Assessing Children's Sociometric Status: Issues and the Application of Social Network Analysis

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ABSTRACT. A child's sociometric status has been recognized as an important predictor of future social and psychological adjustment. Most of the extant developmental research has employed measures based on summary statistics obtained from either peer nominations or ratings. Although these measures demonstrate adequate reliability and predictive validity, alternative methods of analysis using the sociometric matrix are widely used in other areas of social science to examine social networks. In this article, we review sociometric research with children and introduce social network analysis with examples from our work with children and adults. We discuss applications, make suggestions for further research, and provide references to a technical introduction.

SOCIOMETRICS, THE TECHNIQUES USED TO MEASURE the individual's status within the peer group, were developed by Moreno (1934), and their use with children was popularized by Gronlund (1959). Hartup (1970) estimated that the number of sociometric studies was then in the thousands, and interest in sociometrics has increased over the past two decades as a result of attempts to enhance children's social competence. Sociometric measures have been used both to determine the behaviors associated with peer acceptance and rejection and to identify children at risk for social rejection. Although a variety of sociometric instruments have been developed, most research with children has employed either peer-nomination or peer-rating scales, with the child's status determined by either summing negative and positive nominations or calculating an average rating.

Alternative methods for examining sociometric status by analyzing so-

cial networks based on the nomination or rating matrix have been widely used by social scientists (see Burt & Minor, 1983) but appear to have had little influence on sociometric work with children. Historical antecedents for the use of matrix analysis in examining social networks exist in the social psychology literature, and a brief introduction to the work of Festinger (1949), Harary and Ross (1957), and others can be found in Lindzey and Byrne (1968). We (Johnson, Poteat, & Ironsmith 1991) have more recently analyzed the sociometric data obtained from preschool children and addressed some issues related to the use and the reliability of network analysis based on sociometric matrices.

In this article, we examine issues related to sociometric measures, including the reliability of the traditional nominations and ratings. We review classification schemes and the predictive validity of sociometrics and introduce methods for examining group structure, using examples obtained with adults in the work of Johnson and Boster (1993). We offer recommendations for further research, using social network analysis with children.

Methodological Issues in Sociometric Research

Measurement and Reliability

In the late 1970s and early 1980s, developmental psychologists began moving away from the heavy emphasis that was placed on cognitive development during the Piaget decades of the '60s and early '70s and rediscovered social development as a research area (Hartup, 1983). Sociometry quickly became a widely used method for assessing social competence in children (Foster & Richey, 1979; Hymel, 1983). Early studies of sociometry with young children relied on peer nomination measures (Hartup, Glazer, & Charlesworth, 1967; McCandless & Marshall, 1957). The concurrent validity of peer nominations was demonstrated by their correlation with other measures of social competence, such as behavioral observations and teacher ratings. However, nomination measures, particularly negative nominations, were criticized for having only moderate reliability (Hymel, 1983).

Asher, Singleton, Tinseley, and Hymel (1979) developed an alternative to the peer-nomination procedure: a peer-rating scale on which children are asked to rate how much they like to play with a target peer on a 3-point scale, using sad, happy, and neutral faces as anchor points. Asher et al. (1979) found higher reliability using the rating scale with preschoolers (.74 to .81 for 4-week test/retest correlations) compared with

the peer nominations (.38 – .56 test/retest correlations). Some researchers have reported more comparable test/retest reliability for nomination and rating scores (Poteat, Ironsmith, & Bullock, 1986), but nominations are typically found to be less reliable than ratings, especially with preschoolers. Ratings may also be less objectionable than nominations to parents, teachers, and human-subjects review committees concerned about the effects of asking children to make negative nominations of their peers.

Nomination measures continued to be widely used in spite of low reliability because of their predictive validity (Hymel, 1983; Ironsmith & Poteat, 1990; Olson & Lifgren, 1988) and because they appeared to measure a different dimension of sociometric status from what is assessed by ratings (Gresham, 1981; Musun-Miller, 1990). Begin and colleagues altered the peer-nomination procedure to include training and asking the child to nominate more peers or to make nominations across different situations (i.e., whom do you most like to play with indoors? sit next to while listening to stories? sit next to at snack time?) This procedure, similar in some respects to the procedure described by McCandless and Marshall (1957), yielded reliability scores for nominations in the .60–.80 range even across 22-week follow-ups among children at least 5 years old. With younger children, the reliability of nominations continued to be lower than that of ratings (Alain & Begin, 1987; Boivin & Begin, 1986; Dorval & Begin, 1985).

