CENTRALITY MEASURES AS METHOD TO IDENTIFY KEY STAKEHOLDERS
IN FAMILY VIOLENCE COUNCILS

BY

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THESIS

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ABSTRACT

The Family Violence Councils (FVC) are collaborative settings that bring together various organizations involved in the system's response to family violence (e.g., domestic violence shelter programs; law enforcement; courts). FVCs aim to increase coordination among member organizations. Social network analysis (SNA) is a technique that allows one to assess the connections between members (e.g., agencies) within a particular bounded network (i.e., network with a clearly defined set of members; Scott, 1991) and is well-suited to the study of councils. SNA has a variety of tools that can be used to assess the nature of relationships between members (e.g. organizations); centrality measures indicate which members in the network are central and prominent players in the setting. The current study applied three centrality measures in five councils to identify consistent patterns regarding which organizations tend to be most central in the exchange of information among agencies responding to family violence. Identifying consistent central organizations may reveal which organizations are critical to engage to facilitate such information exchange. Further, the study examined whether centrality was related to the degree to which a given organization's policy and practices were influenced by council efforts. The study found domestic violence programs emerged as central organizations in four of the five sites, but the pattern was unique in each of the five communities. The study also found a relationship between an organization's centrality and perceived shifts in its policy and practices. The implications of these findings for research and practice will be discussed.

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INTRODUCTION

Collaboratives are popular structures formed to address systems change in response to various social issues (e.g. domestic violence, child welfare services, juvenile delinquency, community health; Berkowitz, 2001). Collaboratives include coordinating councils, community-based coalitions, and interagency teams (herein referred to as councils; Allen, Watt, & Hess, 2008; Berkowitz, 2001; Wolff, 2001) and typically bring together various stakeholders to promote an integrated response to complex issues. Frequently, interagency coordination is the specific method encouraged to produce such an integrated response across organizational boundaries (Alter, 1990). That is, councils encourage multiple organizations to work together as part of a coordinated whole by, for example, exchanging information, making referrals to one another, and sharing resources (e.g., Foster-Fishman, et al., 1999; Himmelman, 2002). Given the emphasis on interagency coordination, Social Network Analysis (SNA) provides a potent tool for examining such connectivity.

The current study explores the use of a specific class of network indices, centrality indices, to examine the nature of interagency coordination in the form of information exchange, as well as the role that specific organizational types play in encouraging such exchange. Specifically, examining centrality turns our attention to the specific organizations that function as "bridges" or as "hubs of exchange" in the network by connecting otherwise unconnected organizations (Burt, 1995) or being broadly connected to others in the network (i.e., degree centrality). Examining centrality can provide a picture of the specific roles organizations take within interorganizational collaborative networks. Further, the current study examines how various indicators of a

given organization's centrality in the network are related to attributes of the organization being influenced by council efforts (in terms of perceived changes in policy and practice).

Himmelman (2002) provides an important distinction between *collaboration* and *coordination* as dimensions of interagency relationships. Himmelman argues that collaboration falls on a continuum of complexity and commitment – collaboration reflects the greatest degree of shared risk and responsibility among organizational partners. Coordination is positioned just before collaboration on this continuum. Specifically, Himmelman defines coordination as "exchanging information and altering activities for mutual benefit and to achieve a common purpose" (Himmelman, 2002, p.2). Given the common emphasis on encouraging interagency coordination as one component of a collaborative process, one way to understand how councils affect change is to examine the specific nature of coordination across organizations and stakeholder groups, and to look at the exchange of information among these groups.

The Case of Family Violence Coordinating Councils (FVC)

The current study focused on Family Violence Councils (FVC; herein referred to as FVC or councils). These councils are formed to improve the systems response to family violence by encouraging interagency linkages between domestic violence service providers and criminal justice agencies, in particular. The FVC are organized by judicial circuits in the State. Judicial circuits are regions organized by the State court system and typically include multiple counties. Thus, the FVC in the current study have strong ties to the judicial system and are typically chaired by Chief Judges of the circuit or their appointees. The local FVCs in the circuit get funding and technical assistance from the State Family Violence Coordinating Council and its state staff. Each local FVC attempts

to engage the various organizations in the circuit (both within and across counties) that are involved in the systems response to family violence. These organizations include, for example, domestic violence shelters, batterer's intervention programs, child welfare agencies, law enforcement, probation, and courts. As their name would imply, the councils aim to increase interagency coordination in their response to family violence.

In a given circuit, some of the critical responding organizations are active members in the council, some are peripherally involved in the council, and some are non-members, or not actively involved in council efforts. The active member organizations may be particularly important for a given local FVCs efforts, because they are likely to be better connected with other organizations than are more peripheral members or non-members (Allen, 2009). Therefore, identifying those agencies within a network that are both active and central members in the network may reveal the specific nature of the diffusion of new knowledge or innovation throughout the network.

Social Network Analysis

Social network analysis (SNA) is a technique that allows one to assess the linkages between members within a particular bounded network (i.e., network with a clearly defined set of members; Scott, 1991). SNA is well suited to the study of councils because it has a variety of tools that can be used to assess interagency linkages, including, for example, information exchanges, and the relationships between members (e.g., organizations) in a setting of interest (e.g., councils). One set of tools is the indices of network centrality, or metrics that capture the extent to which an actor in the network is connected to other actors in the network.

Defining network terms.

A first step in applying SNA is becoming familiar with the specific language used to describe networks. To begin, a social network is a set of actors and the relationships between them (Koehly & Shivy, 1998). Networks can be a group of friends, a school, or the agencies that comprise a system (e.g., criminal justice, human service) or that are engaged in a collaborative initiative. Actors can include individuals in a setting such as schools, groups in an organization (e.g. student groups in schools), or agencies in a system. Ties refer to the connections between the actors, and these can include the friendships between individuals, the exchange of information and resources between agencies, etc. In this study, settings refer to given networks of councils. Most relevant to the current study is the concept of centrality.

Centrality Measures

Among those tools relevant to the study of interagency coordination are various centrality measures that indicate which members in the network are central and prominent players in the network. Centrality is an important structural attribute of social networks. It is related to other group properties and processes (Freeman, 1979), including, for example, which member in the group has access to more information. Borgatti, Mehra, Brass, and Labianca (2009) in a recent review of network theory and literature state that a "fundamental axiom" in network research is that an actor's (or *node* in network language) position in the network determines in part the opportunities and constraints the actor encounters, "and in this way plays an important role in a node's outcomes" (p.894). An actor's power is then a result of the power of all other actors in the network, and the actor can be affected by changes in the network far away from it

(Borgatti et al., 2009). Thus, the more central an actor is the more powerful or influential its position in the network is, or the more central an actor the better positioned it is to be influenced by the efforts of the collaborative network.

The current study will apply a variety of centrality measures across five councils to identify consistent patterns regarding which organizations tend to be most central in the networks. Identifying central organizations may reveal which organizations need to be engaged to most effectively diffuse information and knowledge among such organizations. Effective diffusion of information might be integral to increasing requisite knowledge among the agencies in these settings, which has been identified as an outcome that collaborative settings are well positioned to accomplish (Allen, Watt, & Hess, 2008).

