



# The effects of friendship networks on adolescent depressive symptoms

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## Abstract

Previous studies have demonstrated that individuals who are socially integrated have better mental health, but these studies have been mostly limited to the adult population. Using data based on a nationally representative sample of adolescents ( $N=11,023$ ), I investigate whether those who are integrated into friendship networks have better mental health, as measured by number of depressive symptoms. The study also extends the literature by utilizing a variety of network measures of integration. The analyses showed that, consistent with previous findings in the adult studies, higher levels of integration were associated with fewer depressive symptoms, although the association was very weak. Number of friends, the simplest and most frequently used measure of integration in mental health research, had a stronger and more consistent effect than other variables which measured more complex aspects of egocentric and school-level network structure. The results also showed that the relationship between having more friends and fewer depressive symptoms was largely mediated by a sense of belonging, which provided support for the often assumed but rarely tested argument that social integration promotes mental health by inducing positive feelings about one's relationships with others in society.

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## 1. Introduction

Previous research has demonstrated that friendships play an important role in psychological and behavioral development in adolescence. Drawing from the

sociological literature on social integration and mental health, I hypothesize that integration into friendship networks at both individual and school levels promotes adolescent mental health. Depressive symptoms are examined as a mental health outcome in this paper. The study not only extends the current adult-orientated literature, but it also examines the critical assumption, which has rarely been tested: social integration promotes mental health by increasing positive feelings about one's relationships with others in society. Currently, we know little about whether and to what extent various aspects of network structure influence mental health because previous studies heavily relied on one network measure—egocentric network size (i.e., the number of network members to whom one is directly connected). I will overcome this weakness of previous studies by using a variety of network measures which relate to the concept of social integration.

## 2. Literature review

### 2.1. *Sociological perspectives on social integration and mental health*

Social integration generally refers to the degrees to which people are connected to each other in society or in social groups. Extending Durkheim's (1865/1966) study of suicide rates in European countries and Faris and Dunham's (1939) study of mental disorders in Chicago neighborhoods, contemporary mental health researchers have demonstrated that individuals who are less integrated have more psychological problems. To measure degrees of integration, these researchers frequently used network variables, which allowed them to describe patterns of social relationships systematically. Among network measures, egocentric network size and density are the two most frequently used. An *egocentric network* is composed of actors with whom the focal person (ego) is directly connected (alters) and the ties among them. *Egocentric network size* simply represents the number of alters in egocentric networks.

There are many studies that report mental health benefits associated with large egocentric networks (e.g., Burt's analysis of General Social Survey, 1987; Fischer and Phillips' study of Northern California residents, 1982). Some researchers have treated egocentric network size as a measure of social support and demonstrated the association between larger egocentric networks and fewer depressive symptoms (see review in Cohen and Wills, 1985).<sup>1</sup> Elaborating the relationship between network size and mental health, some researchers have observed that one close relationship may be sufficient to provide a mental health benefit and that having many

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<sup>1</sup> The reader should be aware, however, that egocentric network size only measures the sum of direct social ties; actual exchange and perceived availability are more appropriate measures of social support (Cohen and Wills, 1985; House et al., 1988; Thoits, 1995).

relationships might not necessarily contribute more to mental health (see reviews in [Baumeister and Leary, 1995](#); [Cohen and Wills, 1985](#)).<sup>2</sup>

Egocentric network size by itself is a limited measure of network integration because it only considers relationships between ego and alters. Another egocentric network characteristic, *density*, complements size because it measures how extensively alters are connected *with each other*. Egocentric network density is commonly calculated by dividing the number of existing ties among alters by the number of all possible ties ([Knoke and Kuklinski, 1982](#)). Through interactions in dense networks, people may develop a sense that they are part of a group rather than having multiple relationships with people who do not know each other. Although some studies have found positive associations between egocentric network density and good mental health, the pattern is not very consistent ([Lin and Peek, 1999](#)). For example, dense egocentric networks only benefited people with low socioeconomic status in [Fischer's \(1982\)](#) study and in [Kadushin's \(1983\)](#) study of Vietnam veterans, those who live in rural areas.

When explaining the processes through which high degrees of integration result in good mental health, many researchers have argued that social integration promotes positive thoughts and feelings about one's relationships with others or about one's group. For example, much contemporary research in sociology is based on [Durkheim's \(1865/1966\)](#) argument that individuals develop emotional attachment in their relationships with others, which in turn promotes mental health by fulfilling the need for belonging. Drawing on the symbolic interactionist perspective, [Thoits \(1985\)](#) similarly argued that social relationships are an important source of self-identities and life meaning because they specify what obligations and expectations people have for each other. A sense of mattering ([Rosenberg and McCullough, 1981](#); [Taylor et al., 2001](#)) and feelings of being loved and wanted ([Cobb, 1976](#); [Turner and Marino, 1994](#); [Umberson et al., 1996](#)) are other positive thoughts and feelings associated with high levels of social integration. However, the mediation effects of social integration on mental health through these thoughts and feelings have rarely been tested in previous studies. One of my study purposes is to fill in this gap in the literature.

Another limitation of the sociological literature on social integration and mental health is its narrow focus on the adult population. Although other age groups are also likely to benefit from social integration, few empirical studies have been conducted. In this paper, I focus on adolescents and examine how friendship networks influence their depressive symptoms. During adolescence, individuals become more independent from their families and develop connections to the larger society through their intensive and intimate relationships with friends. Adolescents also spend a large portion of their free time with their friends and place great importance on their relationships with their friends ([Csikszentmihalyi and Larson, 1984](#)).

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<sup>2</sup> [Durkheim \(1865/1966\)](#) also made an argument for a non-linear relationship between social integration and suicide: people who are highly integrated into society, as well as those who are isolated, are more likely to commit suicide because of overloaded obligations and a blocked desire to achieve personal goals. However, this seems to apply only to extreme situations ([Johnson, 1965](#)). His argument thus does not directly relate to my paper, which focuses on adolescent friendships.

## 2.2. *Developmental approaches to adolescent friendships*

Many studies that have examined the psychological impact of adolescent friendships were based on developmental approaches. Consistent with the sociological literature on social integration, these studies tend to portray friendships positively (cf. Crosnoe, 2000). However, these studies address unique characteristics of friendships in adolescence and how friendships shape mental states in this particular life stage.

Buhrmester (1996) argues that friendships develop because of the individual need for companionship, which emerges in childhood. Although the number of friends may not increase significantly as individuals make a transition from childhood to adolescence, the quality of friendships seems to change due to a new need for emotional closeness. Specifically, friends are no longer just playmates as in childhood but become persons whom adolescents trust and by whom they feel understood. Consistent with this view, adolescent friendships involve intensive and intimate conversation, self-disclosure, and efforts to solve conflict (Buhrmester, 1996). Also in this life stage, friendships develop into crowds, from which adolescents derive a sense of group identity (Monsour, 2002).

