

**Falling Behind: Dynamic Models of the Costs of High School Transitions for Social Networks  
and GPA\***

Diane Felmlee, Cassie McMillan, Paulina Rodis, and Wayne Osgood

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**Contact Information:**

Diane H. Felmlee, Ph.D., Professor, Department of Sociology, Pennsylvania State University, University Park, PA 16802

Email: [dhf12@psu.edu](mailto:dhf12@psu.edu)

## **Falling Behind:**

### **Lingering Costs of the High School Transition for Youth Friendships and GPA**

Entering 9th grade in high school is a crucial turning point in the American school system that poses exceptional challenges. Numerous studies document declines in students' grades from middle to high school (e.g., Benner and Graham 2009; Seidman et al. 1996), and achievement test scores can drop over the same period (e.g., Alspaugh 1998; Rice 2001). For some students, the transition to high school has dire academic consequences. Approximately 22% of students have to repeat 9th grade classes (McCallumore, Megan, and Sparapani 2010), a figure that is even higher in urban schools such as Chicago's, where the failure rate climbs to 40% (Roderick and Camburn 1999). Such set-backs have long-term, negative consequences that increase school drop-out rates and lower educational attainment (Roderick 1993).

Although there is less research on the topic, the transition to high school also appears to affect adolescents' social development. Findings tend to be mixed, with some studies documenting detrimental social outcomes (e.g., Reyes, Gillock, and Kobus 1994; Temkin et al. 2015) and others finding evidence of more positive fluctuations, such as increased social support (e.g., Seidman et al. 1996) and a decline in negative peer relations (Roeser, Eccles, and Freedman-Doan 1999). Yet the evidence for these patterns is weak because, with few exceptions (e.g., Temkin et al. 2015; Weiss and Bearman 2007), existing studies typically lack the data to contrast students who change schools between 8th and 9th grades with those who remain in the same school. Claims regarding trends in student outcomes, therefore, may be characteristic of all students of these ages, rather than triggered by the transition itself. Moreover, most studies follow students for relatively limited spans of time, often only shortly before and after a transition. The main goal of this study, therefore, is to directly examine the effect of the transition from middle school to high school on both social and academic outcomes over the complete high school period. In addition, we compare two types of high school moves: a single school transition from one feeder middle

school to one high school, and a multiple school transition in which multiple, feeder middle schools move into one high school.

Drawing on a social network perspective and life course theory, we focus on the social network as a key component in the transition to high school. We argue that the inevitable disruptions in the social connections of youth associated with changing schools will have largely negative consequences for both their academic and nonacademic outcomes. Given the salience of friendships and academic performance for many youth outcomes, examining possible detrimental changes in these factors constitutes a crucial task for research. A better understanding of the link between high school transitions, social networks, and changes in friendship and grade point average can help to inform developmental and educational theories, as well as provide additional knowledge to support students as they progress from middle to high school.

We begin our study by examining changes in youth friendship networks and academic performance over a lengthy period of six years, starting in 6th grade and ending in 12th. Next, we investigate the degree to which the life transition of departing 8th grade to attend high school influences young people's friendship networks and academic outcomes. Our primary focus will be on changes in individual's indegree, or number of friendship nominations received, and grade point average (GPA). We use data from the Promoting School-Community Partnerships to Enhance Resilience (PROSPER) study, which yields a uniquely large sample of 14,462 students in over 50 adolescent friendship networks.

### ***Adolescent Friendship Networks***

Friendships and the networks of connections they form serve crucial functions among the everyday lives of young people. Strong personal ties lead to improvements in adolescents' mental health (Ueno 2005), enhance academic outcomes (Vaquera and Kao 2008), and shape prosocial and antisocial behavior (Rodkin and Hanish 2007). Social networks provide the environmental context that influences the stability and quality of youth friendships and relationships (e.g., Felmlee 2001; Flynn, Felmlee, and Conger 2014; Umberson, Crosnoe, and Reczek 2010). These ties afford young people a chance to find independence from their familial relationships, deal with the stress and pressures of growing up, and

construct or imitate routines they learn from adults (Bagwell and Schmidt 2011; Giordano 2003; Umberson et al. 2010). The social networks of adolescents, furthermore, provide the social context that influences a range of developmental outcomes across the domains of school, mental health, and various types of supportive and problematic behavior (Rodkin and Hanish 2007). Thus, the number and stability of close friendships are apt to have noteworthy influences on youth.

Recent research underlines the value of social network analysis for understanding the processes that influence adolescent friendships (Cairns et al. 1995; Flynn et al. 2014; McFarland et al. 2014; Rodkin and Hanish 2007; Temkin et al. 2015). These processes include the effect of other social actors (Flynn et al. 2014; Umberson et al. 2010), the centrality of actors within their network (Calvó-Armengol, Patacchini, and Zenou 2009; Haas, Schaefer, and Kornienko 2010), and the influences of friendship dyads (e.g., Felmlee and Faris 2016) and the broader school context (McFarland et al. 2014).

Average indegree, or number of friendship nominations, is a particularly noteworthy aspect of friendship networks that receives considerable attention in the literature. Indegree can be thought of as a measure of network centrality, popularity, or general, social integration. High sociometric popularity is associated with several outcomes, such as prosocial behaviors (Allen et al. 2005; McElhaney, Antonishak, and Allen 2008; Moody et al. 2011), low levels of aggression (Faris and Felmlee 2014), and friendship stability (Bowker 2004; McElhaney et al. 2008; Moody et al. 2011). Centrality in adolescent friendship networks also relates positively and significantly to academic outcomes (Calvó-Armengol et al. 2009). Here we focus on measures of indegree social network centrality.

### ***Life Course Perspective***

In addition to employing a social network framework to examine changes in adolescent friendships, we borrow from a life course perspective on social processes (e.g., Alwin 2012; Elder 1994) to better understand the ways in which young people's relationships and GPAs evolve over the high school years. A life course perspective helps to contextualize transitions in the American educational system and connects individual patterns to the broader social framework (Benner 2011; Langenkamp 2011). Two life

course concepts remain especially pertinent to our topic, in particular those of “linked lives” and “life transitions.” According to the fundamental, life course principle of “linked lives” (Elder 1994), individuals’ experiences are lived interdependently within a set of shared relationships that are embedded in personal networks. One major, normative life event of early adolescence is puberty, and a major goal during that life stage is the establishment of social network ties outside the family, and in particular, friendships (Wrzus et al. 2013). The linked lives of peers, typically in the form of school friendship ties, heighten in salience during the adolescent years.

According to Kahn and Antonucci (1980), the concept of “linked lives” can be thought of as a convoy that evolves over time and contains valued resources for peoples’ well-being and functioning. This notion of a network convoy is particularly informative for theories of social network change. Research suggests that the inner-core of the convoy is likely to remain relatively consistent (e.g., family and close friends), whereas more peripheral relationships are less stable (Wrzus et al. 2013).

A second core concept of the life course paradigm that is relevant to our research is that of “life transitions.” Transitions, or specific life changing events such as marriage, employment, and school changes, occur over relatively short time spans and are located within life course trajectories (Elder 1985). The life course does not simply proceed in a linear fashion along with aging, but rather it includes turning points that are abrupt alterations in individuals’ experiences and outcomes. Transitions disturb established routines and social roles and tend to disrupt social networks. These types of social upheavals can trigger subsequent changes and result in distress (Almeida and Wong 2009; Caspi and Moffitt 1993). Yet at the same time, others note that life transitions may pose new opportunities for life improvement or a chance to remove oneself from a troublesome circumstance (Wheaton 1990). Furthermore, a single life course transition has the potential to shape long-term life course trajectories (e.g., Alexander and Entwisle 1988; Hayward and Gorman 2004), which makes these turning points important to study. One such potentially crucial and normative life transition is the one under study here, matriculation from middle school to high school.

