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Leaping from One Pond to Another:
A Diagonal Mobility Approach to Mental Well-Being across the College Transition

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Abstract

Emerging adulthood, a pivotal segment of the life course for shaping adulthood mental well-being, often involves transitioning to college. While ample research has examined well-being outcomes of the college transition according to social, personal and institutional factors, changes in peer academic ability remain overlooked. Following classic studies of social comparison and relative deprivation, we examine the college transition in terms of change in peer ability across secondary and postsecondary academic environments within a nationally representative sample of adolescents (Add Health; Waves I-III; N=1,404). Based on lagged diagonal mobility models controlling for a variety of pre-college selection factors, we find that depressive symptoms increase among those students who experience a decrease in mean peer ability levels from high school to college, which is consistent with an unmet expectations ("obstruction") view of student well-being rather than a social comparison perspective. Unmet expectations may reflect socioeconomic barriers to attending selective colleges. Meanwhile, self-esteem shows no net transition effects. According to mobility weights, both forms of mental well-being mostly are linked to destination (college) peer ability rather than originating (high school) peer ability.

Keywords: depression, self-esteem, college transition, social comparison, academic ability, big-fish-little-pond effect

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College students are not immune to the suffering and disability associated with mental health problems. In fact, mental illnesses such as depression are equally prevalent among college students and same-aged nonstudents – and, among college students, mental health problems appear to be increasing in number and severity (Blanco et al. 2008; Hunt and Eisenberg 2010). With about two-thirds of American high school graduates currently attending college and this rate expected to rise (Card and Lemieux 2001; Schulenberg et al. 2005), understanding differences in mental well-being among college students is a growing public health concern.

If mental well-being declines with college attendance, this may reflect a difficult transition. Previous research has revealed the importance of personal resources (e.g., grit, optimism, cognitive ability) or institutional supports (e.g., supportive learning communities) to making a successful college transition (e.g., Brissette, Scheier and Carver 2002; Duckworth, Peterson, Matthews and Kelly 2007; Inkelas et al. 2006). However, the ecological shift defining the transition – namely, the degree of change in one's academic environment as one moves from high school to college – has almost entirely been overlooked.

To be sure, scholars have identified numerous factors explaining differences in college adjustment, including student background and differing social and academic climates among universities (e.g., Aries and Seider 2005; Armstrong and Hamilton 2013; Hurtado and Carter 1997; Kurlaender and Grodsky 2013). However, this still leaves unclear how leaping from one academic environment to another shapes mental well-being. Transition effects are not reducible to academic environments taken alone, making differences between environments an important but underappreciated source of differences in well-being.

In terms of key factors defining an academic environment, researchers have long recognized that social comparison against one's peers is a fundamental process by which individuals perceive themselves and their own abilities (Festinger 1957). Therefore, one key ecological variable is the average academic ability among one's peers, as this determines not only standards and expectations for achievement, but also how one perceives one's own abilities and even how one forms career aspirations in light of these self-perceptions (Antonio 2004; Davis 1966; Nagengast and Marsh 2012). In this study, we conceptualize the transition to college in terms of ecological change, measuring it in terms of change in mean peer ability. Drawing on diverse social-psychological perspectives, including social comparison, unmet expectations and reflected glory, we argue that changes in average peer ability from high school to college may ultimately prove beneficial or detrimental to mental well-being, depending on the balance of several countervailing mechanisms we propose.

Our study is the first to isolate associations between college transitions and changes in mental well-being while statistically controlling for originating (high school) and destination (college) peer academic contexts. Change is defined exactly as a difference between academic environments, making it linearly dependent on high-school and collegiate levels of peer ability. However, research on occupational social mobility has developed the diagonal mobility model (DMM) to help overcome this methodological challenge (Sobel 1981, 1985). Using a lagged diagonal mobility model with an extensive vector of pre-college covariates, we examine how the

college transition in particular is linked to changes in well-being, net of academic environments taken alone as well as a variety of selection processes shaping college entry and performance.

