher outside the subgroup, thus possibly influencing the member of the other subgroup. For example, teacher 1 establishes her emphasis on moral agency as she engages in professional discussions with teachers 2,7, and 9 in her subgroup. Then teacher 1 engages in professional discussions with teachers 14 and 15 in subgroup C through which it is likely that she influences teachers 14 and 15 towards the moral agency orientation. In turn, teachers 14 and 15 contribute to the moderate emphasis on moral agency in subgroup C established by teachers 3, 4, and 5.

The effect of cross-subgroup discussions is not limited to those in subgroup C with whom teachers in subgroup A engage in direct discussions. For example, teacher 15 in subgroup C, who engages in discussions with teacher 1 in subgroup A, also engages in discussions with teacher 18 in subgroup D, and likely influences teacher 18 to emphasize moral agency more than he otherwise would. Again, the effect is not limited to teacher 18 who then engages in professional discussions with the other members of subgroup D, and may influence them to emphasize the moral agency orientation more than they otherwise would. Therefore even teachers who do not respond directly to external forces may be affected by those forces through their direct and indirect interactions with the teachers in subgroup A, although the effect is likely to be attenuated with each step in the process.

Of course, teachers may experience the context of the school differently depending on their formal position in the school. For example, the teachers in subgroup D, many of whom teach physical education, interact with a subset of students in a non-academic context, that of coach and athlete. In these non-academic contexts the coaches develop a personal relationship with their students, which Quiroz et. al. (1991) described as indicative of the "pal" orientation (the pal establishes a close personal relationship with the student, characterized by sharing information about personal lives outside of the classroom). Like the teachers in subgroup A with regard to moral agency, the teachers in subgroup D may reinforce each others' emphasis on the pal orientation through their frequent discussions. Then when the teachers of subgroup D engage in discussions outside their subgroup they are likely to influence the members of other subgroups towards the pal orientation.

Although this description of the processes of influence has been at the level of the individual teacher, a similar description can be sustained at the level of the school. For example, we may describe moral agency as being cultivated within subgroup A and then spreading to other subgroups where it encounters the competing pal orientation which is cultivated in subgroup D. Indeed, at the organizational level, the image in Figure 2 represents an equilibrium of the system, with those in subgroup C who are mixed and moderate in their orientations mediating between the competing orientations of those at the top and bottom.

It should not be surprising that these boundaries are key to the simultaneous description of influence with regard to individual contexts and organization processes. We characterize the general nature of influences of, and on, an individual in terms of interactions within the subgroup. We characterize organizational processes by referring to a host of influences within subgroups and then the occasional between subgroup effect. Thus the image in Figure 2 reveals how the effects of processes at the level of individual teachers in one subgroup become "effects of the organization" once they are transmitted to teachers in another subgroup.

4. Application: Subgroups Among the French Financial Elite

Our description of influence within and between cohesive subgroups in Figure 2 pertains to data representing professional discussions among essentially collegial actors -- teachers in a single school -- and relates the pattern of discussion to the distribution of orientations to teaching. But cohesive subgroups also form the basis of other organizations, and may be defined based on other types of social network data. For example, actors in highly politicized groups (Pfeffer, 1982 such as the members of Kadushin's French financial elite (1995) may be organized into cohesive subgroups. Here, the subgroups establish the "ongoing systems of social relations" (p.487) described by Granovetter which create embedded trust. Combining Granovetter*s perspectives with Burt's theory of action, Kadushin characterized the conditions which engender *enforceable trust*, which

> "cannot be an attribute of friendship pairs, nor is it deducible from the possession of common social attributes. Rather it stems from an interwoven network in which there is a clear expectation that actions will have positive and negative sanctions -- not necessarily from one*s immediate friends, but from a more diffuse friendship circle" (page 219).