### *Friendship and GPA Over Time*

The social ties of young people shift considerably over time for a number of reasons. First, children and youth pass through numerous cognitive, behavioral, emotional, and developmental milestones during the school years, all of which are apt to influence their close relationships. In addition, contextual factors likely foster further adjustments to the friendships of children and teens. For instance, shifts in the composition of school classes from year to year can minimize the time children have to interact with the same school friends. Given that extracurricular activities promote friendship formation (Schaefer et al. 2011), changes in sports and other school activities are apt to result in the termination of friendships originating from old activities, and the initiation of novel ties associated with the new ones.

Empirical studies of youth friendships tend to focus primarily on cross-sectional data and ignore the evolution of such relationships over the course of the school year and beyond (Newcomb and Bagwell 1995). Nonetheless, a key measure in recent studies that do examine temporal shifts in adolescents' friendships is friendship stability. Many studies document considerable instability in adolescent friendship networks (e.g., Berndt and Hawkins 1985; Branje et al. 2007; Chan and Poulin 2007; Hartl Laursen, and Cillessen 2015; Poulin and Chan 2010). Several investigations that follow friendships over the school year, for example, find that approximately 50% of friendships remain the same (e.g., Berndt and Hoyle 1985; Bowker 2004; Değirmencioğlu et al. 1998). Those rare projects that examine friendships over more extensive time periods document remarkably high levels of volatility. For instance, Moody et al. (2011) followed young people from 6th to 9th grade, using a subsample from the same set of schools used in the current investigation; the authors documented that only 15% (one in seven) of friendship nominations made by 6th graders lasted until 9th grade. Another long-term study found that almost all friendships changed between 7th and 12th grade, with only 1% remaining stable (Hartl et al. 2015). Not unexpectedly, rates of friendship change increase as the time interval of a study lengthens.

Given the disruptive nature of life transitions on peer networks (Entwisle 1990), and our lengthy time span, our first hypothesis is that friendship network indegree will decrease over the school years from 6th grade until 12th grade. We also suspect that the number of isolated students, those with no

friendship nominations, will increase in numbers during the same period. To the best of our knowledge, this time span represents one of the longest examined in current research.

**Hypothesis 1:** Individual friendship network indegree, or the number of friendship nominations an individual receives, will decrease over time, from 6th grade until 12th grade, and the number of isolates will increase.

Previous research shows that students' academic performances tend to decline following school transitions, such as that to high school (e.g., Benner and Graham 2009; Blyth, Simmons, and Carlton-Ford 1983; Roderick 2003; Seidman et al. 1994; Simmons and Blyth 1987). In addition, 9th graders record the lowest grade point average, the most missed classes, and the highest number of failing grades of any other secondary school year (McCallumore et al. 2010). Based on this literature, and the anticipated difficulties associated with life transitions, we expect that students' grade point average will reach its lowest level in 9th grade, regardless as to whether they change school locations or not.

**Hypothesis 2:** Individual students' GPA will reach its lowest average in 9<sup>th</sup> grade.

### ***The Transition from 8th to 9th Grade***

Normative school transitions between levels of the U.S. educational system represent noteworthy and often challenging phases of childhood and adolescence. The process of changing schools from elementary school to middle school or from middle to high school necessitates adapting to a novel environment and differing expectations that can have broad and lasting consequences. Transitions to another level of schooling, and in particular the shift to high school, typically entail increasingly difficult academic challenges. In most cases, moving school levels means that young people are placed within classrooms with many, if not all, new classmates, in addition to encountering different teachers, guidance counselors, coaches, club mentors, and support staff. More generally, school transitions inevitably involve changes from familiar and routine environments to those that are unfamiliar and may seem unpredictable (Caspi and Moffitt 1993).

At the same time, transferring to a new environment could represent an opportunity for some youth to begin afresh and expand their social ties, such as the addition of new acquaintances with whom they interact for the first time in class, clubs, or sports teams. Although probably uncommon, a few also may take advantage of their shift in surrounds to tackle previously unmet educational challenges (Schiller 1999; Weiss and Bearman 2007), perhaps with the assistance of unique learning aids available in their secondary school. Adolescents who struggle in the earlier grades, either socially and/or academically, would be the most likely candidates for possible transition benefits.

Extensive research considers outcomes for children and adolescents before and after school transitions. The majority of studies focus on the transition from elementary school to middle school (Benner 2011), often examining a shift between 6th and 7th grade. Several scholars argue that the 7th grade transition is particularly demanding (Barber and Olsen 2004; Blyth et al. 1983). Yet matriculation to high school can be arduous as well, and it has important ramifications for young people (Benner 2011). Therefore, here we consider the common, but relatively understudied, transition from middle to high school.

Research often reports academic problems associated with school transitions for children and adolescents. For example, studies quite consistently document that academic grades and outcomes decline, especially for the change from middle to high school (Blyth et al. 1983; Seidman et al. 1994), although little is known about possible long-lasting effects. Declines also are observed for students' school engagement, with adolescents becoming less active in extracurricular activities after high school entry (Seidman et al. 1996), and teachers reporting that students' academic engagement diminishes (Roderick 2003). Students who faced academic difficulties in 8th grade, however, profited from a change to a high school with a smaller proportion of their middle school peers (Schiller 1999). As noted previously, research is inconclusive as to whether or not these patterns of losses or gains persist.

Fewer studies consider adolescent socioemotional adjustment over the course of school transitions. Those that do, however, tend to document that time period as taxing (Benner 2011). For example, youth exhibit higher levels of anxiety and loneliness over the transition from middle school to

high school, with loneliness increasing across the initial years of high school (Benner and Graham 2009). This move also is associated with higher levels of depression (e.g., Newman et al. 2007) and lower levels of self-esteem (Barber and Olsen 2004; Blyth et al. 1983; Seidman et al. 1994; Wigfield et al. 2010).

In studies of friendships before and after normative school transitions, a few find mixed results or no negative effect on socio-emotional functioning and/or friendship structure (e.g., Temkin et al. 2015; Wallis and Barrett 1998), and in another study, unpopular students, in particular, gained from the high school shift (Kinney 1993). Yet the bulk of research reports largely negative consequences of such shifts. For example, friendships tend to turn over and decline in numbers following changes between levels of schooling (Berndt and Hawkins 1985), and shifts of best friends accelerate (Aikins, Bierman, and Parker 2005). Nominations of reciprocated friendships, as well as those of old friendships, decrease over school changes, too (Hardy, Bukowski, and Sippola 2002). In addition, students making an off-time high school transition struggle more academically than those transitioning at a normative time, particularly when socially isolated (Langenkamp 2011). Moreover, as compared to school matriculation in single-feeder school communities, transitions in multiple-feeder districts are particularly damaging to students (Blyth et al. 1983; Crockett et al. 1989; Temkin et al. 2015). In one exception, multiple-school, as opposed to single-school, transition districts provided protection against failing a course for low-achieving middle school students (Langenkamp 2010).

In a review of the literature on school transitions, Benner (2011) noted that although research suggests that students suffer during normative school transitions, very few studies directly compare outcomes in schools that experience physical transitions with those that do not physically transition to another school. The question remains as to whether problematic declines would occur even without a change in location, due perhaps to developmental changes in adolescence. In one direct comparison, Simmons and Blyth (1987) found that students who transitioned from elementary to junior high in the 7th grade were disadvantaged, particularly with respect to self-esteem, as compared to those who remained in the same school. In another comparison study based on earlier grades of our dataset, Temkin et al. (2015) documented significant detrimental effects for students' friendships between 6th and 9th grade in cases in

which multiple schools fed into a single higher-level school, including decreased friendship stability, lower network connectedness, and an increase in social distance. On the other hand, when compared to remaining in the same school, Weiss and Bearman (2007) uncovered little evidence of a significant effect of the high school transition on academic or social outcomes in a sample of 1,680 respondents; effects were small, and in some cases, they reflected limited gains, rather than losses. Gains occurred in particular for students who faced difficulties in their origin school, with 8th grade isolates who changed schools becoming less isolated, for example, than those who did not transition.

Our purpose in this study, therefore, is to examine the effects of school transitions on the friendship networks and grade point averages of students for a lengthy period of time that begins in 6th grade and continues through the senior year of high school. This extensive time period will allow us to examine the degree to which the influence of normative shifts to a high school tends to be long-lasting. Based on both theory regarding life transitions and previous research findings, we hypothesize that school transitions from 8th to 9th grade will have negative ramifications both for friendship indegree, or social network centrality, and GPA.