Some researchers complained that early sociometric studies oversimplified social status by using a unitary dimension of popular versus unpopular and suggested that sociometric status has a more complex structure (Peery, 1979; Coie, Dodge & Coppotelli, 1982). Coie et al. (1982) devised a classification system based on social *preference scores* (positive minus negative nominations) and social *impact scores* (positive plus negative nominations). They identified five categories of social status: popular, rejected, neglected, controversial, and average. Popular children received social preference standard scores above + 1.00; rejected children received social preference standard scores below – 1.00. Neglected children had social impact scores of less than – 1.00 and no positive nominations, whereas controversial children had social impact standard scores above + 1.00 and received some positive and some negative nominations. Average children had social preference standard scores between – .5 and .5. Researchers found that grade-school children showed clear differences in their perceptions of peer behavior. Peery (1979) proposed a similar classification system and found correlations between preschoolers' status classification and social cognition skills. This classification system has been widely adopted in research, and the long-term predictive validity of

these categories is currently being examined (Dodge, 1993; Rubin & Asendorpf, 1993).

Predictive Validity

The significance of sociometric status was underscored by a series of widely cited studies that reported that difficulties in peer relationships in childhood are related to adolescent- and adult-adjustment problems that include dropping out of school, criminal behavior, and psychopathology (Cowen, Pederson, Babijian, Izzo, & Trost, 1973; Roff, Sells, & Golden, 1972; Ullman, 1957). An excellent review of the literature by Parker and Asher (1987) revealed strong support for the relationship between aggressive behavior and low acceptance in childhood and undesirable developmental outcomes, but less compelling evidence existed for the predictive validity of shyness and withdrawal. For instance, Kupersmidt (1983) found that rejected children had higher than expected rates of academic failure, dropping out of school, and delinquency but neglected children did not.

Recent longitudinal research by Kenneth Rubin suggests that shy, withdrawn behavior can also lead to undesirable social outcomes. Rubin and Asendorpf (1993) found that children who exhibit shy, withdrawn behavior in preschool and continue to isolate themselves from others may become actively disliked by their peers by age 11 and may exhibit more internalizing disorders, such as depression.

Parker and Asher (1987) pointed out that existing research makes it impossible to judge whether peer rejection and aggressiveness are the causes of later maladjustment or merely the early manifestation of an underlying disorder. Indeed, research by Dodge (1993) seems to support the latter view. Dodge's ongoing longitudinal study of rejected children provides evidence that the relation between early aggressive behavior and social rejection later in elementary school is less clear-cut than the relationship between early rejection and later aggressive behavior.

This raises a perplexing problem. Many researchers began the search for behavioral correlates of sociometric status in hopes of identifying those social behaviors that led to peer acceptance and rejection and to use these data to design intervention programs to prevent social rejection. Dodge's research raises the possibility that some children may be rejected by the peer group on some basis other than behavior patterns and then develop behavior problems (such as aggression) because of that rejection. Bierman, Smoot, and Aumiller (1993) identified different categories of rejected children, some of whom display aggressive behavior and some who do not, and found different behavioral patterns in these two groups (see also French, 1988). The nonaggressive rejected

boys were perceived by peers as more immature and bothersome and less attractive. These data suggest that sociometric status has a complex etiology that requires sophisticated analysis to determine the relationship between behavior and peer status.

Parker and Asher (1993) have recently reported that many low-accepted (low sociometric status based on a rating scale) children had friends based on peer nominations. Conversely, some high-accepted children did not receive nominations as "best friend" or "very best friend" from children they nominated as "very best friend." This suggests that children's social networks are complex, and the experiences of children with similar social status can differ greatly. Methods for analyzing the complexities of peer relationships can be found in the techniques included under network analysis.

The Analysis of Social Networks

Group Structure

Johnson et al. (1991) contend that classifying children into sociometric categories has the potential for resulting in a loss of important information contained in sociometric data. Their data suggest that the nature of rejection can vary from one child to another, depending on the matrix of friendship reciprocity. For instance, one boy may be disliked by a number of girls but may receive one positive nomination from a boy whom he likes. That child's experience of rejection may be much different from that of a boy who receives negative nominations from other boys whom he perceives as friends. In an exploratory study using methods of quantitative social network analysis (techniques discussed in more detail in the next section), Johnson et al. (1991) demonstrated that preschool children with similar sociometric status can indeed have quite different social network structures. Further research is needed with preschoolers and other children to examine the behavioral differences among children with different social networks and the long-term prognosis for social adjustment.

