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ABSTRACT

This study examined the social networks of college students and how such networks affect student commitment and persistence. The study's theoretical framework was based on application of the social network paradigm to Tinto's Student Integration Model, in which a student's initial commitment is modified over time as a result of the student's integration into the campus community. Freshmen enrolled for the spring 1993 semester responded (322 of 379) to the First-Year Experiences Survey, which involved identifying students with whom they frequently spoke and the dimensions on which they related to these students. Results were compared with enrollment data for the fall 1993 semester to identify students returning for their sophomore year. The largest effect on persistence was associated with the number of nominations received from other students, and this factor operated indirectly through enhanced social integration, institutional commitment, and intention. Overall, students with broader, well-connected networks were more likely to persist, whereas students with a higher proportion of ties falling within their social peer group were less likely to persist. (Contains 52 references.) (DB)

Ties That Bind: A Social Network Approach to Understanding Student Integration and Persistence

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Abstract

The social network paradigm provides a unique way of understanding student integration. Integration, in a structural sense, can be measured with knowledge of the universe of students' on-campus associations. This study surveys such a universe and measures the structural aspects of student relations to assess the ways in which they affect student commitment and persistence. Findings reveal a number of important network influences on affective measures of social and academic integration, GPA, commitments, intentions, and persistence.

INTRODUCTION

Astin's (1993) claim that peers are "the single most potent source of influence" in the lives of college students comes after decades of theoretical and empirical research examining the integrative nature of student experiences on the college campus. Review of the classic work of Newcomb (1943, 1962, 1966), or the more contemporary observations of Horowitz (1987) or Moffatt (1989) demonstrates why student peer culture plays such a central contextual role the understanding of a variety of college outcomes (e.g., Chickering 1974; Antrobus, Dobbelar, and Salinger 1988; Husband 1976; Nora 1990; Stage 1989; Terenzini and Pascarella 1977).

One outcome theorized to be dramatically affected by student peer culture is persistence. Much of the student persistence literature places great emphasis on student integration into campus subcultures (Spady 1971; Tinto 1993). Two major comprehensive conceptual models of student persistence have emerged from the various theoretical perspectives on this phenomenon, Bean's Student Attrition Model (1980, 1982, 1983, 1990) and Tinto's Student Integration Model (1975, 1987, 1993). Although Tinto's integration model places a greater emphasis on the role of within-institution peer culture than Bean's organizational model, which emphasizes the role that external forces play in the persistence process, considerable overlap exists between the two especially in terms of the role of organizational factors and commitment to the institution (Cabrera, Casteñeda, Nora, and Hengstler 1992).

In terms of this latter shared characteristic, commitment to the institution, this is theorized to be affected by peers' attitudes and pressures in both models. Bean theorizes that among other potential modifiers, the encouragement of close friends may enhance a sense of commitment to the institution (institutional fit and quality). Tinto postulates a similar relationship, namely that the higher the level of social integration the greater will be the commitment to the institution. As integration is the central feature of the Tinto model it has therefore been quite carefully elaborated both conceptually and empirically. This should not discount the theoretical role of social structure in Bean's model. For, friendships, or social ties, are presumed to impact the extent of students shared group values, support structure, and affinity for the institution in both models—simply in different ways.

As many have pointed out, however, operational measurement of the manifold dimensions of peer culture is often elusive. Adequate measurement of the effects of these important influences requires knowledge of students' individual group identifications as well as

their desires for group affiliation, membership, and, ultimately, acceptance (Astin 1993; Kuh 1996; Newcomb 1943, 1962, Newcomb and Wilson 1966).

The purpose of this study is to explore such subcultural effects and to assess the role of student social structure in the persistence process. Specifically, I explore the effects of social integration from a social network perspective: a perspective that enables determination of subgroup membership and of the characteristics of relationships to and within those subgroups.

Of the two major theories of student persistence, Tinto's Student Integration Model (1993) will be used as the framework for the development of a method that will permit the identification of and membership student peer groups. Although similarities exist between the two theories, especially in terms of the posited relationships between integration, commitments, and persistence, the Tinto model was chosen as a framework due to the large volume of work explicating his theory. Moreover, the purpose of this paper is less to test a specific conceptual model than to assess the effects of structural integration on commitments and persistence—both conceptual models highlight the importance of these effects.

The Student Integration Model

Drawing heavily from Durkheim's (1951) seminal work on suicide, the role that social structure is presumed to play in the persistence process has well detailed by Spady (1971) and further refined and elaborated by Tinto (1975, 1987, 1993). The Tinto (1993) model specifies a longitudinal process in which a number of background variables (e.g., race, secondary academic performance, parental encouragement, etc.) interact to form students' initial commitment to the college campus and to educational attainment goals. These initial commitments are modified, over time, as a result of students' integration into the campus community. Tinto (1993) theorizes that successful integration yields satisfaction that enhances these commitments and positively influences students' intentions to persist on a particular campus.