At the same time, we are less clear as to whether possible transition effects are likely to persist over the high school years. A move to a high school undoubtedly poses an initial shock to the social and academic experiences of adolescents, but it could be one from which they recover relatively quickly, adapting to the new environment and returning to previous levels of social engagement and school performance. Several scholars (Barber and Olsen 2004; Blyth et al. 1983; Wigfield et al. 1991) argue along these lines, maintaining that most adolescents' social declines are generally limited to the period directly after the transition and that these behaviors may be mostly recovered and ill effects gone a year later. On the other hand, 9th grade often is viewed as the most critical year in high school, one that "makes or breaks" students over the long-run (McCallumore et al. 2010). A new school context that contributes to dwindling friendship centrality and dropping grades may continue to pose challenges throughout high school, therefore. Behavioral patterns established during a teen's entry into secondary school also could pose a standard from which it is difficult to recover. Once set in motion, social

interaction styles and studying habits, for instance, may become resistant to change, suggesting that initial negative school transition effects could persist for longer than a year or two. Yet research seldom follows students long enough to examine such a scenario, and scholars call for lengthier studies on this issue (Benner 2011).

Based on theory and previous literature, we develop the following hypotheses.

**Hypothesis 3:** Friendship indegree will decline following normative school transitions between 8th and 9th grade.

**Hypothesis 4:** Individual's GPA will decline following normative school transitions between 8th and 9th grade.

**Hypothesis 5:** We expect that the effect of a transition that involves multiple feeder schools merging into one high school will be more negative than a transition from a single, lower-level school to one high school.

## **DATA AND METHODS**

### ***Sample***

For our analysis, we consider data on 14,462 students who attended middle and/or high school within one of 28 small public school districts participating in the Promoting School-Community Partnerships to Enhance Resilience (PROSPER) study. Half of the school districts are located in Iowa and the other half are in Pennsylvania. Participating districts were required to have between 1,300 and 5,200 students, 15% of whom must have been eligible for free or reduced lunch. All school districts were located in rural or semi-rural communities with populations ranging from 7,000 to 45,000.

Data were collected for two cohorts: students entering the 6th grade in 2002 and those entering in 2003. Self-administered surveys were distributed to students during the fall and spring semesters of their 6th grade year and during the spring semesters of their 7th through 12th grade years, yielding eight waves

of data that each include an average of roughly 9,000 students. The target sample for at each wave was all currently enrolled students, omitting previous respondents who had left the school and adding new students who had entered. Response rates were generally high over all eight waves, varying from 86-90%, as were participant retention rates, with students participating in a mean of 4.18 waves in the survey. Of the students who participated at any wave, 93.9% nominated at least one peer as a friend. Approximately 83.0% of the nominations were successfully matched to other students participating in the study, while 14.7% of the nominations appeared to be students who were either in another grade level or attended a different school. Coders were unable to match 1.9% of names because there existed multiple possible matches, and they deemed 0.4% of names to be implausible (i.e., names of celebrities). For the purpose of this study, we only consider within-community and within-grade friendship nominations. To ensure equally spaced intervals between the data collection points of our study, we omit the first wave of data that was collected during the fall of respondents' 6th grade years. We also exclude five district-cohort networks from our analysis due to irregularities (e.g., one district was affected by a fire), resulting in a sample of 51, grade-level, friendship networks from 26 school districts.

### ***Definition of Variables***

In each wave of the study, students were asked, "Who are your best and closest friends in your grade?" They were permitted to nominate up to two "best friends" and as many as five "other close friends," allowing each student to nominate a maximum of seven peers. As discussed previously, we only consider nominations of within-community and within-grade friends, from which we constructed a total of 51 global friendship networks. At each wave of the survey, students were also asked, "What grades do you generally get in school?" Responses varied from "mostly A's (90-100)" to "mostly lower than D's (< 60)." We dichotomized this variable so that a score of one indicates that the student reported mostly A's or B's and a score of zero indicates that the student received mainly C's, D's, or lower. In other words, a score of one would suggest a relatively high GPA that is greater than or equal to 3.0 and a score of zero would suggest a GPA that is less than 3.0.

School transitions are the main independent variables of interest in our study. Here we are only referring to normative transitions, and specifically, those that occur between 8th and 9th grade. Youth from all school districts in our study experienced at least one school transition during the course of the study and in three districts they experienced two transitions. However, the timing of these transitions varied across the 26 communities. The vast majority, 84.3%, transitioned between 8th and 9th grade. Other research from this project also examined the less common transition from 6<sup>th</sup> to 7<sup>th</sup> grade (experienced by 35.3%), and its effect on multiple measures of social network centrality (Felmlee, McMillan, Rodis, and Osgood, in press), and Tempkin et al. (2015) studied additional aspects of friendship networks over a shorter time span. These studies reached similar conclusions to those obtained here for indegree.

Other than experiencing varying transition patterns, the school districts have relatively similar characteristics. As confirmed by two-sample *t*-tests, there is no significant difference between the community population size, median household income, proportion of students on free/reduced lunch, average test scores, and dropout rates of districts in which students transition between 8th and 9th grade and those where they do not. However, districts with this transition do tend to spend significantly less money per students than do non-transition districts. Survey response rates tend to be slightly higher in non-transition districts, however this difference was significant in only two waves of the survey.

To test for the effect of school transitions between 8th and 9th grade on individuals' indegree and GPA trajectories, we include two binary variables. The first is a time-invariant variable that indicates whether or not a student attends a school district that transitions between 8th and 9th grade (1 = experienced 8/9th transition). The second is time-variant and is included to indicate how the timing of an observation relates to having experienced a transition (1 = year following 8/9th transition). In other words, a student who attends a school that experiences an 8/9th transition will receive a score of 0 in each wave that occurs during their 6th through 8th grade years and a score of 1 for all waves that were collected in 9th grade and beyond. Students who do not attend schools that experience transitions between 8th and 9th grade receive a score of 0 for each wave of the study. Additionally, to test our fifth hypothesis

we include two binary variables that indicate whether a transition merged multiple feeder schools together (1 = experienced 8/9th multiple-school transition) and, alternatively, whether the transition moved students from a single middle school to a high school (1 = experienced 8/9th single-school transition).

We include several control variables that could be associated with an individual's tendency to receive nominations from their peers and their grade point average. Binary variables were used to control for geographic location (0 = Pennsylvania, 1 = Iowa), cohort (1 = cohort 1), gender (1 = girl), race (1 = white), free/reduced lunch status (1 = receives free/reduced lunch), and living with both biological parents (1 = lives with both). We also include measures of school adjustment and bonding (measured using eight survey items, with a higher score indicating greater adjustment/bonding) and delinquency (measured using twelve survey items, with a higher score indicating higher delinquency). In our statistical models, continuous variables have been centered by their grand mean to ease the interpretation of their coefficients.

### *Centrality Measure and Plan of Analysis*

We measure individual students' positions in their social networks by examining their individual centrality. Specifically, we consider indegree, or the number of friendship nominations each student receives from his or her peers (Wasserman and Faust 1994), a measure that is often interpreted as popularity (Moody et al. 2011; Valente et al. 2005). In our sample, indegree is a discrete measure that varies from zero nominations to twenty nominations. Even though students could only nominate a maximum of seven friends, there was no limit to the number of nominations a student could receive.

To test our research questions regarding the relationship between school transitions, individual centrality, and GPA, we apply multi-level models (MLMs) to account for the nested structure of our data. In our sample, respondents belonged to one of two successive cohorts that were nested within twenty-six school districts. Thus, we employ three-level, longitudinal MLMs where the first level represents the wave of the study, the second represents the student, and the third represents the school district. We take into account the nesting of grade cohorts within districts by allowing the cohort difference to vary across

districts (i.e., by including a random coefficient for cohort). Three-level MLMs are similar to standard regression models except they allow intercepts and slopes in the individual-level model to vary by the groupings at higher levels (Hox 2010). Note that the longitudinal design of our models allows us to test not only how the transition effects indegree centrality and GPA in the year immediately following the move, but also for the remainder of students' high school careers, while controlling for individual- and school-level controls. Furthermore, since MLMs allow us to examine cross-level interactions, they enable us to test whether the effect of the transition on indegree or GPA varies over time. To account for missing data, we used multiple imputation (using chained equations) to estimate ten imputed datasets.

