Social Network Dynamics and Psychological Adjustment among University Students

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Abstract

The present study investigated the social network structure in a university class and how it changed over time. In addition, student rankings of social status in the class based on different network centrality measures were compared, and associations between students' social status and psychological adjustment were evaluated. One university seminar class in which ten juniors and ten seniors were enrolled was followed for six months. Although the class network consisted of some disconnected subgroups at baseline, it became a single group at follow-up. In addition to these structural changes, measures of network integration (density and transitivity) also increased from baseline to follow-up. Comparisons of centrality measures indicated that the information centrality measure best captured thenetwork infrastructure compared to the betweenness, closeness, and degree centrality measures. Furthermore, among the centrality measures, information centrality had the most stablepositive association with psychological adjustment. Theoretical and practical implications of these peer network dynamics and adjustment issues are discussed.

Keywords*:* social network, centrality, psychological adjustment, classroom climate

This work was supported in part by JSPS KAKENHI Grant Number 24500835.
The author thanks Kohei Kusumotoand So Oiya for assistance with data collection.
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Introduction

Human sociality is ancient. This human propensity for group living evolved because it helped humans solve ecological problems such as gathering resources and defending against predators (Crosier, Webster, & Dillon, 2012). Therefore, even now human beings are driven by an interpersonal desire to form and maintain social bonds, and are motivated by a fundamental need for belongingness (Baumeister& Leary, 1995).

Peer relationships in schools are considered to be an important modern social context wherein adolescents benefit from the support and resources these relationships provide (Ennet & Bauman, 1996; Wölfer, Bull, &Scheithauer, 2012). In particular, children's class in school is a critical factor when studying the consequences of children's peer relationships, because they spend a significant amount of time with classmates (Hartup, 1984). In fact, peer relationships or social networks in class are

associated with students' self-regulated learning (Leutwyler&Merki, 2009), bullying (Mouttapa, Valente, Gallaher, Rohrbach, 2004), subjective health (Almquist, 2011), risk behaviours such as smoking and alcohol consumption (Johansen, Rasmussen, & Madsen, 2006), and dropout rate (Hymel, Comfort, Schonert-Reichl, & McDougall, 1996).

These findings suggest that special attention should be paid to the school class as an adjustment factor in adolescence. However, most research to date has considered only elementary, junior high, and high school students; there are far fewer studies on the consequences of social networks in college and university classes. Gerdes and Mallinckrodt (1994) found that maladjustment in college increased risk of dropout within six years. However, the question of whether a student's adjustment relates to social networks in college or university classes, as it is in elementary and secondary school classes needs to be further explored.

Social network analysis (SNA) is a useful tool for analyzing school class dynamics (Almquist, 2011). Because SNA was initially formalized within the framework of graph theory, it took centuries for the idea to transfer from mathematics to the social sciences (Crosier et al., 2012). In recent years, however, anthropology (Apicella, Marlowe, Fowler, & Christakis, 2012), economics (Kim, Choi, Yan, &Dooley, 2011), and psychology (Flynn, Reagans, &Guillory, 2010) have benefitted from SNA.

The social network perspective highlights patterns and structures between social actors rather than the characteristics of the actors themselves; the structure of a network has greater consequences for individual members and the network as a whole than the characteristics and behaviors of the individuals involved (Burt, 1992; Klovdahl, 1985).The SNA approach, therefore, is expected to provide a way to precisely investigate real-life social integration by examining aggregated dyadic data and the influence of direct and indirect peer affiliations in a school class (Wölfer et al., 2012).However, social networks have been studied less frequently than individuals and dyads (Cillessen,2007). As Cillessen (2007) explains:

> The identification of social networks is typically more complex and challenging than the determination of sociometric status or a friendship relationship. Social networks are not fixed entities but clusters of connected individuals that change over time. At any given time, the members of a network are in it with varying degrees of centrality. Over time, the centrality of a network member may increase or decrease. At the periphery, the boundaries of the network are relatively open—individuals move in and out of the group. These characteristics make it harder to judge whether at any given time a person is or is not a group member. (p. 92)

The first purpose of this study is to describe the structure of the social network within a university class, in which students *cannot* move in and out of the class for a certain fixed period, and how it changes over time. In the analysis, we calculated and compared network integration and centrality measures that are commonly used in the SNA approach. This classroom level operationalization and measurement should capture the complexity and dynamic nature of the network.

