Examining graduate committee faculty compositions- A social network analysis example

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Abstract

Social network analysis is the study of relationships of individuals or groups of individuals. Despite the popularity of social network analysis in fields such as sociology, anthropology, medicine and business, very little educational research uses social network analysis. Here, an example of the benefits of social network analysis is presented through an examination of the structure of the master's and doctoral committees formed within a College of Education department at a southeastern university.

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Despite the popularity of social network analysis in fields such as sociology, anthropology, medicine and business, little educational research uses social network analysis. The purpose of this study is to demonstrate a practical application of social network analysis for higher education. Here, a data set consisting of master and doctoral committees from 2004-2009 for a department housed in a College of Education is reviewed. Using social network analysis, the structure of the committees will be analyzed in a way that allows a view of networks created by these committees in a variety of different formats.

Theoretical Framework

Social Network Analysis

The study of social networks is the actual study of the relationships between individuals and groups, rather than just the individuals themselves. Studying social networks enables researchers to study the different connections that make individuals effective, successful and happy. By studying social networks, the actual relationships an individual has with his or her contacts are studied in a way that previously could not have been. Prior research only allowed us to count the number of ties individuals had or to speculate the strength of these ties. Social network analysis allows researchers to view a mapping of the individual's ties and the strength of these ties at the same time.

When social networks are analyzed on this level, the structure of a network can be viewed and substantive outcomes affected by the network structure can be determined. Social network analysis (SNA) shows the informal relationships within organizations that are often critical to understanding where the creative pockets and informal relationships reside. SNA can be very useful when changes are made within an-organization and may allow us to track the diffusion of knowledge throughout a network.

Researchers have tried many different ways in the past to explain differences and outcomes in our society using social capital theory. Bourdieu (1972, 1977) writes that social capital may otherwise be defined as ‘connections’ and that it is accumulated, transmitted and reproduced through clubs, families, and other sorts of interaction. Social network analysis is the physical representation, through maps and analyses, of social capital theory.

Methods

This study is exploratory, uses existing data, and a mixed methods design. It employs structural network analysis, which couples the empirical with the theoretical. This example uses social network analysis to examine the relationships, or ties that occur between professors, or nodes within committees.

Data Source

To demonstrate the power of this methodology, data were collected from a College of Education department at a southeastern university. Using the graduate school data base, a data set was constructed to include all master and doctoral committees registered for a specific department over a 5year span. Data were comprised of listings of chair, co-chair, and other faculty members for the department committees. Also, faculty committee work in other departments is represented, as well as external faculty committee service in the department.

Analysis

Data were transferred and cleaned in Excel. The new Excel spreadsheets were then loaded into UCINET, a popular social network analysis software (Borgatti, et al 2002). At this stage, UCINET’s “symmetrize- addition” tool was used to make the spreadsheets symmetric. Data were then imputed in to NetDraw a freeware social network visualizing program.

In UCINET the relationships, or ties, that occur between professors, or nodes, within master or doctoral committees are being examined. Specifically, the measures that are examined in this study include centrality, an indication of how well a specific node connects with other nodes and tie strength, or frequency of the relationships, and density, a measure of the total connects compared to the possible connections within a network. These can all be performed in UCINET. The second stage involves using the network maps created by NetDraw to look for patterns that may emerge within the network. A detailed methodological framework will be demonstrated in an effort to illustrate the utility of this approach to various studies.

Results

Network Visualization

The first step to begin a social network analysis is to create visual mappings in Netdraw of the social networks created using Excel and UCINET. The following figures are social network mappings of the department. The squares represent professors, or nodes, and the lines between them indicate two members, or nodes, are on the same committee. The width of the line indicates frequency, or strength of tie. The thinnest line represents 1 or few shared committees, and the thickest line represents the most shared committees. To ensure confidentiality, faculty were also coded. The name used indicates a measure of faculty status in the department.

Figure 1 is a visual representation of the networks created between the chair of the committee and other committee members. It is directed, meaning arrows indicate the direction of the relationship. In other words, a chair will have arrows pointing to the other members. *Figure 2* is a visual representation of the networks created between all committee members.