Using the solar system as an analogy, Tinto (1993:123) makes reference to the numerous subcultures revolving around the center of institutional life. Each of these subcultures has a unique character relative to that of the larger institution (Newcomb 1962, 1966; Newcomb and Flacks 1966). Some are more marginal than others in terms of the dominant values of the institution and some may provide a safe harbor for students with values deviant from those espoused by the institution formally or informally (ibid.). Accordingly, the Tinto (1993) model allows for differential impact of integration into these subgroups based on the relative congruence between the values of the group and the values of the larger institution.

A number of studies have sought to empirically validate the global features of the Tinto (1993) model (e.g., Munro 1980; Nora 1987; Nora, Attinasi, and Matonak 1990; Nora and Rendon 1990; Pascarella and Chapman 1983; Pascarella, Duby, and Iverson 1983; Pascarella and Terenzini 1980; Pascarella and Terenzini 1983; Terenzini, Lorang, and Pascarella 1981). To date, however, no empirical research has attempted to assess or capture the effects of subgroup membership and integration on commitments to the institution and persistence.

The most noteworthy line of empirical research examining the role of integration in a general sense is that begun by Pascarella and Terenzini (1980). Using a series of Likert-scaled items, Pascarella and Terenzini (1980) devised five factor-analytic scales operationalizing Tinto's (1993) integration and commitment constructs. Later researchers were able to successfully replicate and employ these scales concluding that they provide a reasonably stable predictor of student departure at the end of the freshman year (Terenzini, Lorang, and Pascarella 1981). Subsequent research, on variety of different types of campuses, suggested that, although the scales yielded better results on residential campuses, the original scales provide a reliable basis on which to differentiate persisters and departures at the end of the first year (Bers and Smith 1991; Pascarella and Chapman 1983; Pascarella, Duby, and Iverson 1983). Thus, until recently, it was presumed that the Tinto (1993) model and the empirical measures validating it were generalizable across a variety of settings.

The large body of work testing various aspects of the Student Integration Model enabled a recent comprehensive assessment of its empirical validity (Braxton, Sullivan, and Johnson 1997). The authors of this effort concluded that, despite the near paradigmatic nature of the model, the peer-reviewed empirical research since the model's inception in 1975 offers only partial support for Tinto's overall theory. Of 13 primary propositions comprising the Tinto model, 5 were found to be 'vigorously' supported by Braxton *et al.* (1997). Of these 'vigorously' supported propositions were the two that define the relationships between social integration, commitment to the institution, and persistence—the two propositions of especial interest in the current inquiry.

Much of the work reviewed and summarized by Braxton, *et al.* (1997) has provided a good first step in elaborating the many cultural nuances implicit in the Tinto (1993) model. However, current methods in the persistence literature assess social integration with sole reliance on egocentric accounts of how strongly students identify, and feel membership, with other students in general. This overlooks the effects of structural integration implicit in the Tinto (1993) model and noted in much of the earlier work on student culture. Moreover, measures and

methods used to this point in time render incapable any attempts to consider the potential effects of individuals' connections to their peer groups. Such consideration follows logically from Tinto's (1993) planetary analogy. The method laid out in this paper enables the empirical development of the planetary model used by Tinto (1993)—that is to portray the relationships between the institution, its subcultures, and its individual students.

A brief introduction to social network analysis is in order to provide the tools necessary for understanding the methodology employed in this paper. This introduction appears in the following section.

Social Networks

The social network paradigm emerged in the late 19th century, figuring prominently in Durkheim's (1951) seminal work on suicide. Since that time, social networks (the sets of acquaintances and friendships that define one's relations with others) and social network theory have made significant contributions to a number of fields.

The quantification and measurement of human relations and group formation presents unique methodological problems for the researcher. Myriad combinations of relations can be present in a group as multiple networks, distinct sets of relations, and ties can exist within a single group at any one time (Tichy and Fombrun 1979). Festinger (1949) and Forsyth and Katz (1946) pioneered the quantification of such relations by operationalizing interpersonal ties using binary arrays. Each row and column within these arrays was used to represent an individual actor and each cell expressed the status of a relationship between any two actors.

A great deal of information can be gleaned from these matrices. For example, by calculating row totals, one can determine the number of ties reported by any one person. Similarly, the column totals provide useful information about the number of times each individual is nominated by others in the network.

More complex matrix algebraic techniques permit the extraction of subgroups based upon similar ties and enable the calculation of a host of network theoretic measures. Much of the early work employing these more sophisticated techniques allowed researchers to better define relationships in small networks (e.g., Alba 1973; Forsyth and Katz 1946; Harary, Norman, and Cartwright 1965). The subsequent advent and availability of microcomputers has enabled network researchers to expand the size of the networks being analyzed and made this a feasible methodological approach to understanding the complex relationships in larger networks.