Like sociologists who study the effects of social integration on mental health, developmental psychologists argue that emotional closeness in friendships fulfills adolescents' need for intimacy and self-validation. Developmental psychologists also remind us that the contribution of friendships is not limited to mental health, but that friendships also provide unique opportunities to establish self-identities and general social skills, which are necessary for adult life. Some characteristics of friendships (e.g., equality, room for autonomy) are particularly important for explaining these unique contributions because they distinguish friendships from relationships with parents (Buhrmester, 1996; Monsour, 2002).

## 2.3. *Previous findings on the effects of adolescent friendships on mental health*

As in adult studies, egocentric network size is the most commonly used network measure in adolescent friendship studies. Past findings are mostly consistent in that having larger egocentric networks contributes to better mental health outcomes (Coates, 1985; Field et al., 2001). However, the relationship between the number of friends and good mental health does not seem to emerge in adolescence; it may already exist in childhood (Gest et al., 2001).

Other adolescent studies have demonstrated the positive association between popularity and good mental health (Coleman, 1961; Östberg, 2003). These studies used leading crowd or liking nominations, which are similar to friendship nominations in terms of measurement procedures. However, they seem to measure characteristics of peer relationships that are somewhat different from what friendship nominations measure. First, students are not necessarily friends with those whom they like or those who they think are members of the leading crowds. Second, measures of popularity and leading crowd memberships are commonly based on the number of nominations each student *receives*, whereas egocentric friendship network size is usually based on the number of nominations each student *gives*

(or number of mutual nominations). Because of these differences, the measures based on liking or popularity nominations are thought to reflect students' positions in the group hierarchy, whereas egocentric friendship networks tend to describe close and often egalitarian relationships, which are just a small part of this student hierarchy (Bukowski and Hoza, 1989; Coleman, 1961; Östberg, 2003). Thus, it makes sense that these measures of popularity and egocentric friendship network size have independent effects on emotional development, although they generally show a moderate, positive correlation with each other (Coleman, 1961; Gest et al., 2001).<sup>3</sup>

As in adult mental health studies, other network variables that measure individual positions in broader networks have rarely been used in adolescent studies. An exception is a study by Hansell (1985), which included two centrality measures. One measure is closeness centrality, which can be calculated by taking the average of the geodesic distance (the number of ties in the shortest paths) between the target individual and other individuals in the network (Lin, 1976).<sup>4</sup> Individuals who have more direct ties than indirect ties are thought to be more central in the network. The other centrality measure used in Hansell's study, reachability, represents the total number of individuals in the network whom one can reach through one's direct and indirect ties. However, these centrality measures were not significantly associated with distress level in Hansell's study.

In fact, density was the only network variable that showed a significant association with distress among more than a dozen network variables examined in Hansell's study. He reported that the following network properties were not significantly associated with distress: number of reciprocated friendships, number of unreciprocated friendships, number of friends of one's friends (including three versions based on sent, received, and reciprocated nominations), and four network roles determined by block models (in addition to egocentric network size, reachability, and closeness centrality already mentioned above).<sup>5</sup>

However, we do not have sufficient evidence to believe that these network properties have no effect on adolescent mental health. Hansell's small sample ( $N=254$ ) might not have allowed him to detect small effects that these network variables might have had on distress. Additionally, the results based on just one school cannot be generalized to other schools, where friendships may create very different patterns.

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<sup>3</sup> The positive correlation between popularity and egocentric network size may be partly attributed to a causal relationship between the two. Bukowski et al. (1993) specifically argue that popularity increases friendship formation because students first have to be liked by at least one other student in order to have a friend and because being popular generally gives more opportunities to develop friendships. Relating their argument to previous theories of friendship development, the authors also refer to Sullivan's (1953) claim that the need for intimate friendships develops in adolescence, after the need for peer acceptance and popularity has emerged.

<sup>4</sup> When calculating centrality closeness scores, it is more common today to take the reciprocal of average geodesic distance so that higher values indicate higher degrees of closeness instead of lower degrees (Wasserman and Faust, 1994).

<sup>5</sup> The roles derived from block models included primary, broker, sycophant, and isolate. See Burt (1976) for more information on block model method.

Because some of these network variables showed significant associations with other outcome measures (e.g., satisfaction with school, ability to cope with school related stressors), the failure to detect significant associations with distress might also have been due to problems with the distress measure. The Senior Form of the Health Opinion Survey, developed by Leighton (1976) and used in Hansell's study, consisted of 28 items and mainly targeted physical symptoms (e.g., sleeping problems, sweaty hands). This instrument is not widely used in current adolescent studies to my knowledge.

#### *2.4. Friendship integration at the school level*

Recently, researchers have devoted an increasing amount of effort to investigating whether and to what extent various social contexts influence mental health. Some of these studies have demonstrated that social integration at the neighborhood and organizational levels contribute to good mental health (Aneshensel and Sucoff, 1996; Maton, 1989; Ross, 2000). As Maton (1989) argues, cohesive groups create a climate that members meet each other's need and that their involvement in the group makes meaningful contributions to the group. Extending his argument, one may not necessarily have to develop extensive egocentric networks to receive mental health benefit because one could experience feelings of security and life meaning indirectly through being a member of a cohesive group.

Given that a majority of adolescent friendships develop and are maintained at school (as shown in the analysis below), the overall integration level at school may have a beneficial effect on mental health beyond the individual-level integration. Although there has been little research on integration at school, some studies have provided indirect support for the argument. For example, schools where students are densely connected with each other through friendships have higher levels of attachment to school (Moody and Bearman, 2003). I will explicitly examine the effect of school-level density on adolescents' depressive symptoms in this study.

Although not directly related to the concept of social integration, Östberg's (2003) analysis of Scottish children showed that classes with no isolated students and those with no extremely popular students had overall fewer psychosomatic symptoms. The researcher interpreted the result to indicate that less hierarchical networks create an egalitarian climate at school, which in turn contributes to better mental health. I will extend Östberg's study by investigating the mental health consequences of school-wide network structure, using a few measures of popularity hierarchy.

#### *2.5. Sense of belonging as a mediating mechanism*

As discussed above, sociologists have argued that high levels of social integration promote mental health through positive thoughts and feelings about one's social life. Although integration into friendship networks may create a variety of feelings among adolescents, I will focus on sense of belonging as a mediating factor. As

previous studies indicate, those who are integrated into friendship networks at school are strongly attached to school. For example, [Moody and Bearman \(2003\)](#) showed that number of friendship nominations received and Bonacich centrality were both positively associated with attachment to school.<sup>6</sup>

In summary, this paper contributes to the literature on social integration and mental health in several ways. Extending previous research based on the adult population, I will examine whether higher degrees of social integration into friendship networks, both at individual and school levels, promote better mental health among adolescents. Previous studies (of both adults and adolescents) have relied heavily on egocentric network size (or number of friends) to measure degrees of integration, and consequently we know very little about whether other aspects in friendship networks influence mental health. I will employ several network measures at both individual and school levels in this study. Another weakness in the literature is the failure to examine the mechanism which links social integration and good mental health specifically, I will test the extent to which integration into friendship networks contributes to adolescent mental health through a sense of belonging.