Figure 1. Networks created between the committee chair and other members

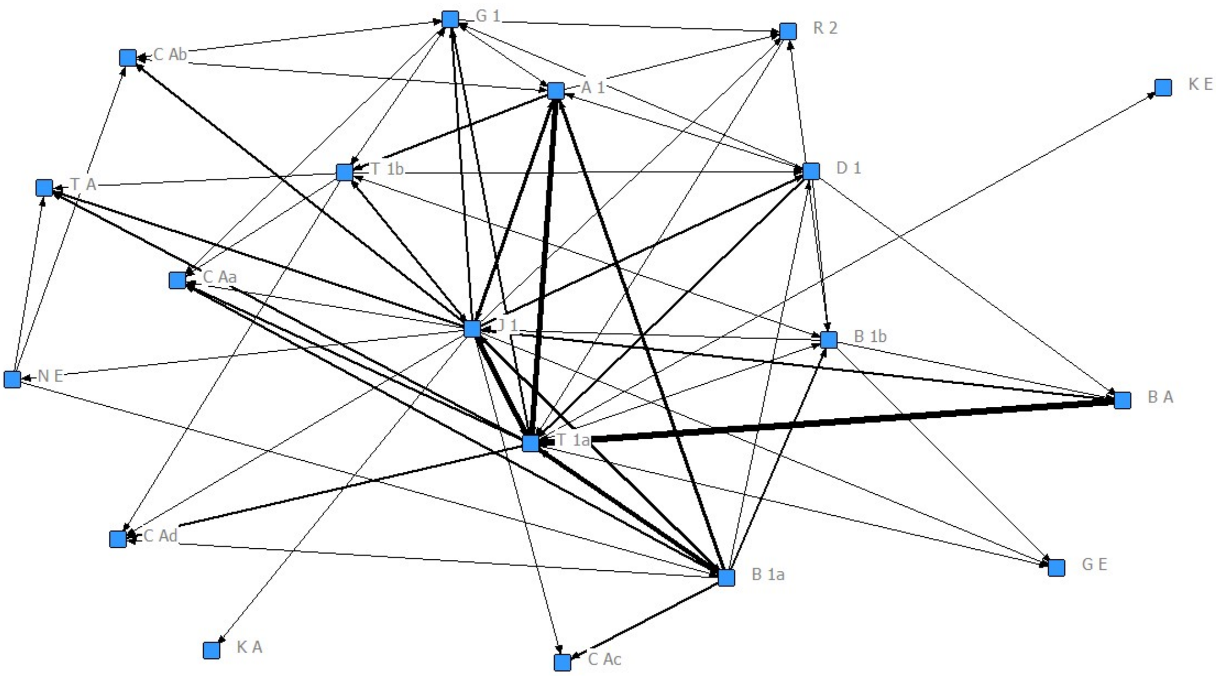