Centrality can be conceptualized at two levels. One is at the level of the individual actor in the network (i.e., node centrality) and the other is at the level of the whole network (i.e., network centralization). Node centrality identifies which individual actors are the most central in a network. Network centralization is the degree to which one actor or node in the network is more central than all other nodes (Freeman, 1979). The current study will examine both levels of centrality (actor-level and network-level centrality) in the councils' networks. Even at the level of the individual actor, there are several ways to conceptualize centrality, and each actor level conceptualization has a corresponding network level conceptualization. An actor being central in a social network suggests that it is more connected to other actors in the network and therefore in a more advantageous position for outcomes such as access to resources in the network (e.g. information, funding opportunities, etc.). A network being more centralized suggests that one particular actor is more connected relative to other actors in the network.

Actor Centrality

  Degree Centrality.

  The three most common conceptualizations of centrality were described by Freeman (1979) in his seminal paper (see Table 1). The first is "degree centrality". In SNA, the degree of a particular actor is the number of other actors s/he is adjacent to or in direct contact with (Freeman, 1979). Thus, the degree of an organization would be the number of other organizations with whom it directly exchanges information. For communication networks, nodes with high degree centrality have high visibility or "potential for activity" (Freeman, 1979). Information exchange networks can be conceptualized as communication networks. An organization that has high degree centrality has access to a lot of direct information because it has direct contact with many other organizations. Thus, this organization may be "in the know" by virtue of these ties. Degree based network centralization would tell us whether one organization has more information exchanges with others compared to all other organizations in the network (Freeman, 1979). Figure 1 illustrates the concept of degree centrality in a hypothetical network of five organizations. In this figure, Organization A has the highest degree centrality because it is the only organization that is directly linked or connected to all other organizations in the network.

  In terms of interagency coordination, organizations with high degree centrality might be critical for access to information or other resources in the field of interest since they are likely to be the most well informed because of their extensive connections and relationships with other organizations. To illustrate, in a social network analysis of social capital in collaborative planning settings, Mandarano (2007) examined degree centrality

as an indicator of each actor's social capital. Social capital was assessed in terms "of new relationships formed, network structures, factors that influenced the formation of new social ties, and influence of the structure of the social networks on realizing successful outcomes" (p. 246). In this application of centrality, the number of an actor's ties (or contacts with other organizations) serves as an indicator of its relationships with others in the setting, and therefore as an indicator of its social capital. The study examined a regional collaborative environmental partnership and found that the United States Environmental Protection Agency (US EPA) consistently emerged as the central organization across different types of exchange networks. In the exchange networks where additional organizations were identified as central, these, too, were governmental agencies. These findings indicated that governmental agencies were more central in the various exchange networks and non-governmental agencies were peripheral by comparison. Mandarano (2007) suggests this information can be used to illustrate gaps in resource and funds exchange networks to revisit activities to bridge those gaps. If done early, this could provide practitioners with specific information to bridge the gap between the most distanced stakeholders and other stakeholders. Such an approach could be used with the FVCs to identify organizations that have the most access to information in the network by means of their extensive connections with others.

Similarly, Mendel, Damberg, Sorbero, Varda, and Farley (2009), in their study of partnerships to support patient safety practice adoption, also examined which agencies were central using two different criteria, including degree, in inter-organization partnerships to identify key stakeholders that had access to resources. They found that government agencies in general tended to be most central in the overall network on

measures of centrality. In particular, the federal Agency for Healthcare Research and Quality (AHRQ) was located in central positions in the network, which was not surprising given that it was the federal agency with the funding resources and the agency that initiated the evaluation of organization partnerships to support patient safety. Since governmental agencies tend to be central in interagency settings, and are also the agencies that tend to have access to funding, they are critical to engage in collaborative efforts in such settings.

Betweenness centrality.

The second type of centrality that Freeman (1979) describes is "betweenness centrality". The betweenness centrality of a given actor is the frequency with which an actor falls in between pairs of other actors on their geodesic distances (i.e., shortest distance between two actors). "An [actor] that falls on the communication paths between other [actors] exhibits a potential for control of their communication" (Freeman, 1979, p.221). An actor that falls on some but not all geodesics connecting a pair of other actors has more limited control. For example, if two organizations are linked by only one other, the latter organization may have a high level of control over their communication. Actors with high betweenness centrality are seen as powerful brokers in a network because they have the potential to cut other actors' information sources (Freeman, 1979). That is, those actors are only connected by virtue of their linkage to the actor, or actor(s) "in the middle." However, in the study of councils, another way to think about an organization with high betweenness centrality is as an organization that has the potential for bringing together organizations that would otherwise not be in contact and therefore as bridges or connectors of agencies. Betweenness network centralization then would be an index of

the degree to which a particular organization has more power to control information exchange than other organizations (Freeman, 1979), or alternatively has more potential to transmit information to otherwise unconnected organizations. In Figure 2, the same five organizations exist in the network as Figure 1. However, in this network, the various organizations are connected to each other by virtue of their links with Organization A. Thus, Organization A is connecting other organizations (e.g. Organization B and Organization D) that would otherwise have no contact with each other.

By examining betweenness centrality in collaborative settings, it is possible to identify organizations that might serve as "information brokers" that connect various stakeholders and therefore increase interagency coordination. For example, Berardo (2009) examined the effects of centrality on interagency connections in multi-organization policy arenas. The policy arenas that were studied were U.S. estuaries. This study found that for complex interagency teams, such as the estuary settings, it might be more cost effective to increase the connections between various stakeholders through other central organizations rather than create a densely connected team overall. The estuary settings are similar to the FVC in that they both are created to bring together various governmental and non-governmental organizations to address a common concern. Many of the organizations in the estuary networks had National Estuary Program (NEP) status which meant they received funding to implement coordination efforts, just like every FVC network receives funding and technical assistance from the state staff for collaboration efforts. Also, just like there were NEP and non-NEP organizations in the estuary network, there are member and non-member organizations in the FVC networks. Given these similarities, betweeneness centrality may be an important component of

efficiency in communication in the FVC networks by creating hubs of information exchange.

In addition to identifying key stakeholders in a setting, one can also examine how being located in central positions affects actors in the network or what actors in central locations are positioned to do. In their review of network analysis in the social sciences, Borgatti and colleagues (2009) found that a firm's centrality in its network predicted the firm's ability to innovate as well as perform well financially. This might be due to the availability of resources to central actors, including the most innovative knowledge in the field. "Perhaps the most common mechanism for explaining consequences of social network variables is some form of direct transmission from node to node" (p.894). This method could be applied to collaborative settings to identify central actors in a setting as possible innovators when it comes to designing and implementing collaborative projects.

Closeness centrality.

The last notion of centrality Freeman (1979) describes is "closeness centrality", which measures how close an actor is to all other actors (i.e. how many lines does it take to connect a given actor to all of the other actors in the network, on average?). It can only be calculated on connected networks (i.e., networks where all actors are connected to each other and there are no isolates; Freeman, 1979). Closeness centrality is also related to control of information but in a different way than betweenness. An actor is central to the extent it can avoid being controlled by others because it is so closely connected to many organizations and therefore not dependent on any single organization to be linked to a network. With closeness centrality, a central position does not have to depend on any one actor as a "go between" to relay messages to it since it is well connected to many

actors (Freeman, 1979). Freeman (1979) states that the "independence of an [actor] is determined by its closeness to all other [actors] in the graph" (p.224). The degree of independence of a given actor being dependent on closeness centrality is somewhat paradoxical; however, it illustrates the importance of interdependency in networks. In order for an organization (Organization A) to be up to date on issues concerning its functioning it has to be connected to other organizations in the systems it is involved in. The more organizations Organization A is connected with, the more sources of information it will have, and the better informed it will be. Organizations that have low closeness centrality are in a vulnerable position to not be well informed because they are not well connected to other organizations. The organization that is most central using this measure is the one to target if one wants to minimize the cost and time for communicating to all other points (Freeman, 1979). Figure 3 illustrates this concept with the same hypothetical network used in previous examples. Organization A is the most closely connected organization in the network because it is the only organization that is either one or two ties away from all other organizations in the network (i.e. it either has direct contact with another organization or has to go through only one other organization to reach another organization). For example, while Organization B has the same number of direct contacts as Organization A (i.e., two), Organization A only has to go through Organization E to get to Organization D, but Organization B has to go through both Organization A and Organization E to get to Organization D. Therefore, Organization A is more closely connected than Organization B. Closeness network centralization works the same as other network centralizations (i.e., it indexes the degree to which one organization is closer to all others). When considering interagency coordination, this is

particularly valuable because identifying the central organization that needs to be engaged for the timely dissemination of information might be critical for effective coordination efforts. This is particularly true when a given organization is critical to the effective implementation of a given effort.