### 3. Methods

#### 3.1. Data and sample

For data analysis, I used the *National Longitudinal Study of Adolescent Health* (Add Health) ([Udry, 1998](#)). Add Health was designed to assess the health status and health related behaviors of adolescents in the US. Many previous studies that examined the relationships between friendship networks and adolescent mental health were based on convenience or small local samples, and most large surveys of adolescents included only a few friendship variables. To my knowledge, Add Health is the only national study that allows one to compute a variety of network variables and examine their effects on adolescent mental health.

A multi-stage stratified sampling technique was used to select respondents in Add Health. First, all high schools in the US were given unequal probabilities of selection, depending on region, degree of urbanization, proportion of white students, and enrollment size. In total, 80 high schools and 52 sister schools which sent students to those high schools (commonly middle schools) were selected. In 1994, questionnaires were administered at each school to students who were present on that day (*in-school survey*,  $N=90,118$ ).<sup>7</sup> About six months later, in-depth, structured inter-

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<sup>6</sup> Bonacich centrality is similar to number of friendship nominations sent, except that friendships are weighted so that among students who nominate the same number of friends, students whose friends have more friends (i.e., those connected to popular friends) receive higher scores than other students whose friends have fewer friends.

<sup>7</sup> The response rate was 79.5%.

views were conducted at respondents' homes (*in-home survey*,  $N=20,745$ ). About 200 students were selected from each school.<sup>8,9</sup>

I used the following restrictions to define my operational sample. I first excluded students at 27 schools which had response rates lower than 80% on the in-school survey. This is because the large number of missing cases in these schools did not allow me to construct reliable network measures. I computed all independent variables with the remaining adolescents ( $N=71,084$  in 105 schools).<sup>10</sup> Of these, 12,842 adolescents participated in the in-home survey, where my dependent variable, depressive symptoms, was measured. My final operational sample consisted of 11,023 adolescents who had valid values for all variables used in the analyses.

### 3.2. Measures

#### 3.2.1. Depressive symptoms

As a measure of depressive symptoms, I used a modified version of the Center for Epidemiologic Studies Depression scale (Radloff, 1977). The CES-D is frequently used as a screening device to detect clinically relevant levels of depression. Nineteen questions were asked to assess certain feelings, thoughts, and physical conditions during the past week.<sup>11</sup> Each question had four response categories (ranging from 0 = "never or rarely" to 3 = "most of the time or all of the time") (see Appendix for the exact wording of the CES-D items and other measures). Although the CES-D generally has good inter-item reliability, the items also form a few factors within the scale, including a factor that represents interpersonal symptoms of depression (Radloff, 1977). This was also true for the modified version of CES-D used in Add Health. Because the four items that formed this factor were very closely related to the concept of social integration and might contaminate measures of depressive symptoms and friendship integration, I excluded them from the scale after making sure that the shorter scale had an adequate

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<sup>8</sup> The in-home sample was stratified by gender and grade level, and students in certain ethnic categories (black students from educated families, Chinese students, Cuban students, and Puerto Rican students) were oversampled.

<sup>9</sup> The response rate was 78.9%.

<sup>10</sup> Schools excluded from analysis due to low response rates might have been somewhat different from those in the operational sample. The average belonging score was significantly lower at the excluded schools ( $t=5.65, p<.001$ ), although there was no significant difference in depressive symptoms. (Note that these contrasts are conservative, given that the average levels of belonging and depressive symptoms are based on students who participated in the study.) Similarly, students who were dropped in the listwise deletion procedure due to absence and uncompleted questionnaires might have had some unique attributes (e.g., less integrated to school, had more psychological and behavioral problems), although this hypothesis cannot be directly tested. The exclusions of these excluded schools and adolescents from analysis might have influenced the estimation of the relationship between integration and mental health.

<sup>11</sup> The original CES-D scale consists of 20 items. Two items, "my sleep was restless" and "I had crying spells" were dropped, and an item, "I felt life was not worth living" was added. Also, two other items were worded differently in Add Health, including "I felt too tired to do things" (originally "I felt that everything was an effort") and "it was hard to get started to do things" (originally "I could not get going").

reliability score ( $\alpha = .84$ ).<sup>12</sup> *Depressive symptoms* represented summed scores from the 15 items. The possible values ranged from 0 to 45. Means and standard deviations of depressive symptoms and other variables are shown in Table 1.

### 3.2.2. Friendship integration

Measures of friendship integration were constructed from the friendship nomination data. Adolescents were asked to list up to five closest male friends and five closest female friends. When respondents and their friends went to the same schools, friends' identification numbers were recorded. *Total number of friends* represents the sum of male and female friends. Friends outside school might have had a unique impact on adolescent mental health because having friends outside school might have reflected adolescents' failure to develop friendships within school and their associations with adolescents (or adults) who had psychological and behavioral problems. Therefore, as subsets of total number of friends, I also computed *number of friends at school* and *number of friends outside school*.<sup>13</sup> Further, as a subset of number of friends at school, I calculated number of friends who did not participate in the in-school survey (*number of non-participant friends*). This variable was used for two purposes. First, it was necessary to exclude non-participants from construction of some network variables to accurately measure certain aspects of network structure. Doing so, however, might have affected scores in these variables, particularly for adolescents who nominated many non-participants as friends. I therefore entered number of non-participant friends in the analysis to reduce this possible bias. Second, having many non-participant friends might also have signaled that adolescents were surrounded by friends who did not conform to school norms (e.g., participation in a school-wide survey). Thus, I examined whether having many non-participant friends was related to a greater number of depressive symptoms. These network variables discussed so far were all based on the number of sent nominations, and their possible values ranged from 0 to 10.

As discussed in the previous section, number of received nominations is commonly treated as a measure of adolescents' positions in the popularity hierarchy at school (Coleman, 1961; Moody, 1999; Östberg, 2003). In the Add Health data, number of received nominations showed a strong positive skewness, indicating the presence of some extremely popular students. Because of this skewed distribution, the variable needed to be transformed. The transformation also made sense because the variable was positively correlated with number of sent nominations. Thus, using a strategy developed by Moody (1999), I constructed an ordinal variable with the following three categories: (1) "popular" (students in the top 10 percentile in number of re-

<sup>12</sup> The following items were excluded: "I talked less than usual"; "people were unfriendly to me"; "I felt that people disliked me"; and "I felt lonely."

<sup>13</sup> Number of friends at school and number of friends outside school did not necessarily sum up to the total number of friends. This is because number of friends at school only included those identifiable in the school rosters, whereas total number of friends included non-identifiable friends at school. Some friends could not be identified in the school rosters because they were new to the schools or only known by nicknames. The incompleteness of rosters also resulted from simple errors in the rosters.