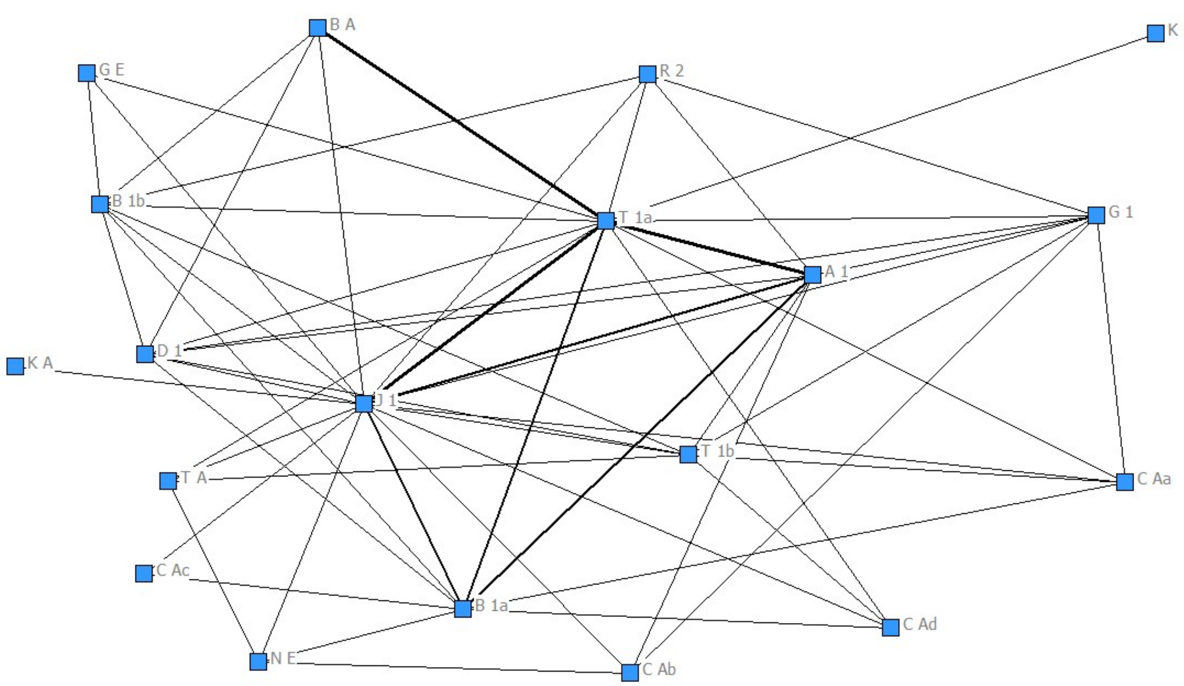
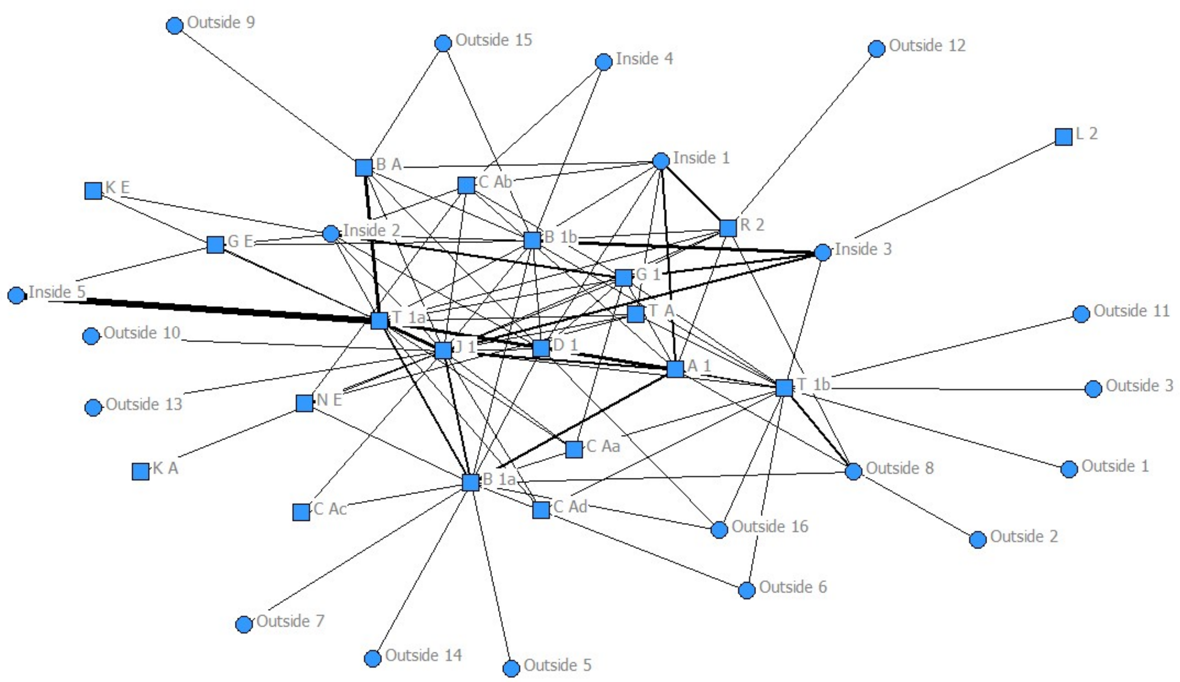