## **RESULTS**

### ***Descriptive Statistics***

In our sample, there are slightly more girls than boys and there is relatively little racial diversity; 84.9% of students are white (see Table 1). Over the course of the investigation, the average number of friendship nominations received by each student was 3.34, with this measure varying from 0 to 20 friendship nominations. The students in the sample tended to report high GPAs. During the study, 73.9% of students reported a GPA that was 3.0 or higher.

### ***Centrality and GPA Over Time***

Based on descriptive statistics, average individual indegree centrality declines across the seven waves of interest, as expected. Average indegree, or number of friendship nominations, reaches its peak during early adolescence at a maximum of 4.05 nominations in 7th grade (See Figure 1). After attaining this maximum level, indegree tends to decline steadily until 12th grade, as predicted, when it reaches its minimum value at 2.23 nominations. There also is evidence that over time, a greater proportion of students became friendship isolates, meaning that no one chose them as a friend (not shown here). In seventh grade, only 8.1% of respondents were isolates, but by twelfth grade this proportion had more than doubled to 22.1% of respondents.

Over the course of our study, GPA reaches its lowest average when respondents are in 9th grade, following matriculation to a new school, as hypothesized. Average GPA is at its highest in early adolescence, reaching a maximum of 3.15 when students are in 6th grade. GPA then steadily declines until it reaches a minimum of 2.89 in 9th grade. After this, GPA starts to increase slightly until students' senior year when the average GPA is 3.14, which is almost as high an average as that from 6th grade (see Figure 1).

### ***School Transitions and Centrality***

***Network Graphs.*** We present visualizations of friendship network graphs for two schools in our sample and plot them at two points in time, one for 8<sup>th</sup> grade and the other for 9<sup>th</sup>, as shown in Figure 2. The first network is from a district in which students transition from middle to high school after they complete their 8th grade year. The second is located in a district where youth do not transition following 8<sup>th</sup> grade, but instead, remain within the same school between 8<sup>th</sup> and 9<sup>th</sup> grades. For both schools, the friendship networks display higher levels of density in 8<sup>th</sup> grade than in 9<sup>th</sup> grade, reflecting a tendency for an overall decline in friendship ties over this period. However, the winnowing of friendships is particularly noticeable for the school that underwent a transition (see the top row of Figure 2). In the graphs for the transition school, for example, there are far fewer ties in the 9th grade network, as compared to those for 9<sup>th</sup> grade in the nontransition school. Several of the densely interconnected friendship groups in 8<sup>th</sup> grade appear to become increasingly sparse in 9<sup>th</sup>, in particular, and youth on the periphery of the network's core lose more connections in the transition school.

***Multi-Level Models.*** Next, we use several three-level Poisson models to perform a statistical analysis of patterns of change in friendship indegree centrality over time, and we examine the degree to which transitions mediate these patterns.<sup>1</sup> In our first model (Table 1, Model 1), we see evidence of trends over time in friendship indegree centrality that are also shaped by the high school transition. Initially,

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<sup>1</sup> The analyses provide support for a multi-level model that allows for random effects at both the individual and school level. There is significant intercept variance at both the individual-level ( $\chi^2 = 91,455.08$ ) and school-level ( $\chi^2 = 322.84$ ), indicating that the intercepts predicting indegree vary at each level of the analysis.

there is a slight increase in indegree (*Wave*:  $b = 0.059$ ,  $p < 0.001$ ), but this trend quickly reverses as students progress through high school, in which case they tend to receive *fewer* friendship nominations (*Wave Squared*:  $b = -0.024$ ,  $p < 0.001$ ). The transition from middle to high school helps further explain the relationship between grade level and the number of nominations received by each individual. In 6th grade, before any schools transition, there is no significant difference in the number of nominations received by students enrolled in districts that transition between 8th and 9th grade and those enrolled in districts that do not transition during this period, or the reference group ( $b = 0.003$ ,  $p = 0.883$ ). However, in 9th through 12th grade, the years that follow the transition, students who make the transition start receiving significantly fewer friendship nominations than are secured by the reference group ( $b = -0.111$ ,  $p < 0.001$ ), lending support to our third hypothesis. In other words, while the indegree of all respondents declines from 9th through 12th grade, students who transition to high school after 8th grade incur an additional post-transition penalty. In the years following the transition, they are expected to receive 11% fewer nominations than their peers who do not go through the transition.

We also examine the extent to which some youth may have benefitted from a school transition in terms of social integration, in results not depicted here. While approximately 48.6% of students who transitioned saw a decrease in individual indegree between 8th and 9th grade, 31.9% of students experienced an increase in popularity. Relatively unpopular 8th grade students, those with between 0-2 friendship nominations, were most likely to experience such increases.

***Time trends.*** Next, to test whether the effects of the transition wane over time, we interact the wave polynomial terms with the district-level indicator for whether or not a transition occurred between 8th and 9th grade (see Model 2). While students who transition still experience a significant decline in the number of friendship nominations that they receive, the slope predicting change in indegree over time does not significantly differ between students who transition to high school after 8th grade and the reference group. Both groups experience an initial increase in friendship nominations that is then followed by a steep decline. The lack of significant difference between the two groups' slopes suggests

that there are long-term consequences of the transition. In the year immediately succeeding the transition, students see a sharp decline in friendship nominations. Following this initial shock, predicted indegree does not rebound back to converge with that of the reference group. Instead, the rate of decline does not differ significantly for those students who transition between 8th and 9th and those who do not (see Figure 3).

***Single vs. Multiple Feeder School Districts.*** Finally, we consider whether the post-transition popularity penalty with regard to indegree is more pronounced for districts in which students transition to one high school from multiple middle schools as compared to those moving from a single middle school (see Model 3). Overall, the penalty appears does not differ significantly for the two types of districts ( $b = -0.031, p = 0.481$ ), and therefore, we do not find support for our fifth hypothesis with regards to social integration.

### ***Isolates***

We also examine whether the high school transition extends its influence to the particularly troublesome situation whereby an adolescent develops into a friendship isolate. Using Bernoulli MLMs we test whether a transition between 8th and 9th grade is associated with an increase in one's odds of receiving no friendship nominations (i.e., being a friendship isolate). Complementing our findings on indegree, experiencing an 8/9th transition is associated with a 32% increase in ones' odds of becoming a friendship isolate. Transitions not only diminish the number of friendship nominations received by the most socially integrated students, in other words, they also further isolate those at the bottom of the social hierarchy (see Figure 4, MLM analyses available upon request).

### ***School Transitions and GPA: Multi-Level Models***

In subsequent analyses, we consider how students' chances of obtaining a high GPA change over time and test whether change is moderated by the timing of normative school transitions, with the use of

three-level Bernoulli models.<sup>2</sup> As indicated by the first model in Table 3, the relationship between time and achieving a high GPA is curvilinear. Initially, students experience a decline in their odds of reporting a GPA of 3.0 or higher (*Wave*:  $b = -0.180, p < 0.01$ ), but later, this trend reverses and students see a modest increase in their odds of reporting a high GPA (*Wave Squared*:  $b = 0.047, p < 0.001$ ). The relationship between grade level and GPA is further shaped by the timing of normative transitions in each school district. At the start of the study, there is no difference in expected GPA between students who attend schools that transition between 8th and 9th grade and those who do not ( $b = 0.175, p = 0.208$ ). But, similar to indegree, students who transition experience a significant post-transition penalty in their GPA ( $b = -0.421, p < 0.01$ ), a finding that gives support to our fourth hypothesis. In the years following the transition, those students who switched schools have 34.36% lower odds of obtaining a high GPA than peers who did not experience a normative school transition.