Table 1  
Descriptive statistics

	Mean	SD		Percent		Mean	SD
<i>Dependent variable</i>			<i>Socio-demographic attributes</i>		<i>School-level variables</i>		
Depressive symptoms	8.86	6.25	Female	.52	School size (divided by 100)	8.17	6.18
			Race/ethnicity		Density	.03	.06
			White	.72	In-degree centralization	3.54	.62
<i>Integration variables</i>			Black	.15	Closeness centralization	1.14	1.03
Total number of friends	7.30	3.22	Hispanic	.08	Eigenvector centralization	5.51	2.01
Number of friends at school	5.75	3.29	Asian	.04			
Number of friends outside school	1.29	2.04	Others	.02			
Number of non-participant friends	.94	1.19	Parents' education				
Number of received nominations	4.79	3.83	Less than high school	.08			
Popularity categories			High school graduate	.33			
Marginal	.37		Some college	.17			
Average	.52		College Graduate	.29			
Popular	.11		Do not know/no answer	.13			
Egocentric density	.21	.20	Single parent family	.25			
Friendship reciprocity	.37	.31	Grade level				
Closeness centrality	7.68	8.00	Grade 7	.16			
Eigenvector centrality	4.50	6.60	Grade 8	.17			
Sense of belonging	10.73	2.98	Grade 9	.17			
			Grade 10	.17			
			Grade 11	.16			
			Grade 12	.16			

N=10,023 for individual-level variables and 105 for school-level variables. Standard deviations were computed only for continuous variables.

ceived nominations at each school); (2) “average” (students who nominated or were nominated by “popular” students but were not “popular” themselves); and (3) “marginal” (other students). Because number of received nominations was partly a function of school size (which determined the maximal number of nominations adolescents could receive), using within-school percentiles was more appropriate to identify “popular” students than using percentiles based on the whole sample. The “popular” student category identified those on the top of school-wide popularity hierarchy. A distinction between “average” and “marginal” students was made with an assumption that being associated with or belonging to the same groups as very popular students gave students higher status in the popularity hierarchy (Moody, 1999).

In addition to these network variables based on adolescents’ direct friendships, I considered other network integration variables that indicated extensiveness of adolescents’ indirect ties and their positions in the school-wide networks. In selecting network variables, I used the following criteria: (1) they were directly related to the concept of social integration; (2) they were not collinear with number of sent or received nominations or other network variables already selected for the analysis; and (3) they had enough variability so that they were able to explain variation in depressive symptoms. There were four network variables that roughly met these criteria: egocentric density, friendship reciprocity, eigenvector centrality, and closeness centrality.<sup>14</sup>

The first two measures described egocentric networks, which consisted of the target adolescent (ego) and his or her direct friends (alters). *Egocentric density* represented what proportion of the ties among alters were present, indicating the degree to which each adolescent’s alters were friends with each other.<sup>15</sup> (The score ranged from 0 to 1.) To calculate *friendship reciprocity*, I simply divided the number of mutually nominated friendships by the number of friends whom the target respondent nominated. Friendship reciprocity complemented numbers of sent and received nominations, each of which considered only one direction of friendship nominations, and the variable allowed me to examine whether mutuality added any psychological benefit to friendships.

The remaining two variables measured adolescents’ positions in school-wide friendship networks. I argue that integrated students should occupy central positions in school-wide networks and that these positions increase their emotional attach-

<sup>14</sup> I calculated these network variables by manipulating adjacency matrices in UCINET 6.26. Adjacency matrices were square matrices with students in rows and columns, and 0’s and 1’s in cells, indicating absence and presence of friendships. I entered 0’s in diagonal cells as is commonly done when calculating these network variables. Except for the cases mentioned below, I kept the matrices asymmetric and thus distinguished sent and received friendship nominations.

<sup>15</sup> When calculating this variable, I considered as alters both those who nominated or were nominated by the target adolescent. Similarly, I considered both sent nominations and received nominations as valid friendships among alters. When respondents had no or just one alter, I assigned them a density value of 0. With egocentric density, I intended to measure the extent to which respondents’ alters were friends with each other, and by assigning 0 to these respondents, I indicated that they did not have any alters who were friends with each other.

ment to school. Although there are many ways to measure centrality, I focus on two that are particularly useful for describing positions in adolescent friendship networks. There were some clusters of friendships in each school, and *eigenvector centrality* measured how closely each adolescent was located to the largest cluster in the school.<sup>16</sup> Because students at certain schools (e.g., those at small schools) were more likely to be members of or located closely to the largest clusters and receive higher eigenvector centrality scores, the final scores were normalized (i.e., divided by the largest possible score at each school) to facilitate the comparison of eigenvector centrality scores across schools. The final value ranged from 0 (the lowest possible value at the school) to 1 (the highest possible value).

*Closeness centrality* showed how closely each adolescent was located to others in the school network. As the first step to calculate closeness centrality, geodesic distance between each possible pair of students was calculated within schools. *Geodesic distance* is the number of ties that one adolescent would have to go through to reach another specific adolescent.<sup>17</sup> The final closeness centrality score was the reciprocal of the average geodesic distance from each adolescent to all others in the same school. As with eigenvector centrality, closeness centrality was normalized at the school level and thus ranged between 0 and 1. Conceptually, two dimensions of centrality (being a member of or close to the dominant group and having more direct friendships) are distinct and may independently contribute to belonging as well as good mental health. However, the two centrality measures were correlated with each other ( $r = .50, p < .001$ ) and with number of friends at school ( $r = .40, p < .001$  for closeness centrality;  $r = .20, p < .001$  for eigenvector centrality).

### 3.2.3. School-level integration

The analyses included five school-level network variables. *School-level density* measured, among all possible pairs of students at school, what percentage of students were friends with each other, indicating the overall connectedness of school friendships. Although not directly related to the concept of social integration, there are some school-level network characteristics that might have influenced depressive symptoms. First, *school size* represents the total number of students enrolled at school. (Due to the large raw values, I divided them by 100.) Adolescents at larger schools were more likely to have a greater number of students whom they did not know personally, which might have reduced emotional attachment to school and in turn increased depressive symptoms. School size was also treated as a control

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<sup>16</sup> The calculation process is similar to conducting factor analysis with adjacency matrices, where one tries to “calculate a column vector  $S$  such that the squared distance between  $SS'$  and [the observed adjacency matrix] is minimized” (Bonacich, 1972, pp. 114–115). Eigenvector centrality of each adolescent then corresponded to his or her factor loading on the factor with the largest eigenvalue (see more details in Bonacich, 1972).