The second purpose of this study is to examine whether the nature of the social network is associated with psychological adjustment of the students involved. Individual students have unique interactions with classmates and play different roles in the social network. These non-shared experiences may have implications for a particular student's adjustment to school (van den Oord & van Rossem, 2002). The dynamics of the class network are likely connected to the overall level of member integration, which in turn is expected to influence students' feelings of belonging in the class (Almquist, 2011).

In Japan, where our research was conducted, more than 50% of high school-educated students pursue advanced education (Japan Statistical Research & Training Institute, 2013). At the same time, maladjustment in college and university has led to serious problems including apathy, failing, and dropping out (Wada & Matsuo, 2012). Therefore, investigating social networks in a university class setting is valuable for understanding adjustment in late adolescence.

Method

Participants

Data were collected from ten juniors (two men, eight women, M_{age} = 20.4 years) and ten seniors (two men, eight women, M_{age} = 21.6 years) enrolled in a seminar psychology course at Waseda University. This class was part of the two-year core curriculum, so this was the second year that seniors were enrolled in the class, and the first year that juniors were enrolled in the class. The baseline assessment was conducted at the beginning of the first semester and the class was held every week for two months. Besides the regular curriculum, students voluntarily met to prepare for the class. They also attended a two-day extracurricular session during summer break. The follow-up assessment was conducted at the beginning of the second semester, that is, after the first semester and summer break. The interval between the two assessments was approximately six months.

Measures

Data were collected using the same questionnaire at both baseline and follow-up.

Social network

Social networking of the class was determined by the strength of the relationships between each student and his/her classmates. All students were given a class roster in numeric order and instructed to underline their own name. They were then asked to indicate the strength of their relationship with each listed person except themselves using a 5-point scale ranging from 1(no tie) to 5 (very strong tie). Participants were instructed to evaluate each relationship in terms of the frequency of contact (including face-to face talking, phone, e-mail, Facebook, Twitter, etc.). In the analysis, a rating of 1 (no tie) was coded as 0 and other answers were coded as 1. The social network in the class was then conceptualized as an unweighted graph. The network was analyzed as an undirected graph because one centrality measure (information centrality) can only be

applied to undirected networks (Stephenson & Zelen, 1989).

Psychological adjustment in the class

Participants completed a questionnaire developed by Ishimoto and Saito (2006) designed to probe students' feelings of belongingness to the class (e.g., "I feel I am needed by the class").This scale consisted of seven items that were rated on a 5-point scale (1 = strongly disagree and 5 = strongly agree).Responses were summed in the analysis (a higher score indicated better adjustment). Cronbach's alphas for the study sample were .84 at baseline and .87 at follow-up.

Statistical Analysis

The analysis was three-fold. First, structural changes in the network from baseline to follow-up were investigated. Two measures of network integration at each assessment were compared: density (proportion of ties that were actually observed out of all the ties that were potentially observable) and transitivity (proportion of transitively closed triplets of nodes <i,k,j> observed among the potentially observable closed paths of length 2 from i to j via k).

Second, we compared social status (or rank) of each student in the class both at baseline and follow-up by calculating node centrality. There are three commonly used measures of centrality in network analysis (Crosier et al., 2012): degree (the number of ties that a node has), closeness (the average length of the shortest possible paths between all nodes), and betweenness (sum of the fractions of the shortest paths between any two nodes that pass through a given third node). Stephenson and Zelen (1989) proposed an additional measure of centrality that is calculated by taking into account all possible paths between pairs of nodes (information centrality). They analyzed a network of homosexual men diagnosed with AIDS and found that the social status of each node was correctly ranked by information centrality, rather than by other measures of centrality (degree, closeness, and betweenness). In the present study, we compared the usefulness of these four centrality measures for describing social status in a university class.