As Johnson et al. (1991) have also pointed out, the entire structure of the group needs to be taken into consideration in determining the status of children in the preschool setting. This concern stems from the fact that rejection itself should be reflected in some manner in the group's structure. Rejected children, for example, may occupy an isolated structural position reflecting their marginal social status. This position or status, however, is defined vis-à-vis the relationships among and between all members of the social group, as opposed to simply taking into account an individual's sum of negative and positive nominations or average peer

rating. This manner of conceptualizing the problem corresponds to the sociological concern for relating social position, social role, and role behaviors.

In social-network analysis, there is an important distinction made between two different methods for partitioning networks into subgroups. The first method determines subgroup membership on the basis of cohesion or intensity of interaction (Burt, 1983a, 1983b). This is historically the most common way of determining subgroups and is best reflected in the concept of a clique. Methods for determining cliques are generally derived from graph theory (Harary, 1969). Thus, cliques among preschool children may reflect play groups, work groups, or any other group in which its members interact frequently or intensely.

The other means for partitioning are fundamentally different in that subgrouping is based on the structural similarity of the actors (subjects). The two primary means for conceptualizing these structural similarities are referred to as general equivalence (Faust, 1988). The first, structural equivalence, determines subgroup membership on the basis of overlap in network linkages. Two individuals (or actors) are structurally equivalent to the extent that they share relations with the same others, independent of the presence or absence of a relationship between each other. The second, regular equivalence, determines subgroup membership on the basis of overlap in relations to the same types of others, not necessarily the same others (White & Reitz, 1983). Two individuals (actors) are regularly equivalent to the extent they structurally share relations to the same types of others. These approaches best reflect the concept of role in which two managers, for example, are equivalent because they share the same structural relations to the same type of others (e.g., employees). Thus, two children may be regularly equivalent because they are play leaders in the classroom, even though they are not members of the same clique.

These equivalence approaches are algebraic in nature and were initially referred to as blockmodels (White, Boorman, & Breiger, 1976). In contrasting these equivalence and clique approaches, Sailer (1978) illustrated the importance of the role distinction in comparing the application of these methods in the study of kinship. Sailer defined cliques as entities, for example, families in a kinship network; but a family is not a role. In kin networks, an example of a role would be "father" or "son." Sailer also defines roles as forming the "blocks" in a "blockmodel," which is a set of blocks and the relationships among the blocks. Clusters can be used to define a "block" as a set of actors (subjects) who are categorized together on the basis of structural similarities (Sailer, 1978, p. 75).

The clique approach is more suited to identifying play groups in the preschool setting or other groups in which interaction is of primary concern, whereas the equivalence approach identifies status/role sets (Burt

1983b). Both approaches can be useful in the study of rejected or neglected children. The role approach, however, has important theoretical and applied implications in that it links the concepts of position or status with role or function in the group. Different types of rejection, for example, may be linked to the different roles and the corresponding behaviors associated with a particular rejected status. Thus, such methods have the potential to aid not only in determining the severity of rejection (Johnson et al., 1991) but also in helping to define the different forms of rejection and their corresponding role behaviors. The need for such research is indicated by the work of French (1988) and Bierman et al. (1993).

Networks Over Time

Classrooms, or any setting for a similar group, develop structure over time, starting from initial contact until the final day of class or group interaction. Two important questions to be answered about that structure involve assessing how quickly the group structure forms and how stable it is over time. The answers to these questions are important for understanding the structural development of rejection and can have important implications for intervention strategies. In addition, over-time approaches help not only in understanding stability and change but also in assessing reliability (Johnson et al., 1991). Bernard and Killworth (1973) and Killworth and Bernard (1976) provide early examples of the concern for both the development and stability of network structure. In the study of an ocean-going research vessel, Bernard and Killworth (1973) posit that group and subgroup size (e.g., cliques) are limited by the constraints of effective communication (i.e., clique or subgroup size tends to be $5+-2$). In addition, they found that the structure of the group forms quickly (within 2 weeks) and stays relatively stable over time. Romney, Borgatti, and Nakao (1989) have corroborated the findings of Bernard and Killworth in their application of three-way correspondence analysis.

In order to illustrate the importance of understanding network structure over time, we will review some examples described by Boster and Johnson (1992) and Johnson and Boster (1993) in their study of winter-over personnel at a research station in Antarctica. This is an example of a closed social system in which the nine separate network structures are examined over the course of a winter-over (an 8.5-month period), a context in which the 22 personnel are isolated from contact with the outside. Aside from the questions of stability and change, we are interested in any changes in the position or status of the individual actors over the course of time. Thus, the development of isolation and rejection can be examined in a group context.