Background

Life after high school marks the beginning of emergent adulthood (Arnett 2000). It generally affords greater autonomy and flexibility, and also brings respite from adolescent social difficulties, all of which may serve to explain increases in mental well-being as adolescence ends (Arnett 2000; Moffitt and Caspi 2000). At the same time, however, entering college students differ remarkably in how well they adjust to life after high school, with some faltering while others excel. Schulenberg, Sameroff and Cichetti (2004:802) have suggested that changes in well-being occurring with college entry may "permanently alter" trajectories of well-being for the remainder of the life course.

Hundreds of studies have assessed who transitions to college successfully and why. Some studies have focused on the diverse resources of incoming students, ranging from optimism to grit to emotional intelligence to indicators of cognitive ability (e.g., Duckworth et al. 2004; Parker et al. 2004). Others have taken a demographic approach, by focusing on how race, class or gender matters to college adjustment and completion (e.g., Buchmann and DiPrete 2006; Correll 2004; Maralani 2007). Finally, some studies have highlighted student retention factors, such as student-faculty interaction or living-learning communities (e.g., Inkelas et al. 2006).

Yet ecological change across the college transition rarely is examined. Several studies have assessed the potential "mismatch" between a student's background and their chosen college (e.g., Kurlaender and Grodsky 2013). However, these studies ignore the fact that the college transition is a movement from one academic environment to another. Following classic research on social comparison, environmental changes in their own right, regardless of personal factors or background, may determine much of the peril or joy of becoming a college student. Changes in ecological factors, such as broad networks of social relationships, institutional resources, and average peer characteristics, often accompany environmental transitions (South and Haynie 2004). These environmental changes may be stressful, and thus impact academic performance and other indicators of adolescent and young adult well-being (for similar examples, see Pribesh and Downey 1999; Gasper et al. 2010).

Schools as Ponds: Social Comparison and Mental Well-Being among Students

Social comparison is an important factor in determining social adjustment and, with this, personal well-being (Buunk and Gibbons 1997; Festinger 1957). Social comparison refers to the search for information about other persons' standings and opinions for the purpose of self-assessment. One's self-concept and mental and physical well-being are likely to suffer when inhabiting a social situation where many others are better off in terms of their achievements, social rank, or resources. Classic research in social epidemiology has found that slight grades in rank among British civil servants predict differences in mental and physical health, suggesting that even slight differences in standing relative to one's peers matter for mental and physical thriving (Marmot 2004). Research on adolescents similarly has shown that one's perceived standing at school, in terms of rank in the academic and social hierarchy, is linked to mental or physical well-being (Quon and McGrath 2014).

For students attending high school or college, social comparison effectively may be forced, given that schools resemble total institutions where young individuals spend many if not most of their daily hours (Diener and Fujita 1997). Perceptions of one's ability or competence at coursework in general or for specific academic subjects (e.g., believing one is as good at school or good at mathematics) often are called the academic self-concept. Following a well-established finding, the average ability level within an academic environment is linked *negatively* to one's academic self-concept after objective ability measures are held constant (Marsh et al. 2008). For individuals who attend schools with peers of high academic ability, social comparisons are unfavorable on average and they generally harm the academic self-concept, due to a relative lack of low-ability individuals. Thus many individuals in such a school may end up perceiving themselves as "small fish in big ponds." Even high-ability students can question their academic ability or merit when surrounded by other high-achieving peers, as Davis (1966) found in his study of occupational aspirations among college students. In contrast, for individuals faced with lower levels of peer academic ability (i.e. for "big fish in small ponds"), peers inspire confidence about one's academic ability or competence.

In turn, academic self-concept may affect a variety of educational outcomes, including attendance, effort, grades, and career aspirations (Davis 1966; Marsh 1991; Espenshade et al., 2005; Wouters et al. 2011). Meanwhile, overall or global self-esteem may be vulnerable, especially among students who value academic performance (Dufner, Reitz and Zander 2014; Marsh et al. 2008; Rosenberg et al. 1995; Schulenberg et al. 2004). Stressful circumstances relevant to the self-concept, such as sudden or undesired changes in one's academic or work situation, have been shown to lessen self-esteem (Conley et al. 2014; Houle 2011; Rosenberg et al. 1995). Self-esteem is a psychological resource that buffers mental health, making it relevant to ongoing levels of distress, anxiety or depression as well (Pearlin and Bierman 2013).