Kadushin characterized these conditions in terms of a combination of structural equivalence and cohesion, but our contention is that the "interwoven network" is captured by the cohesive subgroup, in which actors are connected to many subgroup members. From the level of the individual, the others within one's subgroup with whom one interacts are likely to be associated through direct and indirect ties. It is these ties among subgroup members which constrain the actor. If the ties are friendships, then an actor who betrays a friend within a subgroup will likely encounter "positive or negative sanctions" as the effect reverberates throughout the subgroup -- the "diffuse social circle." Thus trust is enforced within the subgroup. Because there is no similar mechanism through which actors can enforce the trust of non-subgroup members, members of different subgroups may compete openly and directly with one another, even if there are a few friendship ties which cut across subgroup boundaries.

In order to reveal more fully the structure through which actors enforce trust, we have generated an image of the structure of unweighted friendships within and between subgroups in Figure 3. Friendships were concentrated within the subgroups at a rate that would have been found in the identified subgroups less than one time out of one thousand if the actors engaged in friendships without regard for subgroup membership. That is, although as Kadushin noted the density is high among the financial elite as a whole, there is evidence that the friendships are concentrated within cohesive subgroups. Further the algorithm likely has recovered the true subgroup memberships; in simulated data with comparable network properties, the algorithm was five times as likely to assign two actors in the same known subgroup to an observed subgroup as two actors in different known subgroups.

Insert Figure 3 about here

The representation of the entire friendship network in Figure 3 as consisting of a series of cohesive subgroups which are loosely integrated into a whole is consistent with Kadushin's interpretation of the pattern of friendships constituting a moiety which "defines a system in which the members of the community ... are divided into two parts which maintain complex relationships varying from open hostility to very close intimacy, and with which various forms of cooperation and rivalry are associated (Levi-Strauss, 1969: 69)." In particular, Kadushin's left moiety appears at the top of our figure and his right moiety appears at the bottom. But the cohesive subgroups indicate the basis of enforceable trust more so than the left versus right dichotomy of Kadushin's image. First, actors share common socializing experiences mostly with members of their subgroups. Following Kadushin, we include information regarding party membership and whether or not the actor was a graduate of ENA as indicated by an "E". In addition, we include other characteristics of the actors which we found to be related to the structure of friendship (Some of this information was obtained from De Quillacq, 1993). We indicate which actors were members of AFEC (the antisocialist organization) by including an "A" in the actor*s line of information, which actors were bankers by including a "B", which actors were members of the treasury by including a "T", which actors were partners in the prestigious financial advisory firm Lazard Freres with an "LF", and which members were associated with Paribas with the letter "P."

Because the subgroups are consistent with Kadushin*s moiety it is not surprising that party affiliation and graduation from ENA are related to subgroup membership, but the alignment of party membership, education and friendship are clearer in our Figure 3 than in Kadushin's Figure 1 (page 211). The majority of actors in subgroup A are socialists, all of whom graduated from ENA. Subgroup B is anchored by three partners from Lazard Freres (actors 10, 17, and 6), and others who are directly linked to them through activities in the financial advising and banking industries. Most of the members in subgroup C have participated in the soap opera involved in changing chairmanships and board memberships of Paribas, the largest bank in France. Three of the members of subgroup D were appointed by Giscard D'Estaing, and the fourth, actor 23, by Chirac, another conservative prime minister.

These commonalities among subgroup members provide a basis for the norms which apply to each subgroup. For example, the actors in subgroup D are united by their commitment to conservative principles such as privatization of industries and banks, while the members in subgroup A, except for actor 12, are committed to the nationalization of industry and banks, and are more reluctant to enter into the common European community. Further, many of the members of subgroup A were socialized by experiences in the treasury, with its reputation for, and emphasis on, technical prowess. Although the actors in subgroup C are only loosely connected and the common association with the Paribas soap opera has produced some animosities, they share common understandings about the rules of takeovers and ousters, manipulating events through board memberships and back room influence rather than through direct and public confrontations.