**Time trends.** Again, we test whether there is a gradual effect of the transition over time by interacting the wave polynomial terms with our district-level indicator as to whether students experience a transition between 8th and 9th grade (see Model 2). Slopes predicting GPA are significantly different for students who transition compared to those who do not, and these differences further suggest that the transition has a negative impact on students' GPAs. During the earlier years of the study, the decline in GPA is not as pronounced for students attending schools in the transition districts (*Wave x 8/9th Transition*:  $b = 0.255, p < 0.01$ ) and the subsequent increase in predicted GPA is not as steep (*Wave Squared x 8/9th Transition*:  $b = -0.046, p < 0.001$ ). Similar to our models that predict indegree, transitions between 8th and 9th grade appear to have a long-term effect on students' GPAs. In the years preceding the transition, those attending schools in transition districts tend to have greater odds of obtaining a high GPA. After the transition, this relationship completely reverses; the odds of achieving a high GPA are lower for students in transition districts when compared to those in the reference group, and this discrepancy continues to widen until the end of the study. Our findings identify long-term consequences

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<sup>2</sup> Chi-squared tests on the unconditional model indicate that there is significant variance at both the individual-level ( $\chi^2 = 33194.23$ ) and school-level ( $\chi^2 = 185.69$ ), highlighting the importance of applying a multi-level framework.

to the transition. It appears that the grades of many students who attend districts that transition to a different school following 8th grade never recover from the initial penalty.

In analyses not shown here we also investigated exceptions to the general pattern of losses in GPA over the high school transition. We identified a subset of students who appeared to gain from a transition and experienced increases, rather than decreases, in the likelihood of receiving a high GPA. However, this type of benefit was limited to a very small minority (4.66%).

***Single vs. Multiple Feeder School Districts.*** Next, we consider the difference between districts in which students transition to high school from single versus multiple feeder schools. In support of our fifth hypothesis, students' GPAs tend to be more negatively affected by multiple-feeder transitions that occur between 8th and 9th grade rather than single-feeder transitions (see Table 3, Model 3). While there is no statistically significant difference between the single-feeder, multiple-feeder, and reference group districts during the first wave of the study, students' odds of obtaining high GPAs do follow significantly different trajectories over time, depending on the district in which they are enrolled. For example, multiple-feeder districts suffer the greatest post-transition penalty with regard to students' odds of achieving a high GPA. Compared to students who do not transition between 8th and 9th grade, those in multiple-feeder transition districts experience a 51.18% decrease in their odds of obtaining a high GPA in each year following the transition. Students who attend school in single-feeder districts also see a decrease in their odds, but it is significantly lower; respondents in these districts see a 21.65% decrease in their odds of achieving a high GPA at each post-transition observation (see Figure 4).

Furthermore, the initial decline in odds of obtaining a high GPA is not as steep for single-feeder districts that transition students between 8th and 9th grade when compared to those that do not transition between these grade levels (*Wave x 8/9th Single-Feeder District:  $b = 0.186, p < 0.05$* ). For multiple-feeder districts, there is no initial decline in GPA. Instead students in these districts actually see a rise in their odds of obtaining a high GPA during the earlier years of the study (*Wave x 8/9th Multi-Feeder District:  $b = 0.473, p < 0.001$* ). In the latter half of the investigations, adolescents in all types of schools

tend to see an increase in their likelihood of getting high grades. However, this uptick is significantly less for students who attend school in single-feeder districts (*Wave Squared x 8/9<sup>th</sup> Single-Feeder District:  $b = -0.034, p < 0.01$* ), and almost non-existent for those in multiple-feeder districts (*Wave x 8/9<sup>th</sup> Multi-Feeder District:  $b = -0.085, p < 0.001$* ), as Figure 5 illustrates. Once again, findings highlight the costs to GPA for students in school districts in which a high school takes pupils from multiple middle schools or from a single feeder school.

Finally, it is important to note that an adolescent's social network indegree is positively, and significantly, associated with the likelihood of attaining a high GPA ( $b = 0.088, p < 0.001$ ; Table 3, Model 3). Greater social integration into the school, as captured by indegree centrality, thus, appears to occur in concordance with improved school grades.

## **DISCUSSION**

Changing schools to enter high school creates lasting challenges for the social and academic lives of adolescent girls and boys. When compared to students experiencing no such transition, common, normative school transitions from 8th to 9th grade yield significant decreases over time in students' popularity among their peers, as measured by social network indegree centrality. Those same types of school changes also produce significant declines in a student's GPA, with mergers of multiple schools engendering greater GPA costs than the entire grade cohort transitioning between one middle and high school together. Furthermore, these two outcomes are positively correlated, suggesting that shrinking social networks and dropping grades creates an interwoven, downward spiral. Note that our study is one of the few that directly compares youth in schools that transition to high school with those in schools that do not transition, and with a relatively large sample of 14,462 students in 51 grade level networks. Furthermore, other than experiencing different transition patterns, the districts in our sample that transition students between 8th and 9th grade and those do not are almost identical in terms of community population, median income, and other demographic measures. This study design helps to increase confidence that the changes we observe are a result of switching to a new secondary school, rather than due to uniform, developmental adjustments in adolescence or to school-level contextual differences.

Overall, we see dramatic changes in the patterns of friendship networks during the six years between 6th and 12th grades. Our measure of network centrality, indegree, reflects a remarkable decline in social integration, with an initial increase in network indegree until it crests in 7th grade, after which point indegree drops steadily until reaching its lowest level in 12th grade. A continual dwindling of network centrality occurs whether or not students experience a school transition, suggesting that general, contextual changes in high school, such as larger class sizes, likely contribute to reductions in friendship integration.

Our results also demonstrate the key role of school transitions in shaping the friendship networks of youth. As hypothesized, students attending schools that experience transitions between 8th and 9th grade exhibit greater reductions in indegree than those attending schools in districts with no change in school during this period. Furthermore, the shrinkage in friendships, or network indegree, associated with moves between levels of schooling lingers; it does not dissipate over the subsequent years of high school. Teens who experience a school transition to high school, for example, continue to receive significantly fewer friendship nominations during their junior and senior years of high school, as compared to those who do not make the same transition. Furthermore, for some students, changing to a new secondary school has particularly harsh consequences, resulting in them being completely isolated, and chosen as a friend by no one. Note that these long-term effects on sociometric popularity would not be apparent in studies of shorter intervals.

A number of possible explanations arise for the negative effect of school transitions on friendships and centrality. One concerns a lack of opportunity and availability for social interaction. Typically, upon entering high school, a student will have classes and school activities with many new students and have much less daily, school contact with former friends from middle and/or elementary school. This decline in regular contact likely leads to students sending fewer friendship nominations to their old ties, and at the same time, new peers may not know each other well enough to consider one another friends. Other reasons concern the limitations of a sometimes large and intimidating, secondary school environment, combined with difficult academics, which may interfere with the time, energy, and

motivation necessary to develop an extensive friendship network. This trend of decreased social integration is not only evident in the year immediately following the transition to high school, but remains up until students are in 12th grade, which suggests that there are long term consequences to these structural changes.

Patterns regarding students' GPA also appear to be shaped by normative school transitions and display complex forms over time. From 6th through 8th grade, respondents' odds of receiving a high GPA steadily decline over each subsequent observation point for those who do not change schools between 8th and 9th grade. After 9th grade, this trend reverses, and by senior year these odds rebound to rates that are higher than they were at the study's inception. For schools that transition between 8th and 9th grade, however, students incur a post-transition penalty to their GPAs, and the later increase in these students' odds of obtaining a high GPA is not as pronounced, highlighting the negative impact of changing schools.

Furthermore, we find that the type of school transition matters for grades. Districts with multiple-feeder school transitions, as opposed to those between single schools, yield particularly adverse outcomes for students' GPA. Not only do those in such schools suffer from a large post-transition penalty in their odds of obtaining a high GPA, experiencing a multiple-feeder school transition also dramatically changes the relationship between transitions and GPA. Before the change in grade levels, students attending multiple-feeder districts tend to have the highest odds of obtaining a high GPA, while after the transition, they have the lowest. Note, too, that these complex effects on GPA would not be apparent in a study that failed to compare schools that transition to a new secondary school with those that remain within the same school.