Notably, there are other important contributors to the development of centrality measures (e.g., Bonacich 1972; 1987). However, for the current study, only the three measures described by Freeman (1979) were examined given the purpose of collaborative settings is to increase cooperation and coordination among the various stakeholders they bring together (Alter, 1990; Berkowitz, 2001; Allen, Watt, & Hess, 2008). Bonacich's conceptualization seems more appropriate when one is looking at competition and bargaining power as well as cooperation. Also, in a review of approaches to centrality, Marsden (1990) found that according to one study examining the three Freeman measures with Bonacich's measures in a network, all were positively correlated and that betweenness centrality was the least redundant with all others. This is not surprising considering that "the range of variation in scores, both for [actor] centrality and [network] centrality, is greatest for the indexes based on betweenness; they are 'finer grained' measures than the others" (Freeman, 1979, p.237).

Network Centralization

In addition to actor centrality, one can also examine network centralization to see how centralized the network is overall. If overall network centralization is high, then the central actors in such networks are critical to engage for information dissemination or access to resources as central actors. If network centralization is low, such truly "central" actors would not be present. For example, Mendel and colleagues (2009), in addition to

identifying Agency for Healthcare Research and Quality (AHRQ) as central in partnerships supporting patient safety adoption, found that network centralization increased in over time. This highlights AHRQ's critical role, but also suggests that timely dissemination of information and practices is highly dependent on AHRQ. The authors suggest that:

> In a highly centralized network, these central hubs represent single points of failure, which, if removed or damaged, quickly fragment the network into unconnected subnetworks. A less centralized network has fewer points of failure and exhibits greater resilience. At the same time, network centralization, like density, is associated with faster diffusion of innovations. Thus, although a centralized network is more efficient, it may be more prone to failure and less empowering to average members (p.722).

So, although being central in a highly centralized network might be beneficial for the individual central organization, it might be viewed as less empowering for the other organizations and might make coordinated efforts vulnerable to failure because of their central dependence on a given organization. Network analysis measures, such as actor and network centrality, can be used to see which organizations are central players in the network for the dissemination of information and innovation, but we can also use these measures to identify weaknesses in the structure. For example, if a given network is found to have high overall network centralization, it might be overly dependent on its central actors for information exchange and other coordination activities. However, to the extent central organizations are stable and committed to the work of FVCs, such centrality may be more of a strength than a liability. Examining network centralization in

conjunction with actor centralization can inform interagency efforts by highlighting structural strengths and weaknesses, which partners need to be more fully engaged, how positions need to be reconfigured to enhance communication or reduce vulnerability, and which actors are currently central and thus critical to engage in new efforts.

Centrality and council influence.

It is also important to understand how centrality relates to the degree to which given organizations are affected by council efforts to produce change. That is, how likely an organization is to benefit from collaboration may depend on its position in the collaborative network (Borgatti et al., 2009). FVCs are particularly concerned with stimulating policy and practice changes in the network of organizations responding to family violence. This follows an emphasis on producing changes "in the text" that govern the response of front-line providers (Pence, 1999). The extent to which an organization is centrally located in a network may make it more susceptible to influence via council efforts. That is, the organizations that are centrally located, and thus have access to information and resources in the network (Freeman, 1979), are better poised to make informed changes to their policy and practice in response to FVC efforts. Those that are less central may be less subject to influence because they are not well connected to the core of information exchange occurring in the network. Further, different types of centrality may function differently in relationship to organizational change in policy and practice.

Current Study

The current study, therefore, examines three actor and network centralities (i.e. degree, betweenness, and closeness) in the information exchange networks of five Family

Violence Councils to identify the overall pattern of the exchange networks (i.e., network centralization) and the key players in those patterns (i.e., actor centrality). While exchange of information is a key aspect of coordination, very few studies have examined which organizations, or organization types, are central in information exchange networks among the member organizations of collaborative settings. By identifying possible organizations that are key players in information exchange networks, the current study aims to identify organizations that are critical to engage for effective diffusion of knowledge and coordination efforts in collaborative settings, such as Family Violence Councils. Further, although previous studies have utilized one or more types of centrality in their methods, no study to date has looked at the three primary types of centrality (i.e. degree, betweenness, and closeness) in information exchange networks in the same setting and across five such settings. The comparison of multiple settings within the current study allows for greater generalizability, while the use of multiple measures of centrality yields results that have the potential to lead to a more nuanced understanding of information exchange and the role of centrality in collaborative settings.

Finally, the current study examines how centrality is related to the extent to which given organizations have been influenced (in terms of perceived change in policy and practice) by FVC efforts. Given the goal of councils to facilitate such organizational change, the current study examined the relationship between centrality and peer-ratings of an organization's shifts in practice and policy as a result of council efforts. This allows for an examination of the extent to which centrality – in its different forms – is related to the degree to which organizations are affected by the systems change work of FVCs.

Research Questions

The current study examines four questions. First, which organizations emerge as central in FVCs (e.g., domestic violence programs, law enforcement, courts)? Second, do different organizations emerge as central using the different criteria for centrality? Third, to what extent are there differences across sites when looking at centrality? Lastly, is centrality related to the extent to which organization's policies and practices are affected by council efforts?

METHODS

The current study was part of a larger study on the FVCs in the state. For this study, five representative and exemplar local FVCs from the state were chosen. These sites were chosen based on (a) geographic representativeness (i.e., different locations throughout the state; with different compositions in terms of urban, suburban and rural counties), (b) structural make-up (FVCs vary in terms of their subcommittee structure being aligned with substantive issues, like law enforcement response, that are circuit wide and span multiple counties or subcommittees that focus on the response to family violence within given counties), and (c) being generally viewed as settings that have had some important successes. General descriptive information about the five circuits examined in this study is presented in Table 2. Since the network survey was only sent to members of local FVCs, only member response rates could be calculated (i.e., nonmember response rates were zero, by design). However, to reflect a complete network for a given FVC (i.e., one that had all of the key responding agencies), network rosters had both member and non-member organizations on them (see below). Member response rate was calculated by dividing the number of responding organizations by the number of member organizations on the network roster. For the five sites examined in this study, member response rates ranged from 42.4% to 70.6%. This is a typical range for survey data gathered via mail (see Anseel, Lievens, Schollaert, & Choragwicka, 2010).

