This week’s readings describe techniques to determine and analyze centrality and prestige using indices based on centrality measures for dominant themes: Point or degree centrality, closeness centrality, and betweenness centrality. Further applications of centrality measures and synthesis with power-dependency theory is explored in supporting articles.

**Wasserman and Faust, Chapter 5:**

Wasserman and Faust introduce the ideas of centrality and prestige for analysis of actor and group networks. The authors first define prominence as a measurement of direct and indirect ties to an actor, as per Hubell (1965) and Friedkin (1991). This focus encourages the examination of choices made by actors, the choices received by actors, and the indirect ties between actors that can influence these choices. This framework is referenced throughout the chapter.

The central divergence within the chapter is the examination of directional and nondirectional data. Nondirectional data allows the researcher to examine the centrality of actors and groups as a measure of their ties. Involvement in many ties indicates that an actor is highly visible to other actors in the set. Bavelas (1948). Directional data allows for interesting examinations of prestige, or the indegree of ties made visible by the data. Implications of prestige include power dynamics which are scrutinized more fully in later readings.

There are four actor level indices for centrality with nondirectional relations that include **degree centrality, closeness centrality, betweenness centrality, and information centrality.** Each of these themes can be mathematically calculated using standards set by Freeman (1972). Equations and justifications are available throughout the chapter. Group level analysis of these centrality indicators is obtained by comparing the varying centrality between actors in a set.
Wasserman and Faust recommend finding variance to more adequately describe and analyze group level centrality.

Degree centrality is the simplest to calculate and relies on the supposition that actors have centrality is they have the most ties to other actors in the network. Closeness centrality places importance in the proximity of an actor to the other actors in the set with an emphasis on quickness and efficiency. Hakimi (1965) and Sabidussi (1966) offer a classification of closeness using “minimum steps”. This is a function of geodesic distances. Betweenness centrality examines the role of intermediaries, or attempts to quantify the “stress” placed on actors located between points. The betweenness index is a sum of the estimated probabilities that a certain path will be used over all other pairs of actors excluding the one under consideration. Information centrality builds on betweenness centrality by adding weights to geodesic paths that will most likely be used. This index was created by Stephenson and Zola (1989).

The defining illustrations of centrality analysis are the star and circle graphs. The star graph is an illustration of maximum centrality while the circle graph demonstrates minimum centrality when all actors have equal ties to the other.

It is important to remember that nondirectional centrality indices consider activity, directional centrality allows researchers to examine choices made, and prestige indices examine the direct and indirect choices received.

**Freeman, Centrality in Social Networks Conceptual Clarification:** Freeman offers a thoughtful review of centrality topics and a useful background to the indices based on his work examined in the Wasserman and Faust text. The author introduces a conceptual background of centrality beginning with the Bavelas (1948) study regarding communication networks. While
results indicated that centrality was related to group efficiency, the perception of leadership, and the overall satisfaction of participants in a network Burgess (1968) concluded that this and succeeding studies had not produced consistent results. Freeman examines the conceptual and measurement problems of centrality as applied to points or positions in networks and as applied to whole networks.

The article begins with an examination of the unique structural properties held by the star graph, the maximally central graph. This leads to the distinction of degree centrality, betweenness centrality, and closeness centrality.

This evaluation is distinguished from the Wasserman and Faust reading in the focus of the control potential in betweenness and closeness centrality. Freeman specifies that betweenness centrality measures the actor of influence on the geodesic potential to distort or maintain the integrity of information. Freeman further elaborates that closeness is also related to control of information in the measurement of independence, or the degree to which actors can avoid the reliance on other actors to pass information. Leavitt (1951).

Graph centrality is juxtaposed with the concept of compactness in the next section, with the conclusion that ideal indices of centrality should index the differential between the most central point and all others. And be expressed in a ratio of the excess to its maximum potential.

Freeman specifies nine centrality measures founded on three conceptual bases. This results in three competing theories of centrality that have empirical weight and hold a wealth of research opportunity.

**Emerson, Power Dependence Relations:** Emerson proposes that power is the property of a network of relations, and not an attribute of individual actors. He expounds that social relations
entail ties of mutual dependence and that while power may not always be observable in relations, it is always present. Importantly, the author explains that in a power dyad the lesser power can react to the exertion of force, and that these reactions—or choices—vary as network complexity increases.

This article outlines reactionary choices to the exertion of power including withdrawal, extension of the power network, coalition formation, and the emergence of status that correlate with the increasing complexity of networks. Findings of this research vein indicate that:

I. Conformity varies directly with the motivational investment of the group
II. Conformity varies inversely with acceptance in alternative groups
III. Conformity is high at both status extremes in groups with member turnover
IV. Highly values members of groups are strong conformers only if they are valued by other groups as well
V. Coalitions form among the weak to control the strong
VI. The greatest rewards are offered to the less dependent members of the coalition.

(41)

These findings are independent are an interesting beginning to address the theoretical gap proposed by Granovetter in earlier readings.

Cook, Emerson, Gillmore and Yamagishi, *The Distribution of Power in Exchange Networks*: This article attempts to synthesize centrality topics in network analysis with power-dependency theory. The authors begin with a definition of exchange networks as:

I. Sets of actors
II. Distributions of valued resources
III. Exchange opportunities with other actors in networks

IV. Exchange relations between actors in networks

V. A set of network connections linking exchange relations into a single social network. Emerson (1972)

The authors define negatively connected exchange networks as those where alternatives are present such as in dating or friendship networks. Positively connected exchange networks arise in the absence of alternatives. Purely positively connected exchange networks are rare, giving rise to “mixed” networks. The article defines power as a function of position within a network, and explains that the theory of point centrality is weak given its sole examination of direct ties. The importance of indirect ties is reiterated. In this manner, power and influence are a function of centrality.

The authors complete a micro experiment using an undergraduate cohort with a fiscal incentive to examine five hypotheses. At the conclusion of the initial experiment hypotheses 2-4 are completely supported with 5 receiving partial support. The relevant hypotheses include:

2. As the exchange process proceeds through time, occupants of position E will display more power use than F and D in two forms, and increase over time for position E and as a result the greater absolute level of exchange benefit for E.

3. The differential power use of E over F will be displayed before the power use of E over D.

4. In the final phase actor E will exert equal power over actors F and D.
The effects implied in hypotheses 2-4 will be more pronounced under conditions of high exchange incentive than low exchange incentive.

The researchers ran a more complex experiment with a computer simulation that concluded with similar results. This confirmed the hypothesis of power-dependence in negatively connected exchange networks. The authors conclude with an examination of the implications of point vulnerability on power dynamics that implies that vulnerability locates points of minimum dependence through limited exchange opportunities. The authors suggest that these points can be removed with minimal to no impact on the exchange network.

Questions for Discussion:

1. Which centrality measures are most appropriate for your areas of interest?
2. What are the detriments of using group centrality measures?
3. How can “theory gap” distinguished by Granovetter be addressed with negatively connected exchange networks?