What about the opportunities provided by a school transition to start afresh, make new friends, and perhaps rejuvenate slipping grades? There are young people here for whom a high school transition proves beneficial. A minority gain from such a relocation and do, indeed, experience small increases in their indegree centrality following the transition, and a very few improve their GPA's. Adolescents who profit from such a transition tend to be those for whom 8th grade appeared to be particularly challenging,

socially and/or academically, similar to earlier findings (e.g., Kinney 1993; Schiller 1999; Weiss and Bearman 2007). So for those students who struggle in their middle school environment, a change in schools may prove beneficial. But for the bulk of our sample, and as implied by much literature (e.g., Barber and Olsen 2004; Benner 2011; Temkin et al. 2015), the exogenous shock of shifting one's place of education between 8th and 9th grades proves to be costly, with consequences that do not readily dissipate.

Our general findings reinforce several of the tenets of a life course perspective on the social development of youth. According to this theory, life transitions can alter and change individuals' developmental paths in substantial ways, and here we see considerable evidence of such effects for an important life transition, that of changing levels of education. Our focus on the linked lives of young people's friendship networks also demonstrates the ways in which certain friendship ties, presumably those that are the most peripheral, fade with time, although the inner core likely remains more stable (Wrzus et al. 2013). In addition, the dramatic patterns in our study regarding the evolution over time of friendship and GPA from middle school through high school, highlights the importance of gathering information from lengthy segments of the life course.

These results also speak to the importance of continued attention by educators and parents to provide assistance to adolescents in adjusting to a new high school, especially in situations involving multiple school merges. Focusing interventions on students at risk of peer isolation or failing grades during the first year of high school is particularly crucial. For the average teen, moreover, raising awareness of possible challenges he or she may face during the move could provide reassurance to those who experience declines in popularity and grades that they are not alone. In addition, for a few adolescents who face serious problems in 8th grade, perhaps a move to a different school should be given consideration as a chance to start anew. The consequences of early friendship and/or academic patterns often last well into later life course stages, shaping outcomes such as adult health (Allen, Uchino, and Hafen 2015) and economic success (e.g., Shi and Moody 2017). Thus attention to these common difficulties faced by numerous adolescents becomes particularly significant.

Although there are a number of strengths to our investigation, there remain certain limitations.

For example, while our sample of schools is extensive, large, urban communities are underrepresented, and findings may differ in such environments. Additional measures of achievement, such as test scores and teacher's evaluations, also would be useful in examining the effects of school transitions on academic trends over time. Greater details are needed regarding the underlying mechanisms and processes that combine to produce the outcomes documented here, at the level of the individual, peer, teacher, school, and district. The long-term consequences for teens of school transitions also warrant further attention.

In conclusion, the friendship structure among young people often shifts considerably during the years from middle to high school, resulting in shrinking network centrality and additional cases of friendship isolation. Changing schools from middle to high school exacerbates the negative, over time ramifications for individual centrality and isolation, and these effects of school transitions can linger even until senior year. Thus, these findings call attention to the noteworthy phenomenon in which the linked lives of adolescents experience significant paring down, due in part to normative transitions to secondary school. School transitions, especially multiple-school merges, also have serious, detrimental consequences for students' grade point average, consequences that last through the high school years. Our findings suggest that the critical role of school transitions with respect to lengthy, social and academic outcomes deserves greater attention on the part of both educators and scholars concerned with educational processes.

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Table 1. Descriptive Statistics averaged over all waves of the study

|  | Mean  | SD    | Min | Max |
|--|-------|-------|-----|-----|
| Indegree                               | 3.344 | 2.682 | 0   | 20  |
| Transition after 6 <sup>th</sup> Grade | 0.345 | -     | 0   | 1   |
| Transition after 8 <sup>th</sup> Grade | 0.840 | -     | 0   | 1   |
| Transition after 9 <sup>th</sup> Grade | 0.115 | -     | 0   | 1   |
| Cohort 1                               | 0.487 | -     | 0   | 1   |
| Iowa                                   | 0.501 | -     | 0   | 1   |
| Female                                 | 0.515 | -     | 0   | 1   |
| White                                  | 0.847 | -     | 0   | 1   |
| Free/Reduced Lunch                     | 0.260 | -     | 0   | 1   |
| School Adjustment & Bonding            | 3.673 | 0.746 | 1   | 5   |
| Lives with Both Bio. Parents           | 0.601 | 0.489 | 0   | 1   |
| GPA (1 = GPA > 3.0)                    | 0.739 | -     | 0   | 1   |
| Delinquency                            | 1.560 | 2.512 | 0   | 12  |

Table 2. Three-level Poisson models for number of friendship nominations received (indegree)

|  | Model 1 |         |     | Model 2 |         |     | Model 3 |         |     |
|--|---------|---------|-----|---------|---------|-----|---------|---------|-----|
| <i>Fixed Effects</i>                         |         |         |     |         |         |     |         |         |     |
| Intercept                                    | 0.968   | (0.035) | *** | 0.975   | (0.033) | *** | 1.004   | (0.035) | *** |
| Iowa   | -0.025  | (0.025) |     | -0.025  | (0.025) |     | -0.043  | (0.027) |     |
| Average Net. Size                            | -0.001  | (0.000) | *** | -0.001  | (0.000) | *** | -0.001  | (0.000) | *** |
| 8/9 <sup>th</sup> Transition                 | 0.003   | (0.021) |     | -0.006  | (0.030) |     |         |         |     |
| 8/9 <sup>th</sup> Multi-School               |         |         |     |         |         |     | 0.102   | (0.056) | +   |
| 8/9 <sup>th</sup> Single-School              |         |         |     |         |         |     | -0.024  | (0.029) |     |
| Female                                       | 0.236   | (0.015) | *** | 0.236   | (0.015) | *** | 0.237   | (0.015) | *** |
| White  | 0.176   | (0.014) | *** | 0.176   | (0.014) | *** | 0.176   | (0.014) | *** |
| Cohort 1                                     | -0.014  | (0.018) |     | -0.014  | (0.018) |     | -0.014  | (0.018) |     |
| Both Bio. Parents                            | 0.122   | (0.011) | *** | 0.122   | (0.011) | *** | 0.123   | (0.011) | *** |
| Free/Reduced Lunch                           | -0.124  | (0.011) | *** | -0.124  | (0.011) | *** | -0.126  | (0.011) |     |
| Delinquency                                  | 0.006   | (0.002) | **  | 0.006   | (0.002) | **  | 0.005   | (0.002) | **  |
| School Bonding                               | 0.016   | (0.006) | **  | 0.016   | (0.006) | **  | 0.016   | (0.006) | **  |
| GPA  | 0.094   | (0.010) | *** | 0.094   | (0.010) | *** | 0.091   | (0.009) | *** |
| Wave   | 0.059   | (0.009) | *** | 0.049   | (0.028) |     | 0.048   | (0.028) |     |
| Wave x 8/9 <sup>th</sup> Trans.              |         |         |     | 0.012   | (0.031) |     |         |         |     |
| Wave x 8/9 <sup>th</sup> Multi               |         |         |     |         |         |     | -0.010  | (0.037) | +   |
| Wave x 8/9 <sup>th</sup> Single              |         |         |     |         |         |     | 0.020   | (0.031) |     |
| Wave Squared                                 | -0.024  | (0.002) | *** | -0.022  | (0.006) | **  | -0.022  | (0.006) | **  |
| Wave <sup>2</sup> x 8/9 <sup>th</sup> Trans. |         |         |     | -0.002  | (0.007) |     |         |         |     |
| Wave <sup>2</sup> x 8/9 <sup>th</sup> Multi  |         |         |     |         |         |     | -0.001  | (0.008) |     |
| Wave <sup>2</sup> x 8/9 <sup>th</sup> Single |         |         |     |         |         |     | -0.003  | (0.007) |     |
| Post-Transition                              | -0.111  | (0.019) | *** | -0.111  | (0.017) | *** |         |         |     |
| Post-Single Transition                       |         |         |     |         |         |     | -0.104  | (0.019) | *** |
| Post-Multi Transition                        |         |         |     |         |         |     | -0.031  | (0.043) |     |
| <i>Random Effect Variance Components</i>     |         |         |     |         |         |     |         |         |     |
| Individual-Level                             | 0.279   |         | *** | 0.279   |         | *** | 0.279   |         | *** |
| School-Level                                 | 0.003   |         | *** | 0.003   |         | *** | 0.003   |         | *** |
| Cohort within School                         | 0.005   |         | *** | 0.005   |         | *** | 0.005   |         | *** |