A wide variety of descriptive measures of networks has evolved from this field of research. Structural measures of networks may address the characteristics of individual positions; dyadic (between two individuals) or triadic (between three individuals) ties; or other structural configurations in the context of the larger network (Tichy 1981; Wasserman and Faust 1995). Such structural descriptors enable the researcher to address questions of network size (how large is the network?), density (of all possible relationships, what proportion actually exist?), reachability (what is the average number of people separating any two members of the network?), and centrality (does the network include many people with a large number of relations, or only a few?).

Among the most frequently used descriptive network measures is centrality. Centrality can be broadly conceptualized as the degree to which the network or an individual in the network is in a position to influence others in the group or network. It is often assumed that persons at the center of the network, on whom many others are dependent, are in more central, and hence more powerful, positions than those located on the periphery of the group (Marsden and Laumann 1984).

Many measures of centrality have been proposed over the years. One of the earliest and most common of these measures captures the degree to which an individual is connected to others (e.g., Shaw 1954). Very simply, those reporting more ties (by nominating others as friends, discussion partners, or some other relationship dimension of interest) are more connected to the others in network and therefore more central in terms of communication or social exchange. Such "degree" based measures of centrality are calculated by summing the number of nominations made by an individual (outdegree), the number nominations received by an individual (indegree), or some combination of these two.

A group of more complex centrality measures have evolved to address a number of network theoretic concerns (e.g., Friedkin 1991). One of the members of this class of measures captures the extent to which an individual is connected to other central individuals (Bonacich 1987). The rationale for this measure is that individuals with the ability to influence other central (i.e. powerful) members of the network are in better positions to influence communication flows and exchange within the network or group (Hubbell 1965; Bonacich 1987).

Social Networks and Student Integration

Measures of centrality can be viewed as de facto measures of structural integration—by definition, those with higher centrality find themselves more integrated into the network or

group. Thus, centrality provides a means for assessing individuals' degrees of group or subgroup integration. In the context of student integration, the ability to measure degrees of structural integration facilitates a more realistic empirical examination of its effects on commitments and persistence by enabling control over the connections to subgroups in which students integrate. This is a central but empirically unexploited feature of the line of work currently being led by Tinto (1993). Moreover, it follows from the vast student persistence literature, empirical and theoretical, that network characteristics might impact students' perceived integration, academic performance, commitments, intentions, and persistence behavior.

The social network paradigm therefore provides a unique way of understanding student integration and the Student Integration Model. The Student Integration Model specifies a modification of students' initial intention and commitment as a direct result of integration into the campus community. Integration, in a structural sense, can be readily measured with knowledge of the universe of students' on-campus associations. This study surveys such a universe and measures a variety of structural aspects of student relations as well as subgroups. These structural measures are then incorporated into a traditional empirical model used to simultaneously estimate their impacts on persistence. The results from this approach extend previous empirical work by illuminating the structural features of student relationships and subgroups that are associated with student persistence.

DATA AND METHODS

The methodological approach is presented in this section of the paper. In addition to a description of the sample, this section details the collection of data from a census of reported social ties in a freshman class. A presentation of how these data on student social ties are then used to calculate measures of overall and subgroup integration is also provided. These measures are ultimately incorporated into an empirical model of student persistence that is detailed here as well.

Sample

Data were collected during the 1992-1993 academic year from all first-time freshmen at a four-year private liberal arts college located in the western United States. The college has a coed student body and maintains interdenominational affiliations. Although the school's roughly 1200 students come to the campus from the majority of states and many countries throughout the world, the highest percentage hail from within state. Approximately 60 percent of the students

are women, 40 percent are men and 10 percent are from racial or ethnic minority groups. Only 10 percent of the student body resides off-campus and a full 98 percent of the freshman class reside in one of the on-campus dormitories.

Longitudinal data from a variety of sources were collected as a part of a broader data collection effort. Data used in the analysis reported here come primarily from survey data collected at the end of the first year, in early April of 1993. This survey, the First Year Experiences Survey, was mailed to students toward the end of the second semester. This instrument incorporated items included on Pascarella and Terenzini's (1980) follow-up survey from which their integration scales were derived as well as a variety of questions tailored to capture different aspects of their experiences to that point in the academic year. Structural data used to define the students' social networks were collected in a section of this follow-up survey. This was accomplished by asking respondents to list the names of those students with whom they frequently spoke and the dimensions on which they related to these other students (e.g. close personal friend or a source of academic or social advice).[1] Usable responses (including complete network data) were received from 322 of the 379 students (85 percent) enrolled for the spring 1993 semester.[2] Shortly after the close of the spring semester, grade and enrollment data for the first year were collected from the registrar. Finally, at the end of the third week of the fall 1993 semester, enrollment data were collected from the registrar to identify those students returning to the campus for their sophomore year.