Network Bounding

To conduct network analysis a variety of methodological decisions must be made. The first of these is how to "bound" the network, or choose which actors should be included in the network roster. Each judicial circuit constituted a separate and unique

network of organizations responding to intimate partner violence, including organizations at the Circuit (i.e., courts, domestic violence shelter programs), County (sheriff's office, state's attorney) and Local (e.g., municipal police, local agencies) levels. For the purpose of this study, in a given Circuit all domestic violence programs (DV), batterer's intervention programs (BI), courts (C), probation departments (P), sheriff's offices (LE), State's Attorneys (SA), and police departments (LE) were included.[1] It is important to note that in each Circuit, not all relevant agencies were current council members or affiliates. Thus, the network list (or roster) used to survey potential affiliates within each Circuit was formed in a two-stage process. First, all relevant agencies that were included in councils' membership lists were included on the survey roster. Second, any agencies not included as council affiliates, but that played a role in the criminal justice response to intimate partner violence were added (e.g., circuit clerk, states attorney). Resultant network survey rosters included all agencies that could be involved in a coordinated response to intimate partner violence, some of which were members and some of which had no council affiliation (i.e., non-members). Even though only committee member agencies were asked to respond to the survey, the inclusion of both member and non-member agencies' names on the network roster was useful given the aim was to assess member organizations' connections with one another *and* with non-member agencies within their Circuit networks. This allowed us to begin to establish patterns of interaction among the full network of responders and to examine their exchange of information in

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[1] For circuits that were large and had numerous police departments, a random sample of departments was included in its netweor roster. This was important because we wanted to ensure that at least one city police department was included in the network list for each county in a judicial circuit. Therefore, we compiled a list of all city police departments for each county of each circuit. For each county, we used a random number generator to pick one random city police department that was not part of council membership. In most cases, this resulted in adding as many random police departments as there were counties in a Circuit.

light of council membership.

Measures

Exchange of information.

Members were surveyed regarding their contact with all of the agencies identified as part of the network. Specifically, respondents were asked to report how often they exchanged information with each organization in their Circuit's network list (using a six-point Likert-type scale; 1 = Never, 2 = Once/year, 3 = Twice/year, 4 = Monthly, 5 = Weekly, 6 = Daily; these value were recoded from 0 to 5 for all subsequent network analyses). Respondents also had the option of checking a "NO knowledge of, contact with or opinions about" box for each organization. Each organization was listed in a separate row on the survey, and respondents considered the full set of ties for each organization listed in the network roster. The membership status of organizations was not indicated in the roster. If a respondent had checked the "NO knowledge of, contact with or opinions about" box for an organization, the exchange of information tie was coded as "never."

Peer ratings of organizational change as a result of council efforts.

For each organization in the roster, respondents were also asked to rate the degree to which they perceived that membership in the Council had (a) changed policy and procedure within the organization and (b) changed the practices of the organization (using a four-point Liker-type scale; 1 = not at all, 4 = a lot, and 7 = Don't know). If a respondent had checked the "NO knowledge of, contact with or opinions about" box for an organization, the two perceptual variables (i.e., changes in policy and procedure and

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Using random sampling in this fashion was critical given that some network lists would be unduly large if all non-member municipal law enforcement agencies were included.

changes in practices) were coded as missing. Thus, the resultant score is a peer rating, generated by respondents who have at least some contact or knowledge of the target agency.

Member status.

A membership variable was created with 1 = member and 0 = non member, and each organization was categorized on this variable. This variable was created to include in subsequent regression analyses, given that an organization's membership in an FVC makes it more susceptible to influence by the FVC when compared to non-members.

Sector.

A sector variable was created to indicate which system (or sector) in the response to intimate partner violence an organization belonged to. The possible values for this variable were 1 = domestic violence (DV) program, 2 = batterer's intervention program, 3 = law enforcement, 4 = court, 5 = probation, 6 = state's attorney, and 7 = Department of Children and Family Services (DCFS). Each organization was categorized on this variable. After the initial categorization, the sector variable was recoded into six dummy coded variables with domestic violence program being the referent group.

Procedures

Responses regarding the exchange of information across agencies were used to calculate the three different types of node centrality (i.e., degree, betweenness, and closeness) and the corresponding overall network centralization for each council. Network tie data were gathered at the level of individual council members, who responded as representatives of their respective agencies. To form a network matrix at the organizational level, the individual member-level database was aggregated to the

organizational level. If a single organization had more than one respondent, then the mean score of multiple respondents' scores within that organization was used to compute one score for the whole organization. In the aggregate network matrix, a row was included for each organization on the survey roster, including organizations from which we did not receive a survey response.

Analyses

UCINET software was used for all social network analyses. The exchange information aggregate network matrix for each circuit was uploaded to UCINET. Given that social network analysis software requires a complete matrix (i.e., a perfect square matrix of actors X actors), missing data were replaced with 0s ("no tie"). This assumes no contact between a given non-responding organization (member or nonmember) and all others. However, in subsequent steps we used *unconfirmed* ties (i.e., where contact between two agencies is established if either one reports a connection; so if a survey respondent indicated having a tie with a survey nonrespondent, then we took the respondent's word that a tie existed). By using unconfirmed ties, we were able to establish ties involving agencies for whom no one responded but *about* whom other agencies responded (i.e., a domestic violence shelter program may indicate contact with a given law enforcement agency even though no one responded from the law enforcement agency). Thus, exchanges were indicated based on either organization in a given dyad indicating they had contact.[2] Thus, in situations where no data were available contact could be established based on the report of only one organization within a given dyad.

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[2] For example, person 1 from Organization A reports exchange of information with Organization B. However, person 2 from Organization B indicates no contact with Organization A. To reflect the most comprehensive exchange of information between Organization A and B, one has to consider person 1's

To calculate unconfirmed ties, the matrix was made symmetric using the maximum of the two data points generated by any two organizations within the network. The matrix was also made dichotomous so that ties indicating any contact (i.e., at least annual contact) received a "1" and no contact received a "0." To calculate Freeman's centrality measures on networks, the ties have to be dichotomous. Once the symmetric and dichotomous matrices for each council were uploaded to UCINET, the three centrality measures were calculated for each council's network. For those networks that had isolates (i.e., organizations that had no connections with any other organizations in their network), just the connected network was extracted from the overall network to measure closeness centrality since this measure of centrality can only be calculated on connected networks. In UCINET, there is a function to extract the main component from any matrix (i.e. only the connected network, excluding the isolates). Once the main component is extracted, closeness centrality can be indexed on that network. The other two indices of centrality (i.e., degree and betweenness) were calculated on the full network for each council. The three corresponding network centralization indices for each type of point centrality were also calculated on each of the five sites. Network centralization, as explained above, is the extent to which one actor is more central than all other actors in the network. It is calculated by taking the "differences between the centrality scores of the most central point and those of all other points" and it is expressed as a ratio (or percent) of "the actual sum of differences to the maximum possible sum of differences" (Scott, 1991, p.93). Network centralization can vary from 0 to 1 (or 0 to

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unconfirmed tie. This is a common approach when key informants are utilized to establish ties between agencies (see Foster-Fishman, Salem, et al., 2001 for an application of this approach).

100%) for all three types of network centralization, with values closer to 1 or 100% indicating highly centralized networks.

Regression analyses were done to see the relationship between the centrality measures and the two perceptual measures regarding perceived changes in policy and procedure and perceived changes in practice due to membership in the council, while controlling for the effects of the circuit size on centrality. To control for circuit size, four dummy coded variables were created for circuit A – circuit D, with Circuit E being the referent group. These four dummy variables were entered in all regression analyses as control variables. Eight separate hierarchical regression analyses were done. Six of these had an organization's membership status and the four dummy coded circuit variables as control variables, one of the centrality measures (i.e. degree, betweenness, and closeness) as predictor variables, and one of the perceptual variables (i.e. perceived changes in policy and procedure and perceived changes in practice) as a criterion variable. The other two hierarchical regression analyses had an organization's membership status and the four dummy coded circuit variables as control variables, all three centrality measures as predictor variables, and one of the perceptual variables as a criterion variable. Additionally, three more hierarchical regression analyses were done to see if there was a relationship between organization type (i.e., sector) and centrality. For these analyses, the four dummy coded circuit variables were the control variables, the six dummy coded sector variables were the predictor variables, and one of the centrality measures (i.e., degree, betweenness, and closeness) was the criterion variable.