<sup>17</sup> Although there were multiple paths that linked one adolescent to another, geodesic distance was based on the shortest path. When two adolescents were not reachable to each other (e.g., when two adolescents belonged to different components of the network, which were disconnected from each other.), the true geodesic distance would be infinite. Instead, I assigned these cases the largest observed geodesic distance at the school to avoid computation problems in statistical analyses.

variable when examining the effect of other school-level variables because school size were likely to influence other aspects of friendship networks.

Another set of network variables, centralization, shows how hierarchical the friendship network was in each school. As discussed above, I hypothesized that schools with lesser degrees of hierarchy would have lower averages of depressive symptoms. In network analysis, centralization generally refers to the variance of centrality scores among individual members in a given network, and high centralization indicates greater variability in centrality scores and thus steeper hierarchy. Centralization can be calculated for any centrality measure, but I focused on those that I used as individual-level measures. Thus, *closeness centralization*, *eigenvector centralization*, and *in-degree centralization* represented within-school variances of closeness centrality, eigenvector centrality, and in-degree centrality, respectively.<sup>18</sup> Although these indicators measure unique aspects of hierarchy and might have independent effects on belonging and mental health, they were moderately or highly correlated with each other in the Add Health data.<sup>19</sup>

I considered other school characteristics such as sector (public or private) and location (urban or rural) as control variables. However, because these characteristics did not significantly change the relationship between network variables and depressive symptoms in preliminary analyses, they were not included in the analyses presented in the next section.

#### 3.2.4. Sense of belonging to school

To construct a measure of sense of belonging, I first conducted exploratory factor analysis with possible items and selected three items that loaded on the same factor. These included “felt close to people at your school,” “felt like you were part of their school,” and “were happy to be at your school” ( $\alpha = .79$ ). For each question, adolescents chose from five response categories (ranging from 1 = “strongly disagree” to 5 = “strongly agree”). I summed these three items to compute each respondent’s score in *belonging to school*.

#### 3.2.5. Socio-demographic attributes

Adolescents’ socio-demographic characteristics were likely to influence both integration and depressive symptoms, which might have biased the effect of integration on depressive symptoms if they were not controlled in the analysis. *Sex* was a dichotomous variable with males coded as 0 and female as 1. *Grade level* was a set of dummy variables ranging from grade 7 to grade 12.<sup>20</sup> *Race and ethnicity* was a set of five dummy variables including white, black, Hispanic, Asian, and others. As proximal measures of socio-economic status, I used parents’ educational level and family

<sup>18</sup> In-degree centrality is computationally identical to number of received nominations. Thus, in-degree centralization presented the school-level variance of number of received nominations.

<sup>19</sup> The three centralization variables had the following bivariate correlation coefficients: .11 ( $p = .28$ ) between in-degree and eigenvector centralization; .32 ( $p < .001$ ) between in-degree and closeness centralization; and .84 ( $p < .001$ ) between eigenvector and closeness centralization.

<sup>20</sup> Age was not included because of redundancy with grade level.

structure. I created five dummy variables for *parents' education* by using mother's or father's educational level whichever was higher. The dummy variables originally included "less than high school," "high school graduate," "some college," and "college graduate." However, there were a sizable number of students who did not know or did not report their parents' educational levels. Thus, in addition to the information from the in-school and in-home surveys, I used the parent survey, in which a parent of each respondent (mostly the mother) was asked to participate. This additional information did not reduce the number of missing cases to a great extent, and thus I included "do not know/no answer" as a (valid) category for parents' educational level. For *family structure*, students who lived with both parents received a value of 0, and others received 1.

### 3.3. Analysis plan

I first obtained descriptive statistics, using STATA 7.0. Weights were used to correct the statistics for oversampling of certain categories of adolescents mentioned earlier. I then constructed multivariate models, where depressive symptoms measured in the in-home survey were regressed on integration variables measured in the in-school survey, allowing a six-month time lag between the independent and dependent variables. Some models included school-level predictors for (individual-level) depressive symptoms. I used hierarchical linear models to estimate these cross-level effects because they are superior to alternative models such as OLS regression in producing unbiased estimates in these cases (Raudenbush and Bryk, 2002). Although some of my multivariate models did not include any school-level independent variables, I used hierarchical linear models throughout the analyses because it is easier to compare results across models. I conducted these analyses in HLM 5.04.<sup>21</sup>

## 4. Results

### 4.1. The effects of number of friends and popularity categories on depressive symptoms

I started my analyses by examining the effect of number of friends on depressive symptoms and then tested whether other network variables had any additional effect. I took this strategy because number of friends (or egocentric network size) is the most frequently used network measure in previous studies and because it is the sim-

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<sup>21</sup> As the conventional exploratory step in hierarchical linear modeling, I ran a "null" model to see how much variance in depressive symptoms existed at the school level as opposed to the individual level (Raudenbush and Bryk, 2002). The null model specified depressive symptoms as the dependent variable and included no individual-level or school-level predictor, except two random effect terms, one for the individual level and the other for the school level. This model showed an individual-level variance of 37.93 and a school-level variance of 1.45, indicating that schools accounted for only 3.7% of variance in depressive symptoms ( $1.45/(37.93 + 1.45) \times 100 = 3.7$ ). Therefore, it was not likely that I would find school-level variables which significantly predict adolescents' depressive symptoms.

Table 2

Bivariate correlations between individual-level network variables and depressive symptoms

Total number of friends	-.03*
Number of friends at school	-.07***
Number of friends outside school	.06***
Number of non-participant friends	.05**
Egocentric density	-.04**
Friendship reciprocity	-.01
Closeness centrality	-.07**
Eigenvector centrality	-.09***

*N* = 11,023 adolescents in 105 schools.

\*  $p < .05$ .

\*\*  $p < .01$ .

\*\*\*  $p < .001$ .

plest network measure in terms of data collection and computation. As discussed in Section 3, I used several ways to count number of friends. Table 2 presents bivariate correlation coefficients between each of these measures and depressive symptoms. Total number of friends that adolescents nominated was significantly associated with fewer depressive symptoms, as expected, although the correlation was very weak.

Interestingly, other measures that counted subsets of friends had somewhat stronger associations with depressive symptoms. For example, number of friends at school was negatively related to depressive symptoms, consistent with expectation. As I suspected, however, numbers of friends outside school and non-participant friends were *positively* associated with depressive symptoms. Having large numbers of these kinds of friends might have indicated adolescents' failure to develop friendships within school as well as their connections to adolescents with psychological and behavioral problems. Moreover, unlike friendships within school, those outside school were not likely to promote mental health through a sense of belonging to school. In fact, number of outside friends was negatively associated with belonging ( $r = -.18, p < .001$ ). These conflicting effects of friends within and outside school need to be considered as a tentative finding because the study was not specifically designed to examine the differential effects. That is, if students had been asked to name separately friends within school and those outside school, their nomination lists might have included friends not identified by the current instrument. Because considering friends both inside and outside school would have attenuated the relationship between integration and depressive symptoms, I focused on friends within school in the following analyses. My approach here is consistent with previous child and adolescent studies that restricted friendship nominations to students at the same school (Gest et al., 2001; Hansell, 1985; Östberg, 2003).<sup>22</sup>

<sup>22</sup> Given this effect of number of friends outside school, it would make sense to include the variable as a control in the following multivariate models. However, number of friends outside school did not have a significant effect on depressive symptoms or change the effects of other network variables when socio-demographic variables were considered. Thus, for the purpose of simplicity, I will present multivariate models that do not include this variable.