In answering questions about the development and stability of group

structure, Johnson and Boster (1993) employed three-mode, principal-component analysis (Kroonenberg, 1983). This multivariate technique allows for an examination of the relationships among and between items in a three-dimensional matrix R × C × Z. In this technique, the rows of the matrix represent an actor's (subject's) ratings of interactions with all other actors given, the columns are interaction ratings received, and the layers are each of the eight time periods. A plot is produced that visually demonstrates group sociometric stability across time (refer to Johnson & Boster, 1993, for an example).

To examine the changes over time within a group structure, Johnson and Boster (1993) employed a correspondence analysis of the stacked interaction rating matrices (i.e., each of the structure matrices was appended to another in sequence, yielding a 198 × 22 matrix). Correspondence analysis (Greenacre, 1984) is a multivariate technique that allows for the examination of relationships among rows and columns of an $N \times M$ matrix in the same low-dimensional vector space. In this case, the rows of the matrix are interaction ratings given during the nine time periods, and the columns are ratings received. This technique allows the visualization of changes in an individual's sociometric status across time against the background of changes in the entire group (Johnson & Boster, 1993).

These and other means for investigating changes over time in group structure provide a means for examining and relating changes in group-level structures that correspond to changes in the individual actor's positions and, hence, status. In this case, for example, disruptions in the stability of the overall group structure results in part from dramatic shifts in the position and status of individual actors, particularly one actor who was being isolated from the group, an indication of rejection by other group members. For a review of these and other social network approaches, see Wellman and Berkowitz (1988); Freeman, White, and Romney, (1989); and Wasserman and Glaskiewicz (in press).

Conclusions and Recommendations for Further Research

Sociometric measures, based on either ratings or nominations, offer a relatively reliable and valid measure of children's peer-group status. These measures, which are typically based on summary statistics, have resulted in a variety of classification systems and have been demonstrated to have predictive validity for a number of future social outcomes. Nonetheless, the traditional sociometric measures used in the developmental literature do not consider important information included in the data because they fail to examine group structure. Social network analysis offers potentially important information related to the individual's

status and role within the group (Johnson et al., 1991). Basically, network analysis allows the researcher to determine if the low-status (or rejected) child has no reciprocated friendships or if he or she is nominated (or highly rated) by another child identified as a friend. Examining the structure of a group also allows the elucidation of cliques and sources of positive and negative sociometric choices. For example, a low-status child might receive negative nominations or low ratings primarily from children of the other sex or who belong to a particular subgroup within the classroom or play group. All low-status children may not have the same severity of social problems (Parker & Asher, 1993). In addition, network analysis has the potential for allowing the tentative identification of the social role filled by the child within the group. Some children may serve in the role of a social organizer around whom groups form, and others may serve as links between separate cliques. Different types of rejected children may also be identified in terms of the different roles they play within the group.

Social network analysis can also be used as a method for measuring the consistency of social status and structure across time. As pointed out by Johnson et al. (1991), traditional measures of sociometric status may demonstrate a high degree of temporal stability even when there are large changes within the social network. Changes in the social network may reflect aberrant behaviors (e.g., aggression) or rejection for other, perhaps more subtle, reasons. It is also possible to track across time an individual's social status and movement in and out of the group structure. This movement then can be connected to the individual's behavior and other environmental events.

Despite the attraction of social network analysis as a methodology for examining children's peer groups, it has been little used by developmental researchers. Network analysis has its origin in the work of social psychologists but is now more commonly used by other social scientists. The differences in terminology and the mathematical complexity of the procedures appear to be obstacles to the adoption of these techniques by developmental researchers. In this article, we provide a brief evaluation of the techniques of network analysis, and Burt and Minor (1983) present a broad introduction to the methodology. A commercially available set of routines, UCINET (Borgatti, Everett, & Freeman, 1992), is available and will run on most microcomputers.

We are now conducting research to explore the relationship between the sociometric and the behavioral networks of preschool children. Similar research is needed with school-aged children, and attempts should be made to use network analysis to examine behavioral differences between children with similar social status but varying social networks. New class-

ification schemes may also result from the applications of network analysis to children's sociometric data. Social network analysis can be regarded as an additional tool in the ongoing effort to develop a better understanding of the individual's role in, and his or her relationship to, the peer group.

Author Note

Requests for examples of the graphical and plotting procedures discussed in this article should be addressed to Jeffrey Johnson, PhD, Institute for Coastal and Marine Resources, East Carolina University, Greenville, NC 27858-4353.

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