RESULTS

Freeman's Degree Centrality

Freeman's degree centrality and corresponding network centralization were calculated on the complete network across all five circuits. The three most central organizations in each circuit along with the circuit's overall network centralization are given in Table 3. As can be seen from the table, a Domestic Violence Program emerged as a central organization in all sites except Circuit B, indicating that in most Circuits, Domestic Violence Programs tended to have more direct connections with other organizations in their networks. However, it is important to note that Domestic Violence Programs were not the most central organizations in every circuit. Law enforcement organizations, namely Local Police Departments, State Police, and County Sheriff's Departments, were also highly central. Circuit E and Circuit B were more highly centralized networks than the others, indicating that the central organizations in these networks might be more critical to target for access to information, compared to the central organizations in the other, more diffusely-connected networks.

Freeman's Betweenness Centrality

For Freeman's betweenness centrality and corresponding network centralization, again the complete network was examined for the five circuits and the results are given in Table 4. Most of the same organizations emerged as central using the betweenness index as those using the degree centrality index. It is important to note that more Domestic Violence Programs emerged as central using the betweenness index than the degree index, indicating that Domestic Violence Programs are even more important as bridges between otherwise unconnected organizations in the network. However, Domestic

Violence Programs are still not central in Circuit B. Another important contrast between the two tables involves the network centralization rates. The networks are not as highly centralized using the betweenness index as they are using the degree index, which might indicate that while Domestic Violence Programs are important "connectors", they are not the only bridges between unconnected organizations. Other organizations might also be serving as important links in the network, such as law enforcement agencies and County Probation Departments.

Freeman's Closeness Centrality

Circuit D had isolates (i.e., organizations that were not connected to any other organizations in the network) in its network, and therefore the closeness centrality could not be calculated for its complete network. Therefore, the main component, or the connected network, was extracted from the complete network and the closeness centrality analyses were only done on the main component for Circuit D. For the other four circuits, the closeness centrality analyses were done on the complete network, and the results are presented in Table 5. Again, the only change between the degree centrality table and the closeness centrality table is in favor of a Domestic Violence Program, illustrating that Domestic Violence Programs are also closely connected, in addition to being connected to many other organizations in their networks. This phenomenon is a result of the strong correlation between the various types of centrality in this sample, and suggests that even though other organizations might have to rely on Domestic Violence Programs for access to information in their networks, Domestic Violence Programs are fairly independent (i.e., they do not have to rely on others for information). Because Domestic Violence Programs have close ties to many different organizations, they do not have to rely on any

one particular organization for information, thus making them less vulnerable to being cut-off from access to information. For the overall network centralization, only Circuit E was highly centralized with others being more moderately centralized networks. In this circuit, the county criminal justice agencies, namely County Sheriff's Office and County Judiciary, were also highly central in addition to a Domestic Violence Program.

A series of regression analyses were also conducted to see the links between centrality and council efforts, namely perceived shifts in policy and practices. Six regression analyses had membership status and circuit as control variables, one of the centrality measures (i.e. degree, betweenness, and closeness) as the predictor variable, and one of the perceptual variables (i.e. perceived changes in policy and procedure and perceived changes in practices) as the outcome or criterion variable. Two additional analyses were done where all the centrality measures were entered at once as the predictor variables for each of the outcome variables. The results of the regression analyses are presented in Tables 6 – 13. The correlations between the predictor variables are presented in Table 14. All regression analyses were significant ($p < 0.01$), even after controlling for circuit size and membership. For analyses with peer-ratings of changes in policy and procedures as the criterion variable, the degree centrality coefficient ($\beta = .308$, $t(292) = 5.151$, $p = .000$), the betweenness centrality coefficient ($\beta = .154$, $t(292) = 3.124$, $p = .002$), and the closeness centrality coefficient ($\beta = .365$, $t(291) = 6.229$, $p = .000$) were all significant. However, when all three centrality measures were entered together as predictor variables, only closeness centrality was significant ($\beta = .594$, $t(291) = 3.727$, $p = .000$). Similarly, degree centrality ($\beta = .298$, $t(292) = 4.935$, $p = .000$), betweenness centrality ($\beta = .140$, $t(292) = 2.815$, $p = .005$), and closeness centrality ($\beta =$

.355, $t(291) = 5.982$, $p = .000$) were significant predictors of peer-ratings of changes in practices after controlling for membership status and circuit size. But again, only closeness centrality was a significant predictor of perceived changes in practice ($\beta = .588$, $t(291) = 3.654$, $p = .000$) among the three centrality indices when all three were entered simultaneously. The probable reason for degree centrality and betweenness centrality no longer being significant predictors of the outcome variables when examined concurrently with closeness centrality is the high correlation between the three centrality indices. When all three are examined simultaneously, only the centrality index accounting for the most variance (i.e., closeness centrality) emerges as a significant predictor. The implications of the high correlation between the centrality indices are discussed below.

To examine whether a particular organization type (i.e., sector) was more likely to be central, three hierarchical regression analyses were done with dummy coded circuit variables as control variables, dummy coded sector variables as the predictor variables, and each of the three centrality indices as the criterion variable (see Tables 15 – 17). For degree centrality and closeness centrality, four of the six sector regression coefficients were significant. Except for State's Attorney and DCFS, all the other sectors were significantly less likely to be central using these two indices than domestic violence programs (i.e., the referent group). For betweenness centrality, only the DCFS coefficient was not significant, meaning all the other sectors were less likely to be central than domestic violence programs. One of the reasons that DCFS and State's Attorney comparisons with domestic violence are not significant might be that there are significantly fewer organizations in these two sectors than in the domestic violence program sector. For example, every circuit only has one DCFS, making the total number

of DCFS agencies in the sample five. Therefore, even if only one DCFS agency emerged as central in the sample (i.e., Circuit D), then DCFS is disproportionately represented as central in the sample. These results indicate that, overall, domestic violence programs are more likely to be central players in Family Violence Councils.

DISCUSSION

The purpose of this study was to explore what organization types emerged as central in Family Violence Councils (FVCs), and to examine whether centrality was related to the extent to which council efforts affected change in organizational policy and practice. Identifying central organizations in collaborative settings is important because these organizations might be especially integral to coordination efforts by nature of their extensive connections to other organizations in the network. This study was the first to examine three different measures of centrality in a collaborative network and compare them across five networks and explored which types of organizations are central and prominent in one type of collaborative setting, Family Violence Councils.