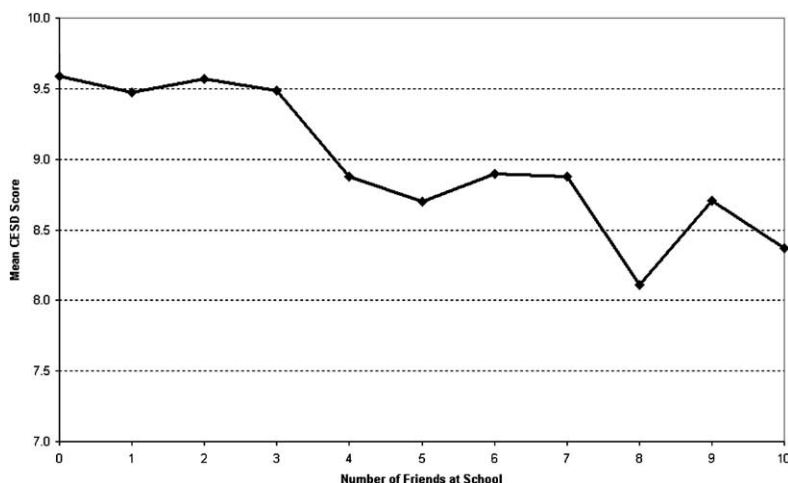


Fig. 1. Mean CES-D scores by number of friends at school.

I took a closer look at the relationship between number of friends at school and depressive symptoms by computing the average CES-D score for each number of friends at school. In this analysis, I was particularly interested in whether number of friends at school had a linear relationship with depressive symptoms. As some researchers have argued, one close relationship may be enough to provide a mental health benefit, and having many relationships may not necessarily contribute more to mental health (see reviews in Baumeister and Leary, 1995; Cohen and Wills, 1985). If this argument applies to the relationship between adolescent friendships and depressive symptoms, mean differences in depressive symptoms among adolescents with small numbers of friends (0 versus 1, in particular) should be larger than mean differences among those with large numbers of friends.

As Fig. 1 shows, however, a straight line seems to approximate the relationship between number of friends at school and depressive symptoms; as number of friends at school increased, average depressive symptoms tended to decrease gradually. If a straight line were used to describe the relationship, the slope would be  $-.11$ , indicating that an increase in number of friends by nine results in a one-point reduction in CES-D score—a very small change considering that the CES-D score (with my modified version of the measure) could vary between 0 and 45.<sup>23</sup>

My analyses so far has focused on number of friends each adolescent nominated, but number of nominations each adolescent *received* measured another aspect of friendship network, positions in popularity hierarchy (Bukowski and Hoza, 1989; Coleman, 1961; Östberg, 2003). Although marginal adolescents had significantly more depressive symptoms as expected (average CES-D score of 9.46), the difference between popular and average students was very small and not significant (8.47 versus

<sup>23</sup> The slope is based on a hierarchical linear model which included number of friends at school as the only predictor of depressive symptoms. The intercept was 9.39. Both slope and intercept were significantly different from 0 at the .001 level.

8.48). The lack of difference in depressive symptoms between these two categories may indicate that there is a limit in the extent to which popularity can reduce depressive symptoms or that being very popular entails some costs (e.g., time spent to maintain relationships, providing support, loss of privacy). It should be noted that this non-linear relationship between popularity and depressive symptoms does not necessarily indicate that having at least one friend is sufficient to receive mental health benefit. This is because the point of declining benefit occurs at the higher end of social integration, rather than the lower end.

#### *4.2. The effects of additional network variables on depressive symptoms*

Table 2 also shows the bivariate relationships between other individual-level network variables and depressive symptoms. As expected, adolescents with dense ego-centric networks had slightly fewer depressive symptoms. However, reciprocity was not significantly associated with depressive symptoms in my analysis.<sup>24</sup> The two remaining network variables, closeness centrality and eigenvector centrality, were negatively associated with depressive symptoms, as expected, although once again these associations were weak.

These additional network measures were moderately or weakly correlated with each other and with number of friends at school. Therefore, I used multivariate models to test whether they were independently associated with depressive symptoms (see Table 3). The multivariate models also included adolescents' socio-demographic characteristics as controls. Throughout the models, females, Hispanics, Asians, older adolescents, and those with less educated parents had more depressive symptoms. As shown in Model 3, popularity categories still had significant effects on depressive symptoms after socio-demographic attributes were controlled, but adding number of friends at school as a predictor reduced the coefficients for popularity categories to non-significance (Model 4). Eigenvector centrality still had a significant association with depressive symptoms when socio-demographic variables and other network variables were controlled, but closeness centrality was no longer associated with depressive symptoms (Model 5). When all network variables and socio-demographic variables were entered simultaneously, none of the network variables (other than number of friends at school) showed significant relationships with depressive symptoms (Model 6).

#### *4.3. The effects of school-level variables on depressive symptoms*

To examine the effects of each of the school-level network variables on depressive symptoms, I first used bivariate models. Each hierarchical linear model

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<sup>24</sup> Past studies that reported the mental health advantage associated with reciprocated relationships tended to ask adolescents (and children) to nominate students that they liked, instead of students whom they considered as friends (e.g., Östberg, 2003). Therefore, greater emotional intimacy in reciprocated relationships and its consequences for depressive symptoms might have been less clear in my analysis, which focused on reciprocity of relationships, where relationships, reciprocated or unreciprocated, were already perceived as friendships by target adolescents.

included the target school-level variable as the only predictor (see Table 4). School size was positively associated with depressive symptoms, consistent with the expectation that bigger schools are more alienating. Although school density had a negative coefficient, it was not significantly different from zero. The results also showed that, contrary to expectations and a previous finding (Östberg, 2003), the three centralization measures were *negatively* associated with depressive symptoms.

Before attempting to interpret the relationships between these school-level network characteristics and depressive symptoms, I conducted multivariate analyses to consider these variables simultaneously and to control for adolescents' socio-demographic characteristics. Among the three centralization measures, I only entered in-degree centralization because closeness centralization and eigenvector centralization were highly correlated with in-degree centralization, and each variable was only weakly related to depressive symptoms. (Using closeness or eigenvector centralization instead did not change the overall findings.)