Models

The model used in this study is based upon the results of a large body of empirical research testing various aspects of Tinto's Student Integration Model. This literature demonstrates the importance of a number of constructs that are theoretically central to student persistence. These include Academic Integration, Social Integration, Institutional Commitment, Goal Commitment, and Intentions. In addition, student GPA, traditionally used as a measure of Academic Integration, was incorporated as a separate construct after preliminary analyses

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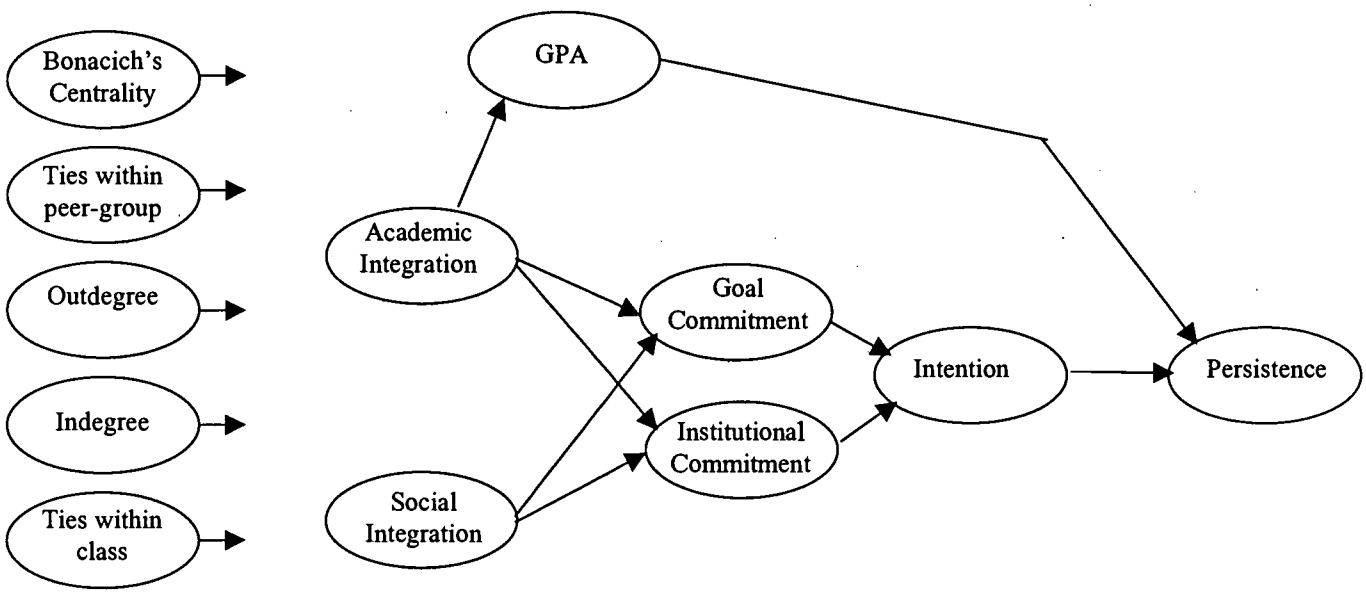
[1] In this paper, ties from the most general of these networks, the discussion network, were used as the basis for identifying peer groups. As criteria for a relationship becomes stricter (source of academic advice, or a close personal friend), the size of the networks becomes quite small. For example, one may have only one or two others whom she considers as close personal friends but is most likely influenced by the much broader set of others with whom she is in frequent contact. The larger discussion networks would, therefore, seem to be a better approximation of genuine subcultures.

suggested they were independent constructs. This modification is consistent with previous work that also found these items loaded poorly as a single measure of academic integration (Cabrera, Casteneda, Nora and Hengstler, 1992).

A series of network measures were also incorporated into the model (see figure 1). Each of these measures captures a different dimension of network centrality that is presumed to affect the constructs in the Student Integration Model.

Figure 1. Hypothetical model



The model was estimated using LISREL 8 as a single level path model. This strategy enabled the testing of more complex relationships than would have been possible using in ordinary regression or discriminant analysis methods. Of especial interest in the current study are the various ways the observed network characteristics might impact persistence directly and indirectly through the intervening variables specified in the theoretical model. Path analytic techniques enable the simultaneous estimation of a number of hypothesized effects and provide a decomposition of those effects across all other variables in the model—thereby providing estimates of the direct, indirect and total effect of any predictor in the model.

Following from Cabrera, Nora, and Casteneda's (1993) earlier examination of competing models of student persistence, I employed a specification that measured persistence as a dichotomous outcome—a specification that challenges the traditional assumptions of linear models (Pedhauzer and Schmelkin, 1991). These challenges were addressed by first using

PRELIS (Joreskog and Sorbom 1993), a program that conditions correlation matrices containing variables measured on non-continuous scales. PRELIS provides correct correlation estimates among continuous and non-continuous variables as well as an estimate of the asymptotic covariance matrix under arbitrary non-normal conditions. The asymptotic covariance matrix was then analyzed in LISREL 8 using a weighted least-squares (WLS) solution. This method yields correct estimates of standard errors and chi-square values under non-normality when one or more of the observed variables are non-continuous (Joreskog and Sorbom, 1993).