Lastly, we examined whether social status in the network was linked to an individual's adjustment to the class. Most researchers agree that peer status refers to a within-group rank ordering of individuals according to their degree of acceptance, rejection, popularity, or dominance (Cillessen, 2007). Students who have difficulty being accepted by any peer group in school experience feelings of anxiety and rejection (Evans & Eder, 1993). In the present study, we hypothesized that students with high social status would have positive feelings about the class. To test the hypothesis, we calculated the correlations between each student's rank (centrality) and his/her feelings of belongingness to the class.All statistical analyses were conducted using R 2.13.

Results

Structural Changes in the Class Network

Figure 1 shows the changes in the network structure over time. The baseline network indicated three groupings: a larger group consisting of only seniors (nodes 11–20), a middle group consisting of only juniors (nodes 1–4, and 7–10), and a pair of juniors (nodes 5 and 6). At follow-up, these groups were "bridged" by four nodes (8, 9, 12, and 15) and became one larger group that included all nodes except one (node 2). Measures of network integration reflected these changes in network structure (Table 1). That is, network density was .20 at baseline and increased to .27 at follow-up. Similarly, transitivity increased from .67 to .72 over time. Both measures were higher in seniors than juniors regardless of assessment time.

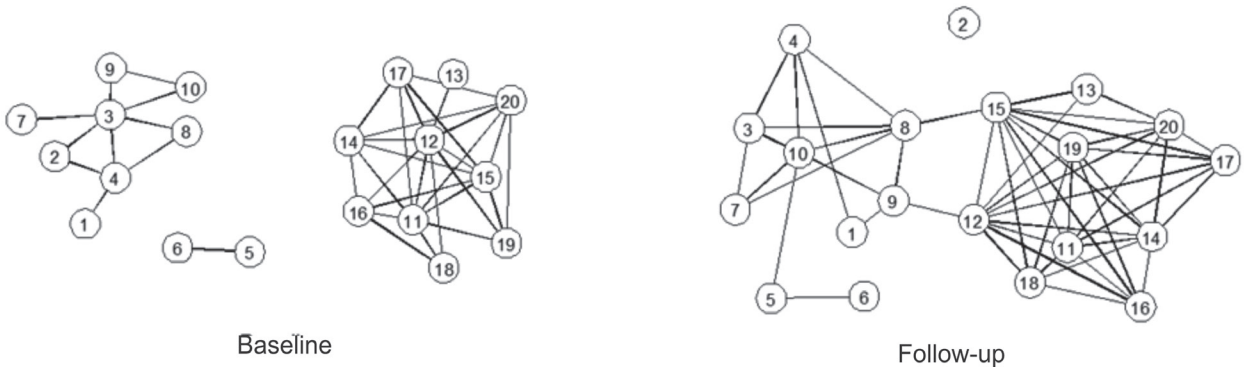

Figure 1. Networks in the class at baseline (left) and follow-up (right)

Table 1
Changes in Network Structure Measures

	All		Juniors		Seniors	
Measure	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
Density	.20	.27	.24	.33	.36	.53
Transitivity	.67	.72	.60	.78	.73	.84

Comparison of Centrality Measures

Table 2 summarizes student rankings based on each centrality measure. For information centrality, students who were isolated from the network (nodes 5 and 6 at baseline and node 2 at follow-up) were ranked as the lowest. Among other peripheral nodes (i.e., having only one path), nodes 1 and 7 were ranked second lowest at baseline and node 6was ranked second lowest at follow-up. Although node 13 was also peripheral at baseline, it was ranked above the remaining peripheral nodes. Three of the "bridge" nodes at follow-up (nodes 8, 12, and 15) were ranked in the top three. The remaining "bridge" node (node 9) was ranked in the middle, possibly due to a smaller number of incidental ties.

Compared to the results based on information centrality, the other centrality measures were problematic for describing the social network characteristics. For example, closeness centrality could not be calculated because such calculations require that all nodes are connected to each other; the network in this study consisted of disconnected subgroups (at baseline) or included an isolated node (at follow-up). Therefore, we were unable to rank individuals according to closeness centrality in this class network.