Figure 2 Networks created between all committee members



NetDraw to visualize all committee members from graduate student committees, rather than just the committee members in the home department. *Figure 3* displays the connections of faculty members within the home department, and their graduate committee members inside and outside the college. Departments within the same college are labeled “inside”. The labels indicate whether or not a committee member is “inside” or “outside” the home department.

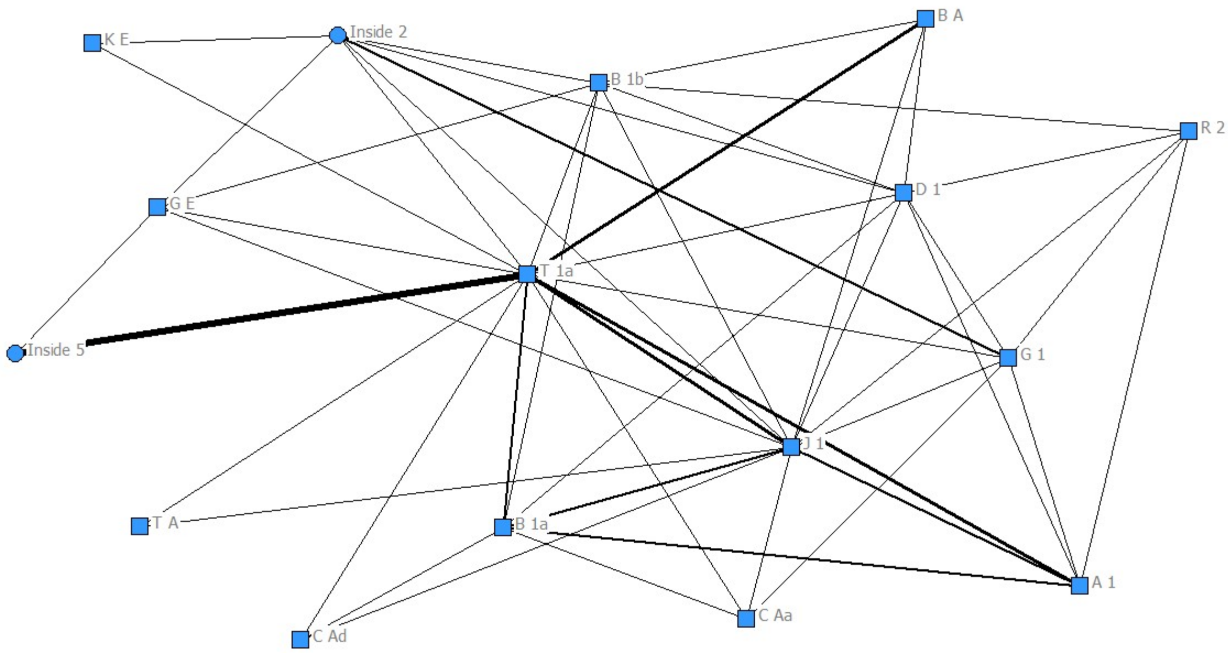
Figure 3 Networks created from faculty members in and outside the department



UCINET and NetDraw have user friendly editing tools that allow the researcher to change the size, shape, color and name of the nodes to create the most efficient visualization of the network. The lines, or ties, can also be changed to be different colors, or thickness.

Although there are many benefits to viewing an entire network, it may also be critical to view an individual, also called an ego, and their social network. Ego networks consist of an individual, or an individual group, and every tie they have. For this example, *Figure 4* is the ego network mapping of faculty member T1a and all the committees on which they serve.

Figure 4 Ego network mapping for faculty member T 1a.



In the map above, faculty member T1a is placed at the center. It is apparent from the thickness of the line that faculty T 1a most frequently works on committees with faculty from “inside 5”, another department within the same college. However, faculty T 1a does appear to serve on committees with many other faculty members.

Quantitative Findings

Although network mappings do create a visual picture, the quantitative side of social network analysis may also appeal to education researchers. Depending on the purpose of the study, UCINET has a wide variety of tools to use such as determining key players and key ties within a network. More complicated techniques may require transferring UCINET data into traditional statistical packages such as SPSS and SAS.

Measures of Centrality

One of the most practical uses of social network analysis is to identify the most important or key players in a network. According to Scott (2000) centrality helps determine the key players, or most prominent members of a network. Centrality is truly the fundamental concept of social network analysis. Nodes with high centrality are often identified by insiders as those “in the know”. Being able to identify those with high centrality may help researchers identify intervention points for strategic change, or simply to identify who in the network may know the most about the current status of the network.

Degree Centrality

There are many different types of centrality, the simplest being degree centrality. Degree centrality is simply the number of ties a node has. The more ties a node has the higher the level of degree centrality. For our example, an individual with a high centrality score would lead to the conclusion that they serve on committees with many different people. For our data, the measure of degree centrality used is the Freeman Degree found in UCINET. This function used on the data from *Figure 3* produces a table similar to *Table 1*.