Table 1. Descriptive statistics

Variable Name	Mean	S.D.	Description
Academic Integration Factor Composite[a]			
ACADFACT	0.000	1.000	Factor Composite: alpha=.84
ACADSAT	4.000	.924	Satisfaction with academic experience
IDEVSAT	3.888	.924	Satisfaction with intellectual development
ACADGROW	4.028	.849	Impact of academic experience on personal growth and interest in ideas
Social Integration Factor Composite			
SOCFACT	0.000	1.000	Factor Composite: alpha=.92
DEVLREL	4.372	.933	Developed close personal relationships with other students
RELTGROW	4.291	.934	Impact of personal relationships on personal growth and attitudes
FRNDSSAT	4.233	.977	Friendships have been personally satisfying
Institutional Commitment Factor Composite			
ICFACT	0.000	1.000	Factor Composite: alpha=.71
GRADHERE	2.601	1.251	Importance of graduating from THIS college
CONFIDEN	4.109	1.002	Confidence in choice of this college
Educational Goal Commitment Proxy			
GRADIMPT	4.695	.763	Importance of graduating from college
Persistence Intentions Proxy			
INTENT	4.093	1.151	It is likely I will attend this college next year
Academic Performance Proxy			
GPA	2.888	.584	Cumulative grade point average at the end of the freshman year (0-4 scale)
Persistence Behavior			
PERSIST	.83	.38	Enrolled during third week of fall 1993 semester? (0=enrolled, 1=not enrolled)
Network Measures			
PBCEN	.937	.478	Bonacich's (1987) centrality (range=0-2.05)
PCTWGT	18.573	15.382	Percentage of total ties falling within clique
PCTWCT	65.707	21.154	Percentage of total ties falling within freshman class
ODG1750	14.150	6.930	Number of nominations made (range=1-32)
INDG413	8.280	3.780	Number of nominations received from others (range=0-20)

[a] Unless otherwise noted, all indicators are measured on a 1-5 scale with high values indicating agreement

Variables

Endogenous Variables. Table 1 contains descriptive statistics of all the variables used in the study. From the Student Integration Model, seven endogenous variables were specified. Social integration is a factor composite of 3 indicators taken from the First Year Experiences Survey. These three indicators assess the degree to which students have developed satisfying personal relationships that have had an impact on their personal growth and attitudes. Academic

Integration is a factor composite of 3 indicators assessing the extent of students' satisfaction with academic experiences and the degree to which these experiences have influenced their interest in ideas. Institutional commitment is a factor composite of 2 indicators, students' sense of the importance of graduating from the institution and the degree to which they feel they made the right decision in attending the institution. Asking students to indicate the degree to which they felt it important to graduate from college assessed educational goal commitment. Students also indicated the likelihood of their enrollment at the college for the fall 1994 term. This item was used to measure enrollment intentions. All of the aforementioned endogenous items were taken fromor constructed from the First Year Experiences Survey. Finally, persistence was measured using enrollment data for the third week of fall 1994 classes. Students enrolled during that period were considered persisters.

Exogenous Variables. As Tinto (1993) and much of the literature on campus culture suggest, student subcultures provide a backdrop for the students' interpretation of the college experience (e.g., Newcomb and Flacks 1966). Accordingly, meaningful measures of subgroup integration necessitated the partitioning of the larger network into sub-networks or cliques that better portrayed these reference groups.

This partitioning was accomplished using a hierarchical clustering algorithm to analyze a matrix of the shortest paths (geodesics) between each of the network members. All network measures are based solely on the discussion network (With whom do you frequently talk?). The total set of people who could be reached directly or though no more than ten others was calculated for each individual in this network[3]. This resulted in a "distance" matrix where each individual had a distance value for all others in the network. These values ranged from 0 to 10 where 0 indicates that a student could not reach a particular peer through ten people or less, 1 indicates that the student and peer are directly linked, 2 indicates that the student can reach the peer in question through one other person, and so on. To provide the least restrictive scenario of relationships and to resolve situations where one student claims direct friendship with another that is not reciprocated, the distance matrix was symmetrized using the minimum value for every pair—if a student's report located him or her four steps removed from a particular peer, but that peer was only two steps removed from the student, the pair would receive a score of two. The

[3] It is assumed that if a student cannot "reach" another in the network through ten others, there would exist very little opportunity for influence between the two actors.

symmetrized distance matrix was then partitioned using a hierarchical clustering algorithm employing maximum linkage.

The results from the hierarchical cluster analysis provided a series of cliquing solutions (sets of common relationship patterns) representing logical subgroupings of students.