Domestic Violence Programs emerged as central actors using all three criteria of centrality in all but one network. Previous research has found that governmental organizations tend to be central in collaborative initiatives (Mandarano, 2007; Mendel et al., 2009). However, the prominence of Domestic Violence Programs relative to governmental agencies may be explained by the agenda of FVCs. The agenda of FVCs is one that Domestic Violence Programs are invested in and might even be driving. Therefore, Domestic Violence Programs are highly involved in the councils and pursue ties in the council and impose themselves as central in the network to drive the council's agenda. This might then position them as change brokers to the extent they are viewed as legitimate players and experts on family violence. So, it might be the agencies that are highly invested in the agenda of the collaborative initiative that emerge as central and prominent players in the setting because of the active role they play in bringing other stakeholders together to respond to specific cases of domestic violence and to build

interagency relationships to improve the response to domestic violence cases more generally. This reasoning supports previous research. For example, Mandaro (2007) found that the US EPA was a highly central organization in estuary networks. This may be because the EPA is highly invested in the environmental agenda of the network. The highly invested and central organizations in a setting are the ones that collaborative initiatives should target for coordination efforts, such as access to information and resources, since these are the organizations that have extensive ties to other organizations in the network or are willing to take the time and effort to build those ties if they are not initially present.

While being highly central, Domestic Violence Programs are not the only prominent organizations in councils. Criminal justice agencies, especially law enforcement agencies, are also central and prominent players in FVCs. This finding supports previous research regarding the prominence of governmental agencies, such as law enforcement agencies, in collaborative settings (Mandarano, 2007; Mendel et al., 2009). Even if other types of agencies (i.e. Domestic Violence Programs) are highly central in a collaborative setting, governmental agencies are still important to involve in coordination efforts for systems response to complex issues. This may be due to the access to resources, such as funding, that government agencies have or it may be due to the necessity of involving government agencies for certain purposes (e.g. legal recourse for family violence). In particular, law enforcement agencies might be central due to their formal role as responders to family violence. By virtue of their work, many law enforcement agencies have to come into contact with other organizations when responding to family violence (e.g. Domestic Violence Programs, DCFS, courts, etc.).

Because of their formal and important role in the response to family violence, law enforcement agencies are often the target of systems change efforts. The position of law enforcement as central in a given network of responders may bode well for being able to leverage change. While domestic violence programs may have strong relationships with other stakeholders, law enforcement agencies may be viewed as organizational "insiders" by other criminal justice agencies. Their investment and centrality in a given network may suggest that they are poised to be an influential player to advance FVC efforts by bringing along their "peer" agencies (i.e., other law enforcement).

A surprising finding, and exception to either Domestic Violence Programs or criminal justice agencies being central, was the emergence of Department of Child and Family Services (DCFS) as central using all three criteria of centrality in Circuit D, as well as the DCFS regression coefficient being the only one that was not significant in the sector comparisons with domestic violence in all three regression analyses. One possible explanation for this is the vast area that Circuit D encompasses (as evident by the square miles listed in Table 2). Due to the vast size of the circuit, regional organizations, such as DCFS, might be the only organizations that formally serve numerous counties, and therefore are connected to organizations across counties, because their work mandates them to do so. This might also be true of the State Police, as a particularly central law enforcement agency given that they generally cover a broader region than any given township or city agency and often provide support to smaller law enforcement units.

Perhaps not surprisingly, the centrality of organizations in a given network was related to the perceived influence of council efforts on policy and practice. Degree, betweenness, and closeness centrality were related to peer-ratings of the impact of

council on changes in policy and practices. These three measures of centrality were linked to council efforts above and beyond the agency being a member of the council. So, while members of the council might be perceived has having greater shifts in their policy and practices relating to family violence, the extent to which these organizations are connected is also related to their being perceived as influenced by council efforts. This is further indication of centrality being an important attribute of networks because it might not only indicate which organizations to target for coordination efforts but also indicate that having a central position in a network makes organizations more poised for influence by FVC. However, it is important to note that when all three measures of centrality were examined simultaneously, only closeness centrality still predicted outcomes of interest, likely due to the high collinearity between the three centrality indices (see discussion below). This means that closeness (rather than degree or betweenness) may be the active ingredient in the centrality findings. That is, the key is not how many contacts an organization has, nor whether it is a bridge between contacts, but rather how close it is to all other members, on average. Conceptually, closeness is the index that would be used to capture how quickly contagious disease spreads from one person to all others in the network, because high closeness means the fewest steps from the focal actor to all other actors in the network. Thus future research on coordination in FVCs might consider conceptualizing centrality not only in terms of social capital (number of contacts or bridging/brokering), but also in terms of closeness--i.e., the network structural position that suggests quicker access to information from all others in the network, and perhaps quicker influence to all others in the network, on average.

There were certain limitations in this study. First, the study used organization informants' self-report regarding information exchanges with each other. Such self-report might be susceptible to self-presentation bias (i.e. respondents report more ties than actually exist to portray their organizations in a positive light) and assumes that a respondent's memory regarding her or his information exchanges with another organization is accurate. Future studies should use more objective measures of exchanges between organizations (e.g. paperwork regarding contacts between organizations) and compare those to self-reports of exchanges to see if the same network structure emerges using both types of information. A second limitation in the study is the high correlation between all three centrality indices (degree and betweenness: $r = 0.749$; degree and closeness: $r = 0.948$; betweenness and closeness: $r = 0.711$). Correlations as high as these indicate that the three might not be separate constructs. All three indices were still included in all analyses because conceptually they represent different phenomenon (i.e. degree centrality represents how vast an organization's direct contacts are, betweenness centrality indicates an organization's potential to be an information broker, and closeness centrality is how closely an organization is linked with others), and therefore the implications for a network and its organizations might be different using the different criteria. However, given the high correlation between the three, future studies interested in examining different measures of centrality in the same networks should look at the correlation between their centrality scores and if they are high, should consider choosing the measure most relevant to their outcome of interest.

This study examined what organization types emerged as central in five Family Violence Councils using three different criteria of centrality, namely degree,

betweenness, and closeness centrality. Domestic violence programs emerged as central

organizations in four settings, which is not surprising given their investment in the

agenda of the FVCs and therefore their involvement in the councils to shape the agenda.

In addition to domestic violence programs, law enforcement agencies also emerged as

central in the networks. This may be due to the formal role of law enforcement agencies

in the response to family violence, which by its very nature requires them to contact and

work with other organizations (e.g. courts, probation, DCFS). In especially large circuits,

regional agencies, such as DCFS and State Police, were also central and it was

hypothesized that this may be because such agencies are the only organizations that

formally serve multiple counties, and therefore have connections with organizations

across county boundaries. The study also found that centrality was positively related to

perceived influence of council efforts on policy and practices; that is, organizations that

were more central were also perceived as having the council impact changes in their

policy and practices. Future research should examine centrality in collaborative networks

longitudinally and see if the overall network becomes more centralized over time and

how the overall network centralization is related to the goals of the collaborative, such as

increased coordination. Examining collaborative networks longitudinally would also

allow one to see if the same organization types remain central as the collaborative

matures. For example, organizations that are providing the funding for the collaborative

might be more central during its formation. However, once the collaborative has matured,

other more direct service or advocacy agencies that are seen as experts in the field might

become more central. Such examination could help us further understand if the same

organization types remain prominent players in collaborative settings, and therefore are

important to target for change efforts.

Table 1

Definition of Three Centrality Indices

Centrality	Definition	Formula
Degree	Number of other actors a particular actor is directly connected to	$C_D(p_k) = \sum\limits_{i=1}^{n} a\,(p_i, p_k)$ $a\,(p_i, p_k) = 1$ if and only if p_i and p_k connected by a line; 0 otherwise
Betweenness	Frequency with which an actor falls in between pairs of other actors on their geodesic (i.e., path of shortest distance between any two actors)	$C_B(p_k) = \sum\limits_{i<j}^{n} \sum\limits^{n} \dfrac{g_{ij}(p_k)}{g_{ij}}$ g_{ij} = number of geodesics linking p_i and p_j $g_{ij}(p_k)$ = number of geodesics linking p_i and p_j that contain p_k $i \neq j \neq k$
Closeness	The number of social steps (ties) it takes, on average, to connect a given actor to all other actors in the network	$\dfrac{1}{C_D(p_k) = \sum\limits_{i=1}^{n} d\,(p_i, p_k)}$ $d\,(p_i, p_k)$ = the number of edges in the geodesic linking p_i and p_k

Note. Formulas adapted from "Centrality in Social Networks Conceptual Clarification," by L. C. Freeman, 1979, *Social Networks, 1,* p. 220 – 225.