While the prior experiences of the members of each subgroup provide the basis for establishing the norms and morays of the subgroup, it is the dense friendship patterns within subgroups, especially subgroups A and B, which establish the structure through which trust is enforced. In Burt's (1992) terms, the actions of those individuals who are closely tied to a set of actors who are members of a single subgroup are constrained. In their dealings with one another they must conform to the subgroup norms, for to violate the subgroup norm may result not only in the loss of a specific friend, but may bring negative sanctions among the circle of friends defined by the subgroup. For example, the capacity for friendship of actor 26 in subgroup A and actor 17 in subgroup B places them in the middle of fairly densely knit subgroups. Given their location in the network structure, one might assume that they were highly influential. On the contrary, their behavior is constrained by the host of others with whom they are friends. To deal aggressively with a member of their own subgroup may result in the loss of several friendships which would be particularly difficult personally for these two actors who are described as "too nice," or "too social," to be highly influential[2].

The constraints on actors 17 and 26 as a result of their centrality in cohesive subgroups represents the effect of enforceable trust described by Kadushin and Granovetter. At the level of the subgroup, this resolves an interesting paradox. Granovetter and Kadushin describe

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[2] These actors have ID's among the highest in the group because we assigned ID's according to the extent to which the actor's were described as influential by other members of the group. Only the relative influence of actors 1 through 20 were known. The ID's of actors 21 through 28 were assigned randomly.

enforceable trust as occurring among actors who are located in a complex web of interactions among actors who share a normative environment. Although the commonality of actors lies partly in their structural equivalence, it is difficult to observe the commonalities in Kadushin's figure. In our figure, the whole of the phenomenon is captured by the cohesive subgroup. Actors 17 and 26 are constrained by their pattern of friendships because, not only are they directly connected to their friends, but they occupy structurally similar positions as their friends; e.g., the friends of actor 26 are themselves friends. Thus a cohesive subgroup, although defined by a criterion which emphasizes direct connections within the subgroup, contains a set of actors who are directly connected and structurally similar by virtue of their interacting with common others within the subgroup. It is these compounded processes which produce the opportunity for enforceable trust.

In contrast to actors 17 and 26, who are highly central to their subgroups but not very influential in the network, stands actor 1 (of subgroup C) who is only loosely tied to his or any subgroup and is the most influential in the network. This has provided him the freedom to deal aggressively with subgroup members, such as actor 22 (also of subgroup C) whom he kept from control of Paribas. Given the cross-sectional nature of the data one can interpret actor 1's actions two ways. First, actor 1 had the freedom to deal aggressively with actor 22 because actor 1 would experience little loss of friendships as a result of the conflict (the only friendship actor 1 has in this subgroup is with actor 28, whom actor 1 helped install as head of a bank rival to Paribas). On the other hand, perhaps actor 1 had more friends within subgroup C prior to his dealings with actor 22, and the data reflect this loss of friendship, which actor 1 was apparently willing to risk for his action of opposing actor 22 . There is no indication of any falling out between actor 1 and other members of subgroup C, and so the data support the first explanation. On the other hand, either explanation is consistent with the argument that subgroups form the basis, or lack thereof, of enforceable trust. There was no recourse for actor 22 when he was not supported by actor 1. Any negative effects which he could have created in actor 1's friendship network either did not exist or were expendable from actor 1's perspective[3].

The effects of enforceable trust can be described at the level of the subgroup, as there was little conflict within the most densely knit subgroups. In fact, the only reported direct conflict within subgroup A occurred when actor 12, now designated as a member of the right, and the socialist actor 24 stopped talking during actor 12's appointment by the conservative prime minister Balladur. Most interestingly, this friendship was resumed when power changed hands and actor 12 was no longer the appointee of a conservative politician. Perhaps this was facilitated by actors 25 and 26 who are both friends of actors 12 and 24. The only reported conflict between actors in subgroup B occurred when actor 10 resisted the push actor 6 made for his son-in-law to become a partner in Lazard Freres. This was not a direct conflict between the two, as it concerned a third party, and there are indications actor 17 has played an important role

[3] Other actors are positioned similar to actor 22, and are similarly unconstrained in their actions. Actors 2 (of subgroup C) and 21 (of subgroup D) also are relatively unrestrained by enforceable trust, and they take advantage of their position to engage in aggressive dealings (bidding for companies, take-overs, ousters) with other actors in the network, with few personal repercussions.

in maintaining the cohesiveness of the subgroup. Moreover, this event occurred recently, and the diagram of friendships may not fully reflect the consequences of this event. Time will tell if the conflict between actors 6 and 10 is great enough to divide the subgroup.