The results of the hierarchical cluster analysis of social distances were interpreted according to the maximum distance within each of the subgroups identified. For example, a group in which each member can reach any other member directly is considered a 1-clique. That is, each member can reach all others in the group in one step. A 2-clique is defined as any group in which the members can reach any other member of that group by going through a maximum of one other person. For example, consider John, who may not know Mary, who is also a member of his group, but does know another member of the group, Henry, who knows Mary, thus allowing John to reach Mary through one intermediary, Henry. John can reach Henry in one step and Mary in two steps (John → Henry → Mary). Similarly, 3-cliques can be defined as groups in which any member can contact any other member with the help of a maximum of two or fewer intermediaries (i.e. within three steps). This logic extends through n-cliques.

The opportunity for social influence is greater when actors are more proximate. Research suggests the existence of a threshold at the 2-clique level after which the potential for influence is greatly diminished (Friedkin, 1983). Based on this knowledge, student cliques were established according to the most conservative 2-clique solution. The discussion network yielded 83 distinct 2-cliques. These ranged in size from 1 to 11 students each with a mean membership of 4.01 students each. One isolate, a student that could not be connected within two steps, was found (group size 1). A number of clique level summary measures are shown in Table 2 to provide a general sense of the ways cliques vary on some characteristics of interest to educational researchers. Although these differences are not modeled in the present study, the exploitation of such differences provides promising areas for future research.

Table 2. Summary measures of selected clique characteristics

Variable Name	Mean	S.D.	Description
PERSIST	80.29	.25	Group persistence rate
GPA	2.88	.39	Group grade point average
APTITUDE	1019	116	Group SAT average
MINORITY	12.54	20.10	Proportion of non-whites in group
FEMALE	66.97	36.36	Proportion of females in group

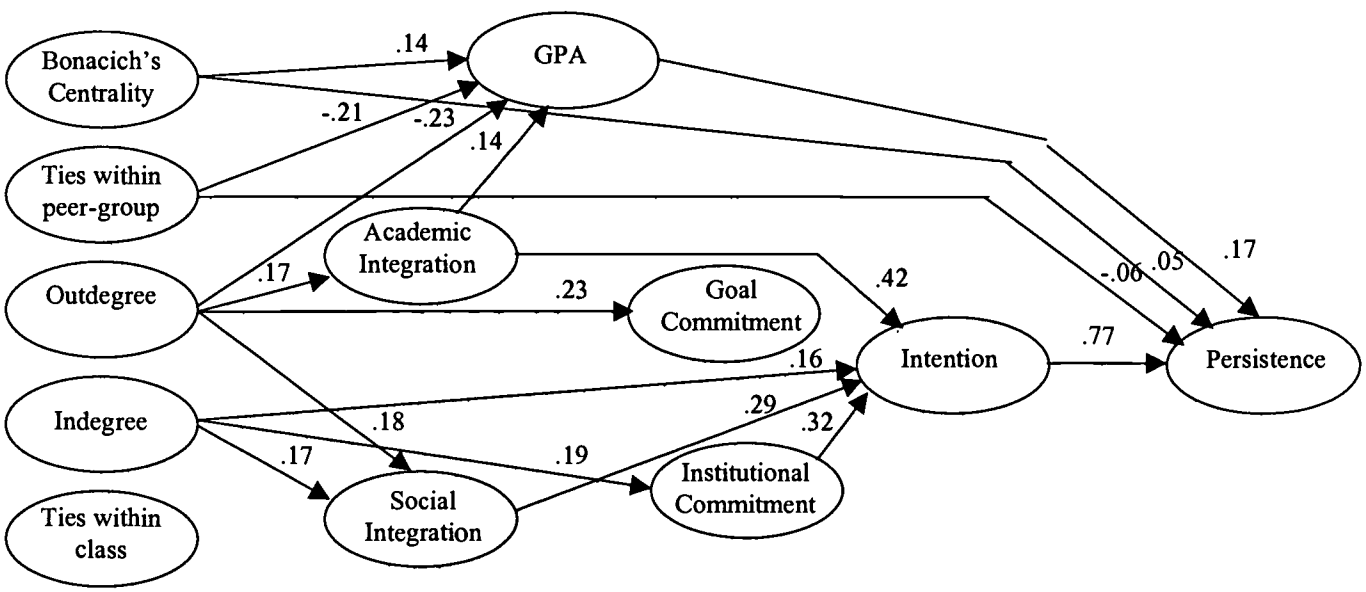
Five variables capturing theoretical dimensions of social network centrality were treated as exogenous. Network degree comprised two of these measures. The variable ODG1750

represents the number of acquaintances named by each student while INDG413 reflects the number of nominations received from others in the freshman class. The degree to which a student is connected to other more highly connected peers was assessed using Bonacich's (1987) weighted centrality score (PBCEN). The degree to which a student is connected to other members of his or her immediate peer group was measured by calculating the percentage of the student's ties that fell within (as opposed to outside) that student's peer group (PCTWGT). Similarly, calculating the percentage of a student's ties that fell among members of the freshman class itself captured the degree to which students report acquaintances with upperclassmen (PCTWCT). Summary statistics for these measures are found in Table 1 above.