Table 2

Description of Circuits

Site	Square Miles	Number of Counties	Council Structure
Circuit A	1,123	2	Primarily focused on one county
Circuit B	3,946	6	Circuit wide
Circuit C	1,482	3	Mix of circuit and county level organization
Circuit D	4,812	12	Circuit wide
Circuit E	5,446	9	Circuit wide

Table 3

Degree Centrality and Network Centralization

Site	1st central organization	2nd central organization	3rd central organization	Network Centralization
Circuit A	Domestic Violence Program	County Probation department	Police department	43.08%
Circuit B	State Police	Police department	State's Attorney's Office	60.72%
Circuit C	Domestic Violence Program	County Judiciary/Courts	Domestic Violence Program	48.22%
Circuit D	Department of Child and Family Services	Domestic Violence Program	County Sheriff's Office	53.08%
Circuit E	County Sheriff's Office	County Judiciary/Courts	Domestic Violence Program	65.24%

Table 4

Betweenness Centrality and Network Centralization

Site	1st central organization	2nd central organization	3rd central organization	Network Centralization
Circuit A	Domestic Violence Program	County Probation department	Police department	32.36%
Circuit B	Police department	State Police	State's Attorney's Office	28.60%
Circuit C	Domestic Violence Program	Domestic Violence Program	Domestic Violence Program	20.49%
Circuit D	Domestic Violence Program	Department of Child and Family Services	County Probation Department	31.22%
Circuit E	County Sheriff's Office	County Judiciary/Courts	Domestic Violence Program	20.69%

Table 5

Closeness Centrality and Network Centralization

Site	1st central organization	2nd central organization	3rd central organization	Network Centralization
Circuit A	Domestic Violence Program	County Probation department	Police department	43.53%
Circuit B	State Police	Police department	State's Attorney's Office	53.27%
Circuit C	Domestic Violence Program	County Judiciary/Courts	Domestic Violence Program	46.89%
Circuit D	Department of Child and Family Services	Domestic Violence Program	Domestic Violence Program	52.22%
Circuit E	County Sheriff's Office	County Judiciary/Courts	Domestic Violence Program	61.26%

Table 6

Degree Centrality as Predictor of Perceived Changes in Policy and Procedure

Variable	Model 1			Model 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Constant	1.461	0.044		1.422	0.043	
Member	0.258	0.038	0.340**	0.139	0.044	0.182**
Circuit A	-0.175	0.072	-0.127*	-0.305	0.073	-0.221**
Circuit B	-0.418	0.053	-0.481**	-0.421	0.051	-0.486**
Circuit C	-0.098	0.063	-0.084	-0.139	0.061	-0.119*
Circuit D	-0.185	0.048	-0.223**	-0.128	0.048	-0.155**
Degree				0.007	0.001	0.308**
R^2		0.363			0.417	
Change in R^2		0.363**			0.054**	

Note. N = 296. * $p < .05$. ** $p < .01$.

Table 7

Betweenness Centrality as Predictor of Perceived Changes in Policy and Procedure

Variable	Model 1			Model 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Constant	1.461	0.044		1.473	0.044	
Member	0.258	0.038	0.340**	0.219	0.040	0.288**
Circuit A	-0.175	0.072	-0.127*	-0.196	0.071	-0.142**
Circuit B	-0.418	0.053	-0.481**	-0.436	0.052	-0.502**
Circuit C	-0.098	0.063	-0.084	-0.123	0.062	-0.105*
Circuit D	-0.185	0.048	-0.223**	-0.185	0.048	-0.224**
Betweenness				0.012	0.004	0.154**
R^2		0.363			0.384	
Change in R^2		0.363**			0.021**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.

Table 8

Closeness Centrality as Predictor of Perceived Changes in Policy and Procedure

Variable	Model 1			Model 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Constant	1.463	0.044		0.706	0.129	
Member	0.255	0.039	0.336**	0.114	0.043	0.149**
Circuit A	-0.175	0.072	-0.127*	-0.300	0.070	-0.217**
Circuit B	-0.419	0.053	-0.483**	-0.437	0.050	-0.504**
Circuit C	-0.099	0.063	-0.085	-0.109	0.059	-0.094
Circuit D	-0.181	0.048	-0.219**	-0.079	0.048	-0.096
Closeness				0.016	0.003	0.365**
R^2		0.363			0.438	
Change in R^2		0.363**			0.076**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.

Table 9

All Centrality Measures as Predictors of Perceived Changes in Policy and Procedure

	Model 1			Model 2		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Constant	1.463	0.044		0.204	0.316	
Member	0.255	0.039	0.336**	0.106	0.044	0.139*
Circuit A	-0.175	0.072	-0.127*	-0.305	0.075	-0.221**
Circuit B	-0.419	0.053	-0.483**	-0.433	0.050	-0.499**
Circuit C	-0.099	0.063	-0.085	-0.080	0.061	-0.069
Circuit D	-0.181	0.048	-0.219**	-0.039	0.052	-0.047
Degree				-0.003	0.004	-0.135
Betweenness				-0.009	0.006	-0.113
Closeness				0.026	0.007	0.594**
R^2		0.363			0.447	
Change in R^2		0.363**			0.084**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.

Table 10

Degree Centrality as Predictor of Perceived Changes in Practice

	Model 1			Model 2		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Constant	1.451	0.044		1.414	0.043	
Member	0.254	0.038	0.341**	0.140	0.043	0.189**
Circuit A	-0.209	0.070	-0.155**	-0.332	0.073	-0.245**
Circuit B	-0.396	0.052	-0.467**	-0.400	0.050	-0.471**
Circuit C	-0.052	0.062	-0.046	-0.091	0.060	-0.080
Circuit D	-0.207	0.047	-0.256**	-0.153	0.047	-0.190**
Degree				0.006	0.001	0.298**
R^2		0.356			0.406	
Change in R^2		0.356**			0.050**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.

Table 11

Betweenness Centrality as Predictor of Perceived Changes in Practice

Variable	Model 1			Model 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Constant	1.451	0.044		1.461	0.043	
Member	0.254	0.038	0.341**	0.219	0.039	0.294**
Circuit A	-0.209	0.070	-0.155**	-0.228	0.070	-0.168**
Circuit B	-0.396	0.052	-0.467**	-0.412	0.052	-0.486**
Circuit C	-0.052	0.062	-0.046	-0.074	0.062	-0.065
Circuit D	-0.207	0.047	-0.256**	-0.207	0.047	-0.257**
Betweenness				0.011	0.004	0.140**
R^2		0.356			0.373	
Change in R^2		0.356**			0.017**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.

Table 12

Closeness Centrality as Predictor of Perceived Changes in Practice

	Model 1			Model 2		
Variable	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Constant	1.453	0.044		0.734	0.127	
Member	0.251	0.038	0.337**	0.116	0.042	0.157**
Circuit A	-0.209	0.071	-0.155**	-0.327	0.069	-0.242**
Circuit B	-0.398	0.052	-0.469**	-0.414	0.049	-0.489**
Circuit C	-0.053	0.062	-0.046	-0.063	0.058	-0.055
Circuit D	-0.204	0.048	-0.252**	-0.107	0.048	-0.132*
Closeness				0.015	0.003	0.355**
R^2		0.355			0.426	
Change in R^2		0.355**			0.072**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.