Notes: \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , robust standard errors are reported, + significantly different from single-feeder districts at  $p < 0.05$  (Wald test)

Table 3. Three-level Bernoulli models for attaining a 3.0 GPA or higher

|  | Model 1 |         |     | Model 2 |         |     | Model 3 |         |       |
|--|---------|---------|-----|---------|---------|-----|---------|---------|-------|
| <i>Fixed Effects</i>                         |         |         |     |         |         |     |         |         |       |
| Intercept                                    | 0.673   | (0.157) | *** | 0.837   | (0.136) | *** | 0.768   | (0.221) | **    |
| Iowa   | -0.074  | (0.138) |     | -0.074  | (0.138) |     | -0.015  | (0.134) |       |
| Average Net. Size                            | 0.001   | (0.001) |     | 0.001   | (0.001) |     | 0.001   | (0.001) |       |
| 8/9 <sup>th</sup> Transition                 | 0.174   | (0.135) |     | -0.015  | (0.137) |     |         |         |       |
| 8/9 <sup>th</sup> Multi-School               |         |         |     |         |         |     | -0.052  | (0.271) |       |
| 8/9 <sup>th</sup> Single-School              |         |         |     |         |         |     | -0.068  | (0.186) |       |
| Female                                       | 0.407   | (0.041) | *** | 0.407   | (0.041) | *** | 0.412   | (0.037) | ***   |
| White  | 0.362   | (0.061) | *** | 0.363   | (0.062) | *** | 0.364   | (0.051) | ***   |
| Cohort 1                                     | -0.120  | (0.042) | **  | -0.120  | (0.042) | **  | -0.121  | (0.042) | **    |
| Both Bio. Parents                            | 0.715   | (0.031) | *** | 0.715   | (0.031) | *** | 0.717   | (0.035) | ***   |
| Free/Reduced Lunch                           | -0.560  | (0.048) | *** | -0.564  | (0.048) | *** | -0.580  | (0.034) | ***   |
| Delinquency                                  | -0.057  | (0.005) | *** | -0.057  | (0.005) | *** | -0.059  | (0.006) | ***   |
| School Bonding                               | 1.177   | (0.026) | *** | 1.179   | (0.025) | *** | 1.182   | (0.022) | ***   |
| Indegree                                     | 0.089   | (0.006) | *** | 0.089   | (0.006) | *** | 0.088   | (0.006) | ***   |
| Wave   | -0.180  | (0.057) | **  | -0.399  | (0.034) | *** | -0.400  | (0.062) | ***   |
| Wave x 8/9 <sup>th</sup> Trans.              |         |         |     | 0.255   | (0.077) | **  |         |         |       |
| Wave x 8/9 <sup>th</sup> Multi               |         |         |     |         |         |     | 0.473   | (0.088) | *** + |
| Wave x 8/9 <sup>th</sup> Single              |         |         |     |         |         |     | 0.186   | (0.072) | *     |
| Wave Squared                                 | 0.047   | (0.009) | *** | 0.086   | (0.006) | *** | 0.086   | (0.010) | ***   |
| Wave <sup>2</sup> x 8/9 <sup>th</sup> Trans. |         |         |     | -0.046  | (0.011) | *** |         |         |       |
| Wave <sup>2</sup> x 8/9 <sup>th</sup> Multi  |         |         |     |         |         |     | -0.085  | (0.013) | *** + |
| Wave <sup>2</sup> x 8/9 <sup>th</sup> Single |         |         |     |         |         |     | -0.034  | (0.011) | **    |
| Post-Transition                              | -0.421  | (0.123) | **  | -0.414  | (0.140) | **  |         |         |       |
| Post-Single Transition                       |         |         |     |         |         |     | -0.244  | (0.065) | ***   |
| Post-Multi Transition                        |         |         |     |         |         |     | -0.717  | (0.129) | ***+  |
| <i>Random Effect Variance Components</i>     |         |         |     |         |         |     |         |         |       |
| Individual-Level                             | 2.164   |         | *** | 2.164   |         | *** | 2.189   |         | ***   |
| School-Level                                 | 0.062   |         | *** | 0.062   |         | *** | 0.063   |         | ***   |
| Cohort within School                         | 0.009   |         |     | 0.009   |         |     | 0.009   |         |       |

Notes: \*\*\* $p < 0.001$ , \*\* $p < 0.01$ , \* $p < 0.05$ , robust standard errors are reported, + significantly different from single-feeder districts at  $p < 0.05$  (Wald test)