RESULTS

Figure 2 presents the LISREL parameter estimates for the model. Only statistically significant paths appear in this figure. Based on modification indices produced by LISREL, some paths were added among the exogenous variables in the model.

Figure 2. Estimated model.



The overall fit of the model was quite good with a chi-square of 20.87 (*df*=36, p=.98), suggesting the model should not be rejected on statistical grounds. In addition to chi-square, it is customary to examine the goodness of fit index (GFI), adjusted goodness of fit index (AGFI), and the

comparative goodness of fit index (CFI). These are measures of the variances and covariances in the data accounted for by pre-specified constraints and parameters in the model. In general, the values should be considerably above .9 for a good fitting model (e.g., see Heck and Thomas, in press). Consistent with the chi-square, these statistics suggest a good fitting model (GFI=1.00, AGFI=.99, CFI=1.00). One final measure of model fit, the root mean square residual (RMR), was also considered. The RMR is the average of the magnitude of the residuals. While this coefficient can depend on the scaling of the variables, in most cases a RMR between .05 and zero indicates a good fitting model. The RMR for the specified model was .04. The variables in the model accounted for 65 percent of the variance in persistence and 45 percent of the variance in intentions.

It is important to note that the model does not account for measurement error—that is, all constructs are being treated as observed—and that is likely reflected in the highly desirable values for these fit indices.[4] However, even taking this into account, the values suggest the model fits the data adequately.

The parameter estimates in figure 2 are indices that represent the simultaneous contribution of each variable in the overall model. The values are standardized path coefficients, which permit the comparison of size differences in the magnitudes of the coefficients (Stage, 1990). Among the traditional components of the model, variables generally functioned as theoretically expected. Academic and social integration indirectly affected persistence through intentions with no direct effects detected. Net of other factors in the model, academic integration had a larger impact on intentions than was found for social integration (.29 v .42). Interestingly, neither of these effects was mediated by commitments as theorized in the Student Attrition Model. In addition to affecting intentions, academic integration also had a relatively strong (.31) impact on GPA, which, in turn, had a direct effect on persistence. While institutional commitment was found to influence intentions (.32), goal commitment had no effect. The role of commitments in the model then is mixed and, with the exception of GPA, only intention was found to directly impact persistence behavior (.77).

LISREL 8 permitted the testing of all possible paths linking the network variables to the constructs in the traditional specification of the Student Integration Model. Through an iterative

[4] While LISREL is capable of producing complex models that incorporate latent variables and associated measurement error, the purpose of this examination is to assess the degree to which structural characteristics of students' social networks impact known features of the Student Attrition Model. Had my purpose been to develop or test alternative models, I would have incorporated these features into the

process, non-significant paths were deleted from the model. The final model therefore, contains only paths found to have a statistically significant effect on one or more endogenous variables. Final modification indices failed to suggest new paths that should be explored.

Several notable network effects emerged from the analysis. Student outdegree, the number of nominations made, was found to negatively impact GPA while positively impacting academic integration (.17), social integration (.18) and educational goal commitment (.23). The interesting, positive/negative relationship between outdegree, academic integration, and GPA is due to the presence of a threshold effect of outdegree in terms of GPA. Subsequent analysis of the outdegree-GPA relationship revealed a moderate positive association between these two variables at lower levels of outdegree (50^{th} percentile and below, or 12 or fewer) and a moderate negative association at higher levels. In practical terms, this suggests that students reporting greater degrees of connectedness also report greater satisfaction with their academic experience which, in turn, positively impacts both educational goal commitments and GPA. However, these advantages are offset for students reporting large communication networks, who are actually directly penalized in terms of GPA. Overall, the positive returns to outdegree outweigh the negative and create a positive total impact on intentions (.12) and persistence (.06) (see table 3).

In contrast to the relationships between outdegree and the academic components of the model, student indegree, the number of nominations received by others, impacted only social components of the model. Indegree was found to positively affect social integration (.17), institutional commitment (.19), and intentions (.16). Interestingly, this was the only variable in the model that was found to affect student commitment to the institution (.19), the variable that has the largest direct impact on intentions (.32). This, combined with the positive impact of indegree on social integration, makes for the largest total effect of the network characteristics on both intentions (.27) and persistence (.21).