On the other hand, there are several examples of conflict among members of loosely knit subgroups C and D, and between members of different subgroups. Actor 9 (of subgroup A) strongly resents actor 1 (of subgroup C) who opposed actor 9 as the head of Paribas. The lack of enforceable trust applies as much to actor 9, whose resentment no one attempts to mediate, as well as to actor 1, who experienced few repercussions as a result of his opposition to actor 9. Actor 3's bid for actor 5's bank also represented conflict between subgroups (subgroups D and B respectively), as did actor 23's (of subgroup D) bid to merge with the bank headed by actor 28 (of subgroup C). By far the deepest and most enduring animosities run between subgroups because there are few mechanisms for enforcing trust or mediation relationships between members of different subgroups. Thus the location of friendships within and between subgroups help us to understand the specific mechanisms through which trust is enforced among the French financial elite.

And yet there are enough commonalities between actors of different subgroups to integrate the whole into a moiety. For example, the basis of the bridges between the members of Subgroup A and the members of subgroup D resides in commonalities represented by employment in the treasury. As such the Socialists who are central in subgroup A establish themselves as mediators between the AFEC members of subgroup C and the more advantaged members (in terms of attending ENA) of the right in subgroup D. Perhaps the role was established when the socialists were in power and adopted the pragmatic route of privatizing industry, requiring them to draw on commonalities with members of other subgroups of varying economic advantage and politics. This interpretation would be consistent with the bridges between the members of subgroups A and B, many of which have a basis in employment in the banking industry.

5. The General Value of Embedding Subgroups in a Sociogram

We have revealed the structures of two very different social networks. The image of professional discussions among teachers in “Our Hamilton High” helped us to explore the structure through which teachers influence each other’s approach to teaching. The image of friendship patterns among the French financial elite helped us to specify the mechanism through which actors enforced the trust of other actors. Further, each image sustained a description of the processes at the level of the individual and the group as a whole. Visually, subgroups are the key to generalizing a set of interactions in the sociogram making it possible to describe effects on actors of members of a given subgroup, and effects of subgroups on one another. The visual representation is consistent with theoretical descriptions of subgroups linking individual and organization as individuals influence one another through direct interactions within the subgroup, and then integrate into the larger organization through interactions outside of the subgroup (Granovetter, 1973; Nadel, 1957; Simmel, 1955).

The techniques demonstrated in this article hold great potential for characterizing the

structure of other social networks[4]. The extent to which the potential will be realized will depend on several factors. The definition of a cohesive subgroup almost inherently assumes that the data are not directed. Actors influence each other, and trust is enforced, through mutual ties. For directed data, perhaps it may be more sensible to first categorize actors into structurally similar blocks instead of cohesive subgroups, although to the extent that blocks are structurally equivalent and not cohesive the interpretation of such figures will not benefit from the generalization of processes within subgroups (see Frank 1996 for the difficulty in interpreting figures based on blocks of structurally similar actors).

Most importantly, the interpretation of images of network structures will depend on theoretical descriptions of processes related to the form of the social network data. We interpret Figure 2 in terms of influence, and Figure 3 in terms of enforceable trust. While the methods for generating the sociograms may be applied across many disciplines, the interpretations of the figures, will, of course, be discipline dependent. Figures representing economic exchange may be interpreted using theories of rational action. Figures representing political support may be interpreted according to game theory. And yet the representation of social networks in our figures has allowed us to integrate components from seemingly eclectic theories. Our images reveal representations of strong and weak ties, structural holes, and processes at individual and group levels. We hope that broader applications will reveal commonalities in theories of several disciplines even as each set of data is interpreted using the predominant theories of the most relevant disciplines.

[4] We are working with Steve Borgatti to incorporate the clustering program KliqueFinder and the techniques for constructing the MDS-based images into the next version of UCINET in order to make the approach described in this article more accessible.

Figure 1
Theoretical representation of Subgroups Embedded in a Sociogram

Reprinted with permission from page 65 of Burt (1992). *Structural Holes*. Cambridge: Harvard University press.