When school size, density, and in-degree centralization were simultaneously entered in Model 7 of Table 3, their coefficients became smaller than in the bivariate models, but school size and in-degree centralization were still significantly associated with depressive symptoms. The coefficients dropped further in size in Model 8, which controlled for adolescents' socio-demographic backgrounds and number of friends at school, and none of the school-level variables was significantly related to depressive symptoms in this full model. Thus, the unexpected, negative relationship between degree of hierarchy and depressive symptoms can be explained partly by the fact that hierarchical networks tended to be smaller and denser. Although these school characteristics do not offer a full explanation, the unexpected effect of school-level hierarchy was very weak and did not seem to influence depressive symptoms once individual characteristics were considered.

#### 4.4. Does belonging mediate the effect of integration on depressive symptoms?

The analyses above showed that number of friends at school was the only network variable which had an independent effect on depressive symptoms. In the last analysis, I investigated the extent to which the benefit of having many friends could be attributed to a strong sense of belonging. As shown in Model 9 of Table 3, adolescents with a strong sense of belonging had fewer depressive symptoms after socio-demographic attributes were controlled. Comparing Models 8 and 10, one can see that belonging reduced the coefficient for number of friends to non-significant and accounted for 87.5% of the effect.<sup>25</sup> However, the coefficient for belonging did not change much whether number of friends were included or not (compare Models 9 and 10), indicating that belonging had a more direct effect on depressive symptoms than did number of friends. In short, the results gave support for the argument that integration contributes to mental health by strengthening a sense of belonging.

<sup>25</sup> Based on the following calculation:  $[(-.16) - (-.02)] / (-.16) = .875$ .

Table 3  
Multivariate models of depressive symptoms (unstandardized HLM coefficients)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Intercept	7.66**	8.40***	8.11***	8.47***	7.91***	8.39***	9.98***	7.93***	13.54***	13.57***
Sex (female=1)	1.75***	1.83***	1.75***	1.81***	1.74***	1.80***		1.83***	1.63***	1.64***
Race/ethnicity (ref. = white)										
Black	.72*	.62	.68*	.62	.68*	.63		.63	.39	.38
Hispanic	1.53***	1.44***	1.49***	1.44***	1.51***	1.45***		1.44***	1.56***	1.55***
Asian	1.58***	1.50**	1.54**	1.50**	1.53**	1.51**		1.51**	1.82***	1.81***
Others	-.43	-.45	-.48	-.47	-.45	-.44		-.44	-.39	-.39
Grade level (ref. = Grade 9)										
Grade 7	-1.16***	-1.17***	-1.19***	-1.18***	-1.12***	-1.15***		-1.15***	-.95***	-.95***
Grade 8	-.66**	-.67**	-.67**	-.67**	-.55*	-.63*		-.65*	-.68**	-.68**
Grade 10	.07	.05	.05	.05	.02	.03		.05	-.16	-.16
Grade 11	.39	.32	.35	.32	.32	.30		.32	.07	.06
Grade 12	-.05	-.15	-.08	-.14	-.13	-.17		-.15	-.38	-.39
Parents' Ed. (ref. = H.S. Graduate)										
Do not know/no answer	1.15***	1.05***	1.07***	1.03***	1.09***	1.05***		1.05***	.95***	.94***
Less than high school	1.48***	1.42***	1.43***	1.41***	1.45***	1.42***		1.42***	1.36***	1.35***
Some college	-.46	-.43	-.44	-.43	-.44	-.42		-.43	-.30	-.30
College graduate	-1.19***	-1.13***	-1.13***	-1.12***	-1.14***	-1.11***		-1.13***	-.97***	-.97***
Single parent family	.64**	.58**	.62**	.59**	.62**	.59**		.58**	.47*	.46*
No. of non-participant friends	.19*	.38***	.21*	.36***	.18	.35**		.38***	.27**	.29**
No. of friends at school		-.16***		-.13***		-.14***		-.16***		-.02

Popularity category (ref. = marginal)										
Average										
Popular										
Egocentric density						-.57	-.60			
Reciprocity						.23	.34			
Closeness centrality						.01	.01			
Eigenvector centrality						-.05***	-.02			
Sense of belonging									-.54***	-.53***
<i>School-level variables</i>										
School size/100								.05*	.01	
School density								-1.62	-.38	
In-degree centralization								-.44*	.11	
Intercept variance	.70	.69	.69	.69	.67	.68	1.27	.72	.43	.43
Degrees of freedom	104	104	104	104	104	104	101	101	104	104
$\chi^2$	309.31***	307.26***	307.22***	307.13***	298.54	301.14***	439.81***	305.01***	239.73***	239.65***
Level 1 error variance	36.02	35.83	35.91	35.82	35.94	35.82	37.92	35.83	33.71	33.71
Deviance	70911.01	70856.76	70879.82	70853.76	70897.16	70864.05	71507.60	70862.61	70160.03	70167.14
No. of parameters	2	2	2	2	2	2	2	2	2	2

*N* = 11,023 adolescents in 105 schools.

\* *p* < .05.  
 \*\* *p* < .01.  
 \*\*\* *p* < .001.

Table 4

Bivariate associations between school-level network integration variables and depressive symptoms (unstandardized HLM coefficients)

School size/100	.06 <sup>***</sup>
School density	−5.12
In-degree centralization	−.64 <sup>**</sup>
Closeness centralization	−.45 <sup>***</sup>
Eigenvector centralization	−.19 <sup>**</sup>

$N=11,023$  adolescents in 105 schools. Based on four HLM's with one school variable in each model. Intercepts for these models are: 8.21 (size); 8.90 (density); 11.03 (in-degree centralization); 9.27 (closeness centralization); and 9.79 (eigenvector centralization).

<sup>\*\*</sup>  $p < .01$

<sup>\*\*\*</sup>  $p < .001$ .

## 5. Discussion and conclusion

The results supported the general proposition that adolescents have fewer depressive symptoms when they are integrated to friendship networks at school. Other findings elaborated this overall result. First, among network variables, number of friends was the strongest predictor of depressive symptoms. Although other variables generally showed significant bivariate relationships with depressive symptoms in the expected directions, the associations were very weak, especially when number of friends was controlled. These findings do not necessarily add any new information to the existing literature, but they provide verification for previous studies that relied on number of friends as the only network measure. This information is also important in terms of reducing the costs of future studies because number of friends can be directly measured by respondents' nominations, whereas constructing more complex network measures requires nominations from other members of egocentric or whole networks.

The analyses also showed that a straight line approximates the relationship between number of friends and depressive symptoms, and thus did not support the argument that people benefit only little from having more than one friend. It should be remembered, however, that the current study focused on adolescents' friendships at school, whereas past adult studies often included spouses and other family members as network members. In fact, those adult studies emphasize the importance of significant others (spouses and unmarried domestic partners) and very close friends whose presence provides a mental health benefit equivalent to that of significant others. Therefore, it is possible that the linear relationship between number of friends (or number of egocentric network members in general) and depressive symptoms is unique to adolescents and that the relationship becomes non-linear in the later stages of the life course when adolescents make transitions to adulthood and significant others come to occupy special positions in their egocentric networks.