The betweenness measure ranks nodes according to the "control" they exert in the network (Stephenson & Zelen, 1989). For example, in the present study node 3 was ranked highest at baseline. This is because if node 3 was removed, it would eliminate the connection between two

Table 2
Comparison of Centrality Measure Ranking

Overall rank	Information				Degree				Betweenness				Closeness			
	Baseline		Follow-up		Baseline		Follow-up		Baseline		Follow-up		Baseline		Follow-up	
	Node	Value	Node	Value	Node	Value	Node	Value	Node	Value	Node	Value	Node	Value	Node	Value
1	11	0.074	12	0.067	12	9	12	10	3	29.0	15	97.1	1	NA	1	NA
2	12	0.074	15	0.067	11	8	15	10	12	23.0	8	94.1	2	NA	2	NA
3	13	0.074	8	0.062	15	7	11	8	4	13.0	10	70.0	3	NA	3	NA
4	14	0.074	11	0.061	3	6	14	8	11	7.0	12	63.9	4	NA	4	NA
5	15	0.074	14	0.061	14	6	19	8	15	2.7	9	59.3	5	NA	5	NA
6	16	0.074	19	0.061	20	6	20	7	16	1.3	5	34.0	6	NA	6	NA
7	17	0.074	20	0.059	16	5	8	6	14	1.0	4	7.9	7	NA	7	NA
8	18	0.074	17	0.058	17	5	10	6	20	1.0	20	2.7	8	NA	8	NA
9	19	0.074	16	0.058	4	4	16	6	1	0.0	11	1.6	9	NA	9	NA
10	20	0.074	18	0.058	19	4	17	6	2	0.0	14	1.6	10	NA	10	NA
11	1	0.036	9	0.058	18	3	18	6	5	0.0	19	1.6	11	NA	11	NA
12	2	0.036	10	0.056	2	2	3	4	6	0.0	1	1.2	12	NA	12	NA
13	3	0.036	4	0.050	8	2	4	4	7	0.0	3	1.1	13	NA	13	NA
14	4	0.036	3	0.049	9	2	9	4	8	0.0	2	0.0	14	NA	14	NA
15	7	0.036	13	0.048	10	2	7	3	9	0.0	6	0.0	15	NA	15	NA
16	8	0.036	7	0.045	1	1	13	3	10	0.0	7	0.0	16	NA	16	NA
17	9	0.036	1	0.039	5	1	1	2	13	0.0	13	0.0	17	NA	17	NA
18	10	0.036	5	0.028	6	1	5	2	17	0.0	16	0.0	18	NA	18	NA
19	5	−0.012	6	0.018	7	1	6	1	18	0.0	17	0.0	19	NA	19	NA
20	6	−0.012	2	0.000	13	1	2	0	19	0.0	18	0.0	20	NA	20	NA

Note. The nodes of juniors are assigned numbers 1−10 and those of seniors are assigned numbers 11−20.

groups (one consisting of nodes 1, 2, 4, and 8, and another consisting of nodes 9 and 10), and would isolate node 7. In contrast, removing node 9 from the network would not influence any node's connection to others, so node 9 had a betweenness score of zero (ranked lowest). Nevertheless, the usefulness of this measure in the present study is questionable, because there were many (11) other nodes in the baseline network that had betweenness scores of zero. This distorted distribution nullified centrality distinctions among individuals in the baseline network. Results at follow-up showed the same pattern.

Rankings based on degree centrality were the most similar to those for information centrality, but there were some discrepancies between the measures. For example, although nodes 5 and 6 were ranked the lowest according to both centrality measures at baseline, other nodes (1, 7 and 13) shared the same rank according to degree centrality. As another example, although both information and degree measures ranked nodes 12 and 15 highest at follow-up, the latter ranked four additional nodes (11, 14, 19, 20) higher than node 8.

Associations between Centrality and Psychological Adjustment in the Class

Kendall rank correlation coefficients (Kendall τ) were estimated to examine associations between the four centrality measures and adjustment in the class. As shown in Table 3, all centrality measures (except the closeness measure, which could not be

calculated) were positively correlated with the adjustment score, suggesting that high-centered students felt more adjusted in the class compared to low-centered students. This trend, however, was only statistically significant for information centrality (both at baseline and follow-up) and degree centrality (at baseline).