Two of the network variables were found to impact persistence directly. The first of these, PCTWGT, the percentage of self-reported ties that that fall within a student's peer group, was found to have negative impacts on both GPA (-.21) and persistence (-.06) for overall total effect of -.10. This measure can be viewed as the extent to which a student is bound to her or his peer-group to the exclusion of connections to those in other peer-groups. Students with fewer out-of-peer-group ties have less of an opportunity to be influenced by individuals in the broader network. From a resource standpoint, these students are more reliant on others in their peer-

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present analysis.

group for various forms of help and support and are therefore less able to turn outside this circle (see Granovetter, 1973). It might be said that relatively peer-group bound students are more "provincial" than their classmates with a wider range of connections. For the reasons given above, this provinciality may result in lower academic performance, and a lesser likelihood of persisting.

Bonacich's (1987) measure of centrality (the degree to which a student is connect to other connected students) was also found to have a direct positive impact on persistence (.05) as well as GPA (.14). These effects support the notion that student networks can and should be viewed as social and academic resources from which students draw. In contrast to the provincial nature of students tightly bound to their peer groups, students with greater degrees of connectedness to peers who are also highly connected might be seen as social cosmopolitans—students who are able to move in and out of other peer groups with relative ease.

The percentage of social ties falling within the freshmen class had no significant effect on the endogenous variables in the model.

Decomposition of Effects

Summarizing the findings, Table 3 displays the total and decomposed network effects on the endogenous variables in the model. The largest network effect was associated with student indegree, the number of nomination received from other students in the freshman class. Its impact was solely indirect, operating through enhanced social integration, institutional commitment, and intention.

Table 3. Direct, indirect, and total effects of network variables on traditional persistence constructs

	Academic Integration	Social Integration	GPA	Institution Commitment	Goal Commitment	Intent	Persist
PBCEN							
Direct	—	—	.14	—	—	—	.05
Indirect			.00				.02
Total			.14				.07
PCTWGT							
Direct	—	—	-.22	—	—	—	-.06
Indirect			.00				-.04
Total			-.22				-.10
OUTDEG							
Direct	.17	.18	-.23	—	.23	.00	.00
Indirect	.00	.00	.05		.09	.12	.06
Total	.17	.18	-.16		.32	.12	.06
INDEG							
Direct	—	.17	—	.19	—	.16	.00
Indirect		.00		.00		.11	.21
Total		.17		.19		.27	.21
PCTWCT							

The percentage of social ties that fell within one's peer group had the next largest total effect on persistence. The effect of this measure was negative, with 40 percent being direct and 60 percent

operating indirectly through GPA. In short, students with higher proportions of ties falling within their social groups are less likely to persist.

Centrality, as measured by Bonacich's (1987) assessment of students connections to other connected students, also had positive direct and indirect effects on persistence. Almost three-quarters of its effect on persistence was direct with the other one-quarter operating through its impact on GPA.

SUMMARY AND CONCLUSIONS

Student social relations and social networks have direct and indirect impacts on a number of important student outcomes. The results of this study demonstrate some of the ways that social structure informs constructs of satisfaction that are central to a number of theories of student development and persistence. It also demonstrates that previous operationalizations of integration have missed an important, albeit difficult to measure, dimension of the construct—structural integration vis-à-vis students' social networks. These network characteristics are shown to operate independently of affective measures of integration and appear to have non-trivial impacts on a number of factors theorized to affect persistence intentions and behavior.

One important confirmation made by this study is that student acquaintances are generally a good thing. More important than this confirmation however is the illumination of some of the ways in which acquaintances affect theoretically important constructs in student development research. Aside from the potential negative impact on grade performance—a contingency addressed in Tinto's development of the Student Integration Model—those reporting larger communication networks are likely to have higher levels of academic and social satisfaction, stronger intentions of continuing enrollment, and are in fact more likely to persist. More popular (or at least more visible in terms of indegree) students enjoy many of these same positive influences as well as exhibiting stronger commitments to the institution. Interestingly, only this degree of connectedness as reported by others was found to impact student commitment to the institution. Being named by others as a discussant has a substantial impact on intentions and persistence.

While the number of acquaintances is important, their structural location also has important impacts on vital outcomes such as grade performance and persistence. Two findings highlight this. First, a broader discussion network is better. Those students with a greater proportion of ties outside of their peer group perform better academically and are more likely to persist. Moreover, similar benefits accrue to those students who develop ties with other students who themselves have broader ties. From a resource perspective, those students who possess

broader, well connected networks, such as those described above are able to more easily make connections with others due to the multitude of paths reaching to many parts of the overall network. In terms of student success, the results of this study suggest that, while acceptable academic performance is a necessary and sufficient condition for persistence, strategic use of one's social network can enhance both academic performance and the quality of college life—critical factors in the persistence process.

The results from this analysis suggest a new perspective for understanding student integration. The relationships between the social networks, integration, and persistence examined in this study are put forward to advance the understanding of the role of social interactions in the persistence and attrition process. The picture that emerges from this examination is one portraying the differential effects of various network characteristics on persistence vis-à-vis satisfaction, performance, commitment, and intentions. The methods developed here should be employed in future research examine subgroup influences that are theorized to operate as students form attitudes and make decisions concerning a variety of issues.

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