Although number of friends that adolescents nominated did not have a curvilinear effect on depressive symptoms, popularity categories, (which were constructed

from number of received nominations), had a non-linear effect: being associated with very popular students (i.e., the “average” category) was sufficient to receive a mental health benefit, and popular students were not in any better mental states than average students as far as depressive symptoms were considered. However, this finding does not necessarily demonstrate the importance of having at least one friend because the declining benefit was observed in the higher end of the distribution (i.e., between “average” and “popular”). As I pointed out earlier, the non-linear relationship is likely to reflect the ceiling effect or the costs in time and energy, which may counterbalance the psychological benefit of being a very popular student.

The results were consistent with the assumption that good mental health among socially integrated individuals in part results from their positive affects and cognitions about social environments. However, this investigation needs to be extended in future research in two ways. First, social integration is likely to create a variety of feelings and thoughts which have desirable psychological consequences, and I was able to examine only a sense of belonging. Future studies should also consider other concepts such as a sense of mattering, life meaning, and a feeling of being loved and wanted. These additional constructs will not necessarily help us explain a greater portion of the mental health benefit associated with network integration because belonging already explains most of the effect. However, it is still important to examine the extent to which social integration influences each of these constructs as well as the degree to which they are correlated with each other. Answering these questions should help us understand whether social integration creates specific thoughts and feelings or improves the way individuals think and feel about their social environment in general. Second, the current study targeted the adolescent population, and the mediating processes should be examined for adults. It is particularly interesting to see whether social relationships that are more common among adults (e.g., relationships at work) promote mental health in ways similar to how friendships contribute to good mental health.

Another set of findings concerning contextual effects showed very little effect of school-level network integration on depressive symptoms. The results therefore indicate that adolescents’ immediate environment is more important than larger context. The finding parallels the literature on urbanization, which suggests that patterns of social relationships in urban cities (e.g., large population size and low network density) have little effect on a sense of alienation and mental health, especially when compared to the effects of personal networks (Fischer, 1982; Freudenburg, 1986).

The present study has a few limitations, in addition to the ones already mentioned. First, drawing on previous research, the study focused on network measures of integration. Other studies have conceptualized social integration as a process of social norm internalization and measured levels of social integration by the degrees to which individual attitudes and behaviors are consistent with social norms (Heimer, 1996; Hughes and Gove, 1981; Umberson, 1987). Future research may examine how this aspect of integration relates to network integration, sense of belonging, and mental health.

Second, like many other contemporary sociological studies, this paper focused on depressive symptoms as a mental health outcome. However, it is possible that social integration has other mental health consequences. For example, many adolescents feel pressured to develop extensive circles of friends (Coleman, 1961), and a failure to accomplish the task may undermine their self-esteem as well as sense of mastery. Social integration may also influence positive well-being. In the adult literature, some authors have argued that social relationships are an important factor for a feeling of happiness and life satisfaction (e.g., Bradburn, 1969; Diener, 1984). Therefore, these authors suggest that social integration should be related to positive well-being more strongly than mental health problems, assuming that positive well-being is not just lack of emotional problems. The same argument can be made for the adolescent population. Due to the lack of adequate mental health measures other than CES-D in Add Health, I was not able to include these constructs of positive mental health. Future research needs to examine the relative significance of each construct as an outcome of social integration.

Third, throughout the paper, I assumed social integration influences mental states, and I did not consider the possibility for the reciprocal causality. However, healthy mental states may motivate social involvement as well as allowing for more effective development and maintenance of social relationships (Adams, 1988; Thoits and Hewitt, 2001). On the other hand, individuals with psychological problems may become socially isolated because of others' negative reactions (Dunham, 1965; Link et al., 1989). In addition, mental states may influence how individuals perceive presence and absence of friendships. Examining these issues in future studies should contribute to our better understanding about the relationships between social integration and mental health.

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## Appendix A. Measures

### A.1. Depressive symptoms (*in-home*, $\alpha = .84$ )

*How often was each of the following things true during the past week?* (0 = “never or rarely”; 1 = “sometimes”; 2 = “a lot of times”; 3 = “most of the time or all of the time”)

1. You were bothered by things that usually don't bother you.
2. You did not feel like eating; your appetite was poor.
3. You felt that you could not shake off the blues, even with help from your family and your friends.
4. You felt that you were just as good as other people. (*reversed*)
5. You had trouble keeping your mind on what you were doing.
6. You felt depressed.
7. You felt you were too tired to do things.
8. You felt hopeful about the future. (*reversed*)
9. You thought your life has been a failure.
10. You felt fearful.
11. You were happy. (*reversed*)
12. You enjoyed life. (*reversed*)
13. You felt sad.
14. It was hard to get started doing things.
15. You felt life was not worth living.

### A.2. Integration into friendship networks (*in-school*)

*List your closest male friends. List your best male friend first, then your next best friend, and so on. Girls may include boys who are friends and boyfriends. (The question was repeated for closest female friends.)*

See text for information about how each network variable was calculated.

### A.3. Sense of belonging (*in-school*, $\alpha = .79$ )

*How strongly do you agree or disagree with each of the following statements?* (1 = “strongly disagree”; 2 = “disagree”; 3 = “neither agree or disagree”; 4 = “agree”; 5 = “strongly agree”)

1. I feel close to people at this school.
2. I feel like I am a part of this school.
3. I am happy to be at this school.

### A.4. Sex (*in-school*)

What sex are you?

*Recoded as: 0 female; 1 male.*

#### A.5. Grade level (*in-school*)

What grade are you in?

*I constructed 6 dummy variables including: 7th grade, 8th grade, 9th grade, 10th grade, 11 grade, and 12th grade.*

#### A.6. Race/ethnicity (*in-home*)

1. Are you of Hispanic or Latino origin?
2. Which one category best describes your racial background? (white, black or African American, Asian or Pacific Islander, American Indian or Native American, or other)

*I used the first question to identify Hispanic respondents, regardless of their answers to the second question. Native American and others were combined.*

#### A.7. Parents' education level

1. How far in school did she/he go? (*in-school*)
2. How far did you/your current spouse/partner go in school? (*parent survey, if the parent participated*)

*When there was a difference between parents' and adolescent respondents' reporting, I used parents' reporting. If parents did not give valid answer, I used adolescents' reporting. Between mother's and father's, I took the higher education level. I constructed 5 dummy variables including: less than high school; high school graduate; some college; college graduate; and do not know/no answer.*

#### A.8. Family structure (*in-school*)

1. Do you live with your biological mother, stepmother, foster mother, or adoptive mother?
2. Do you live with your biological father, stepfather, foster father, or adoptive father?

*Recoded as: 0 live with both parents; 1 live with no or single parent.*

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