Table 3
Correlations Between Adjustment Scores and Centrality Measures

Centrality Measure	Baseline	Follow-up
Information	.38*	.34*
Degree	.52**	.28
Betweenness	.30	.19
Closeness	NA	NA

Note. *p < .05. **p < .01.

Discussion

The results of the present study show that social network structure in a university class changes over time. At the beginning of the class, there were some disconnected subgroups, each of which included only students in the same year (i.e., juniors or seniors). Such disconnections, however, vanished half a year later, resulting in one large network consisting of all but one student. These network dynamics were confirmed by the increase in measures of network integration (density and transitivity) from baseline to follow-up. The more frequently individuals interact with one another; the stronger their feelings of friendship toward one another are likely to be (Homans, 1950). Thus, these findings suggest that frequent interactions among students increase integration in a university class. The seniors' subgroup was more integrated than the juniors' subgroup. This may also indicate the importance of continuous interaction for greater integration, because seniors had already taken the same class in the previous year, and already knew each other at the time of the baseline assessment. (Friendships between juniors from different classes could also occur, but they were limited in the time they could spend together during the regular curriculum).

By comparing the centrality measures, we found that information centrality most effectively captured subtle network infrastructure, consistent with previous empirical research (Stephenson & Zelen, 1989) and simulation studies (TerMaat, 2013). Traditional degree, betweenness, and closeness centrality measures are calculated by assessing the adjacency (direct path) or efficiency (shortest path) between a pair of nodes. In contrast, information centrality is calculated by assessing all paths between two nodes and weighs them by their length. By using the information measure in the present study, specific characteristics of each node in the class network were obtained. For example, among the four measures, only information centrality could distinguish between three levels of peripheral nodes (having only one path) at baseline: node 13, which was connected to the highest-ranked node (12), was the most central; a second tier included nodes 1 and 7; and a third tier of nodes (5 and 6) was isolated from the network. Furthermore, at follow-up, information centrality ranked node 8, which played a role in bridging subgroups, ahead of other "central" nodes (11, 14, 19, and 20), which were only connected to nodes of the same year. As discussed earlier, social network perspective highlights patterns and structures between social actors rather than the characteristics of the actors themselves (Burt, 1992). In this regard, the present study suggests that information centrality is useful for estimating social networks based on each student's structural role in the class.

There are, however, some limitations in the use of information centrality. First, this measure can only be applied to undirected networks. Consequently, other central measures must be used when the relationships between nodes are directed (e.g., when collecting data by using snowball sampling techniques in which current subjects recruit future subjects from among their acquaintances). Second, as Stephenson and Zelen (1989) indicated, other central measures

may make better practical sense for other networks, such as in operations research design (e.g., the traveling salesman problem, where the goal is to find the shortest route between nodes). This is because the centrality measure is based not only on the shortest (i.e., efficient) paths, but also on the "information" contained in all (i.e., potentially redundant) possible paths between pairs of nodes. It is necessary to carefully select an appropriate measure that fits the data or to use several measures together to examine social networks from different viewpoints (Suzuki, 2009).

Regarding the associations between social status and psychological adjustment, we found that high-centered students were better adjusted in the class than low-centered students. As with many organisms living in groups, achieving high social status may be the most beneficial way for humans to survive and reproduce (Crosier et al., 2012). Farmer (1996) found that high-centered elementary students were more athletic, cooperative, popular, and studious in class relative to low-centered students, and they were more likely to be leaders. Wölfer et al. (2012) also indicated that socially integrated adolescents (secondary school students) had better social skills, were more popular, and scored lower on relational aggression compared to their less integrated peers. Therefore, the results of the present study are consistent with previous research.

One of the interesting findings in this study was that the association between adjustment score and information centrality was the most stable (i.e., was observed at both baseline and follow-up) compared to the association with the other centrality measures. This suggests that, besides the established practice of ranking based on social status, information centrality can be used to predict an individual's level of adjustment. We look forward to future studies that replicate these findings with larger samples and technically improved network analyses, or that address the remaining unanswered research questions.

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