Table 1 Selected Faculty Using Degree Centrality Measure

Faculty	*Degree*
T 1a	72.00
J 1	47.00
B 1a	31.00
A 1	30.00
B 1b	27.00

This table shows that Faculty T 1a has the highest centrality, or serves on more committees with different faculty than all other faculty members in the department.

Closeness centrality is another measure commonly used in social network analysis. This measure refers to the number of ties between a node and all other nodes. It is often used as a measure of the length of time it takes for information to pass between a node and all other nodes. *Table 2* gives the faculty members with the top five closeness degrees for the Freeman closeness function of UCINET from *Figure 3*. nCloseness is a standardized value on a scale from 1-100 where the higher the score the “closer” to all other nodes. For example, the center of a star that touches all other points would have an nCloseness value of 100, whereas an isolate, a node without connections, would have an nCloseness value of 0.

Table 2 Selected Faculty Using Closeness Centrality Measures

Faculty	*nCloseness*
J 1	68.421
B 1a	59.091
T 1a	58.209
B 1b	56.522
D 1	56.522

Betweenness centrality is a measure of the number of times a node falls along the shortest path between two other nodes. It may be used as a measure of the control of a network. In other words, nodes that have high betweenness centrality may have the ability to hinder or change information passed along them. A node with an nBetweenness score (standardized) of 0 would never be along the shortest path between two nodes, whereas a node with an nBetweenness score of 100 would along the shortest path between every other node. The following table gives the faculty members with the highest betweenness centrality scores for *Figure 3*.

Table 3 Selected Faculty Scores for Freeman Betweenness

Faculty	*nBetweenness*
J 1	29.569
B 1a	21.437
T 1b	20.957
B 1b	13.440
T 1a	12.007

Eigenvector centrality not only counts the number of nodes each node is connected to, but also weights these nodes according to their centrality. Essentially it is a measure of how well connected are the people to which you are connected. It is often used as a measure of popularity in communication networks. *Table 4* shows the standardized values of Bonacich eigenvector centralities for faculty from *Figure 3*. The scale ranges from 1-100 and the higher the score, the better connected the nodes one is connected with.

Table 4 Selected Faculty Scores for Bonacich Eigenvector Centrality Measures

Faculty	*Degree*
T 1a	91.525
J 1	45.436
A 1	38.906
B A	32.365
B 1a	31.784

When comparing the previous tables several faculty members appear on different tables. This does not necessarily have to be the case. An individual may have a high degree centrality, lots of connections, but have a low betweenness centrality because they are not ~~be~~ very connected to individuals outside their group. Eigenvector centrality is a measure of the quality of the nodes a node is connected to, rather than the quantity of connections of a node. All four measures of centrality are used frequently in social network analysis. However, depending on the research question, some measures of centrality may be more relevant than others. Because the purpose of this study is less interested in the flow of the network and more interested in how many different committees a faculty member sits on, degree centrality is the most relevant measure of centrality for this example.

Density

Network density is also commonly used in social network analysis. Network density, simply put, is the number of ties divided by the number of possible ties. Although it may not make practical sense for everyone in the department to serve on a committee with every other person in the past five years, it is expected that a certain amount of inter-departmental collaboration. UCINET uses the following formula to determine the overall density of a network with undirected ties and no ties to oneself: $Density = \frac{T}{\frac{n(n-1)}{2}}$; where T is equal to the number of ties in the network and n is equal to the number of nodes.

The density of *Figure 2* is .4678, meaning that 46.78% of all possible committee relationships are established. This number should be interpreted with caution because the larger the network, the lower the measure of density may be. The network used in this study is a relatively small network, there is more confidence that this measure is accurate, meaning there is less chance for error. To measure density, *Figure* 2 was used to ensure only faculty members in the department are being analyzed. It should also be noted that the density equation does not take into account the current status of the faculty member (full time, adjunct, emeritus) or the length of time the professor has served in the department.

Conclusion

This study has both methodological and practical implications. Methodologically, this study serves as a demonstration of the power of the use of social network analysis in higher education. Practically, this study also has policy implications by being able to visually display the connections created by committees, and better inform the department when making admission and advisory decisions.

Social network analysis is a methodological breakthrough that allows researchers from many different fields to visually display and evaluate network structures. Although used often in schools of management, medicine, sociology and anthropology, social network analysis has yet to make as large of an impact in the growing body of higher education literature. As this example demonstrates, the techniques and methods used in social network analysis are easily adaptable to research questions in education.

References

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