Figure 1. Change in indegree and GPA over time

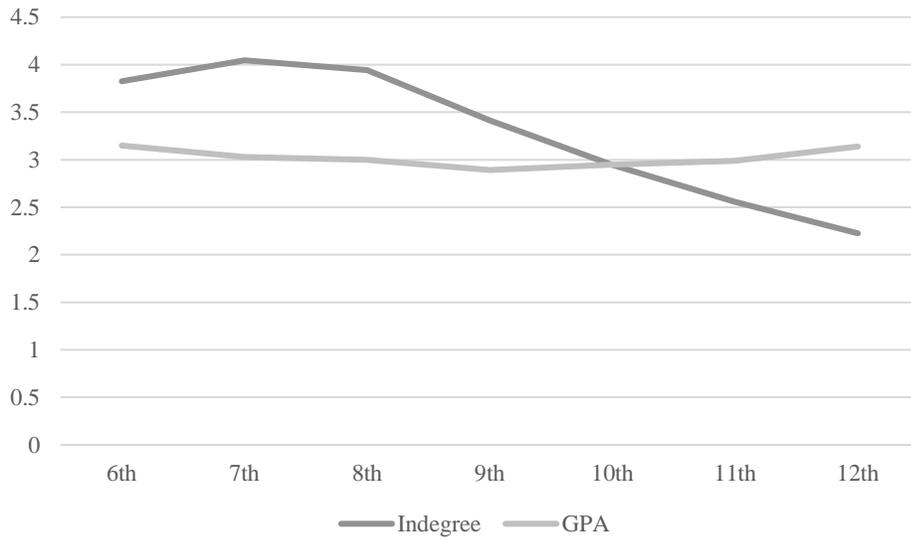
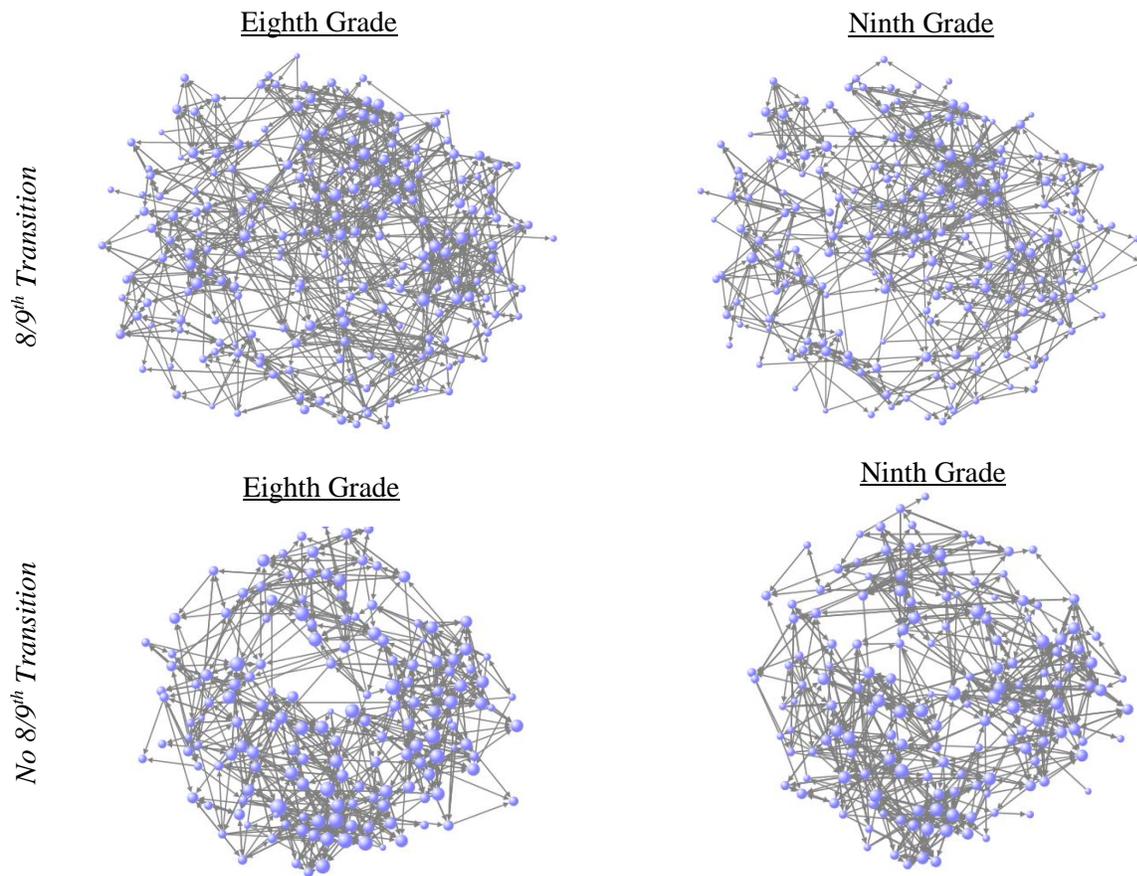
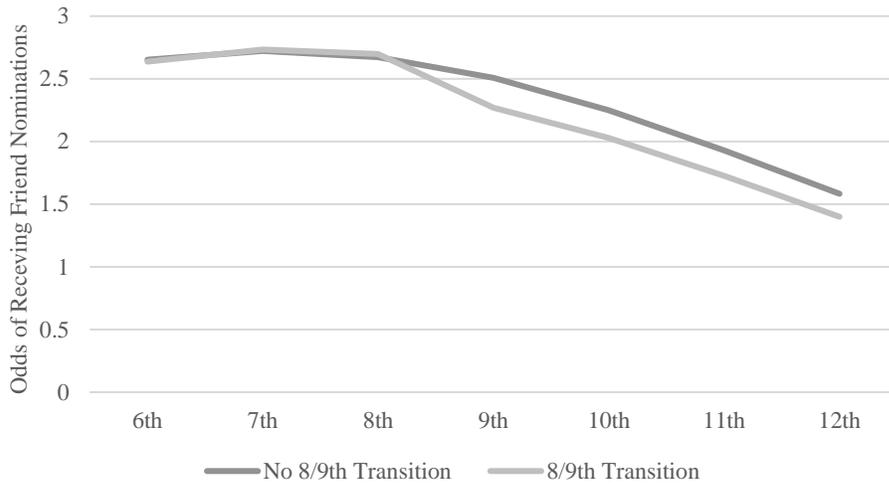


Figure 2. Friendship Networks for 8/9<sup>th</sup> Transition and 8/9<sup>th</sup> Non-Transition Schools at Eighth and Ninth Grade



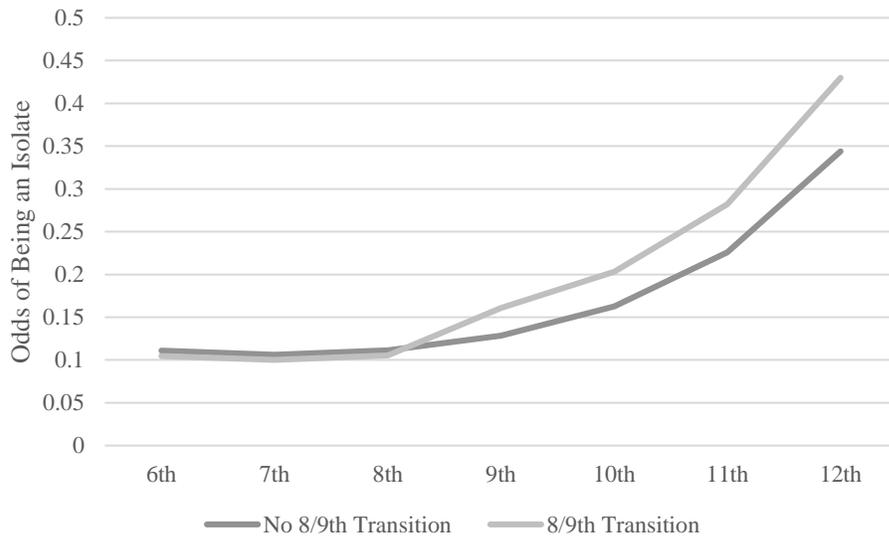
Notes: Nodes are sized by indegree. Ninth grade nodes have been locked in place so that each node is in the same exact location as it was in eighth grade. Isolates and missing nodes were removed from both graphs.

Figure 3. Change in individual odds of receiving friendship nominations over time and by transition patterns



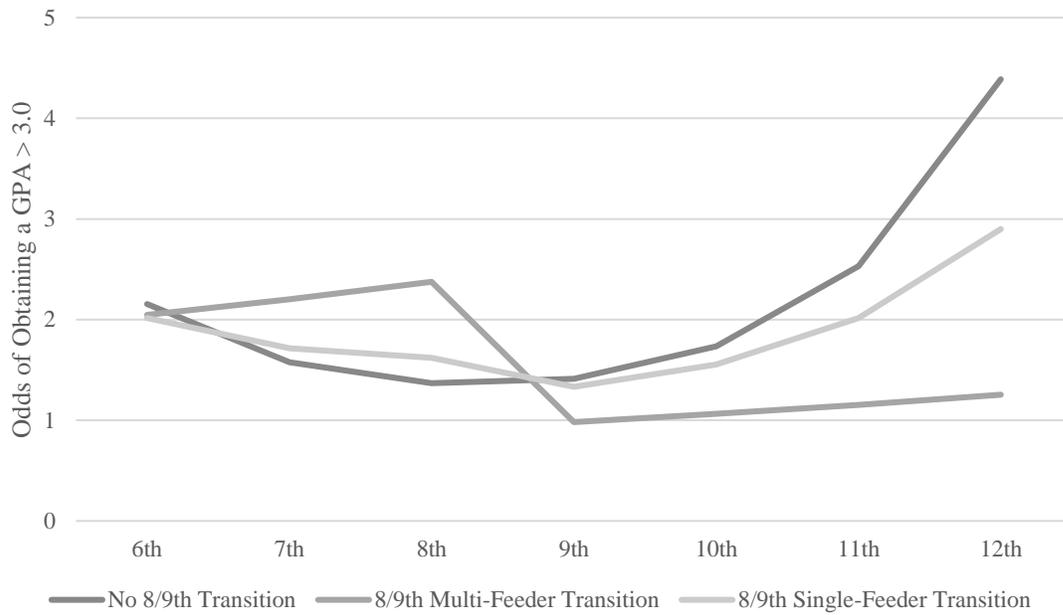
Note: Controls for state, average school size, individuals' gender, race, cohort, family structure, free/reduced lunch status, delinquency, and school bonding.

Figure 4. Change in individual odds of being an isolate over time and by transition patterns



Note: Controls for state, average school size, individuals' gender, race, cohort, family structure, free/reduced lunch status, delinquency, and school bonding.

Figure 5. Change in individual odds of receiving a high GPA over time and by transition patterns



Note: Controls for state, average school size, individuals' gender, race, cohort, family structure, free/reduced lunch status, delinquency, and school bonding.