Table 13

All Centrality Measures as Predictors of Perceived Changes in Practice

Variable	Model 1			Model 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Constant	1.453	0.044		0.267	0.311	
Member	0.251	0.038	0.337**	0.107	0.043	0.143*
Circuit A	-0.209	0.071	-0.155**	-0.337	0.074	-0.250**
Circuit B	-0.398	0.052	-0.469**	-0.408	0.050	-0.482**
Circuit C	-0.053	0.062	-0.046	-0.033	0.061	-0.029
Circuit D	-0.204	0.048	-0.252**	-0.064	0.051	-0.079
Degree				-0.002	0.004	-0.120
Betweenness				-0.010	0.006	-0.132
Closeness				0.025	0.007	0.588**
R^2		0.355			0.437	
Change in R^2		0.355**			0.082**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.

Table 14

Intercorrelations Between the Predictor and Criterion Variables

Variable	1	2	3	4	5	6
1. Member	___	.501	.296	.459	.466	.455
2. Degree		___	.749	.948	.415	.410
3. Betweenness			___	.711	.243	.233
4. Closeness				___	.409	.406
5. Change in Policy					___	.961
6. Change in Practice						___

Note. N = 296.

Table 15

Sector as Predictor of Degree Centrality

Variable	Model 1			Model 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Constant	18.493	1.866		26.783	3.034	
Circuit A	20.275	3.751	0.311**	21.068	3.638	0.323**
Circuit B	-7.322	2.621	-0.179**	-6.239	2.556	-0.152*
Circuit C	3.692	3.278	0.067	4.316	3.188	0.078
Circuit D	-9.019	2.517	-0.232**	-8.363	2.422	-0.215**
Sector 7				10.530	7.375	0.076
Sector 6				-4.451	3.835	-0.078
Sector 5				-8.532	3.835	-0.149*
Sector 4				-12.955	3.324	-0.300**
Sector 3				-10.626	3.053	-0.296**
Sector 2				-23.227	8.221	-0.151**
R^2		0.211			0.288	
Change in R^2		0.211**			0.078**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.

Table 16

Sector as Predictor of Betweenness Centrality

Variable	Model 1			Model 2		
	B	*SE B*	*β*	*B*	*SE B*	*β*
Constant	1.259	.568		5.074	0.909	
Circuit A	1.837	1.141	0.103	2.051	1.090	0.115
Circuit B	0.099	0.797	0.009	0.478	0.766	0.043
Circuit C	1.578	0.997	0.105	1.632	0.956	0.109
Circuit D	0.006	0.766	0.001	0.302	0.726	0.029
Sector 7				2.363	2.211	0.063
Sector 6				-3.948	1.150	-0.253**
Sector 5				-4.399	1.150	-0.281**
Sector 4				-4.933	0.996	-0.418**
Sector 3				-4.677	0.915	-0.477**
Sector 2				-6.486	2.464	-0.154**
R^2		0.019			0.141	
Change in R^2		0.019			0.122**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.

Table 17

Sector as Predictor of Closeness Centrality

Variable	Model 1			Model 2		
	B	$SE\ B$	β	B	$SE\ B$	β
Constant	53.722	0.912		56.936	1.495	
Circuit A	8.027	1.834	0.253**	8.324	1.792	0.263**
Circuit B	-2.742	1.282	-0.138*	-2.301	1.260	-0.116
Circuit C	-0.600	1.603	-0.022	-0.329	1.570	-0.012
Circuit D	-6.498	1.237	-0.342**	-6.264	1.199	-0.329**
Sector 7				6.093	3.633	0.091
Sector 6				-0.801	1.889	-0.029
Sector 5				-3.953	1.889	-0.142*
Sector 4				-5.210	1.641	-0.246**
Sector 3				-4.165	1.505	-0.238**
Sector 2				-10.025	4.050	-0.134*
R^2		0.207			0.274	
Change in R^2		.207**			0.067**	

Note. $N = 296$. * $p < .05$. ** $p < .01$.
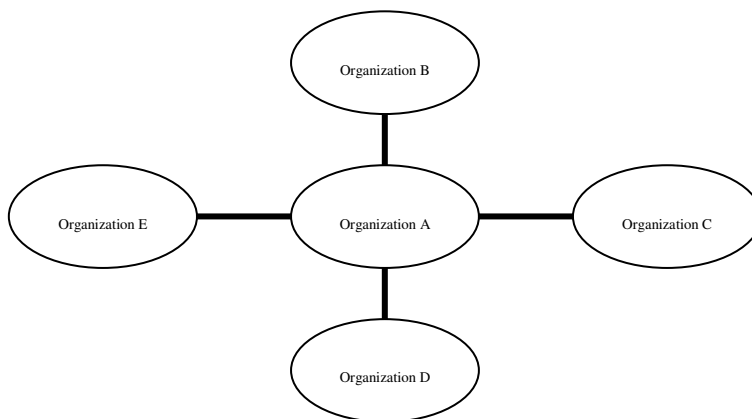
Figure 1

Degree Centrality
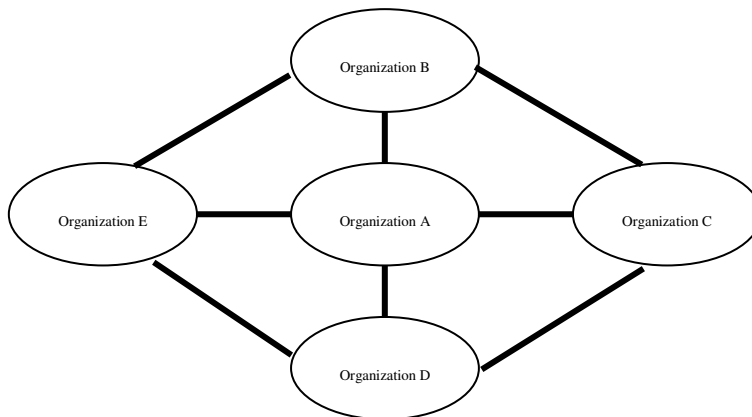
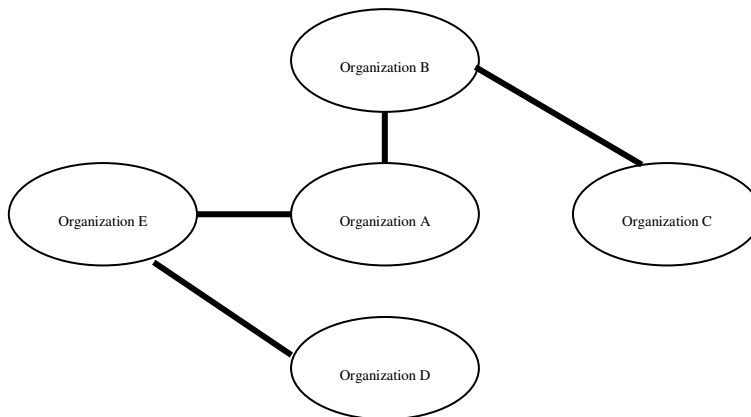*Note.* Organization A has highest degree centrality.

Figure 2

Betweenness Centrality

Note. Organization A has highest betweenness centrality.

Figure 3

Closeness Centrality

Note. Organization A has highest closeness centrality.

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