Indeed, mental health usually is assessed in terms of levels of anxiety, depression, or other similar negative affect, and has been shown to diminish in response to college adjustment difficulties (Conley et al. 2014). While depression has been shown to predict dropping out of high school and not enrolling in a four-year college (Fletcher 2008), it also reflects and shapes social and peer experiences at school, such as number and quality of peer friendships (Falci and McNeely 2009; Ueno 2005). Also, depressive symptoms are linked to unrealized expectations for educational or occupational attainment (Hardie 2014; Reynolds and Baird 2010).

Most studies on academic social comparison and student well-being focus on the elementary and secondary grades, largely ignoring the collegiate level. However, earlier evidence suggests that reference group phenomena may be unique among college students (Bassis 1977), in that one's well-being may to some degree reflect glory or *enhancement* by higher average peer ability (i.e. collective self-esteem or pride for one's social group) rather than negative contrasts against high-achieving peers (i.e. unfavorable social comparisons, or feeling like a small fish in a big pond). However, college environments may be viewed as meritocratic in terms of how they evaluate student success, and meritocratic environments actually tend to increase the importance of "frog pond" or social-comparison phenomena to overall personal well-being (Trautwein et al. 2006).

Most importantly, however, these studies have yet to examine environmental *change*, as experienced during transitions between academic contexts. This is an important oversight, given how mental well-being often changes in proportion to the degree of environmental change being experienced by individuals (Pearlin and Bierman 2013). Some relevant work has examined

multiple school contexts, school transitions, or longitudinal outcomes. Owens (2010) and others have examined the simultaneous importance of multiple social contexts for determining academic outcomes (e.g., school and neighborhood; school and classroom; within-school tracking; Liem et al. 2013; Zell and Alicke 2009). While valuable, such studies do not focus on transitions between educational institutions across time. Marsh and colleagues (2007) find that average math performance in high school predicts the mathematics self-concept several years later; however, they do not investigate the potential role of academic transitions in producing such correlations. Moreover, the university often is assumed to represent a more challenging environment for all individuals making the transition, without explicit attention to individual-level gains, losses or stabilities in relative academic standing (Dai and Rinn 2008; Jackson 2003).

<div align="center">Mental Well-Being across College Transitions</div>

Below, we outline theoretical predictions for how the college transition shapes mental well-being, drawing mostly on a social comparison ("frog pond") perspective. However, we also draw on relevant research that links mental well-being to unmet expectations and to reflected glory (pride in one's peers rather than contrasting social comparison). In view of these multiple perspectives, differing net patterns in well-being may occur among transitioning students, depending on the balance of several countervailing mechanisms we propose.

Increase in Relative Standing (Decrease in Mean Academic Ability)

An increase in relative standing across the college transition would be associated with moving to a college that shows less academic ability on average relative to one's high school. Following social comparison ("frog pond") theory, such an increase would mark a lowering of academic relative deprivation, due to attending a school that is effectively a smaller pond. This should boost one's academic self-concept, and, with this, one's mental well-being. Meanwhile, increases in relative social standing may be experienced as attentional profit (e.g., due to lowered peer competition for the display of academic or cultural skills; DiMaggio 1982). Either mechanism would be consistent with an increase in mental well-being across the transition.

On the other hand, an increase in mean ability could signify a personal loss, due to a sense of failure or unmet expectations. High-school environments contain a variety of significant others, such as teachers, counselors, and peers, who instill college aspirations in students that are consistent with the material or objective prospects of school inhabitants (Bourdieu 1986; Nora 2004). In turn, high schools of differing mean abilities should socialize individuals into certain expectations for the type of college they ought to attend, with higher-ability high schools tending to produce expectations for attending more selective colleges. A deep, internalized sense of what type of education one ought to achieve may set educational expectations that, if unmet, trigger losses in mental well-being due to the obstruction of personal goals (Carr 1997; Hardie 2014; Reynolds and Baird 2010; Pearlin and Bierman 2013; Wheaton et al. 2013). If one experiences attending a less rigorous college in terms of personal failure, well-being is likely to decrease.

Decrease in Relative Standing (Increase in Mean Academic Ability)

Alternatively, decreased relative standing across the transition refers to attending a college where mean ability is higher relative to that of one's high-school peers. In line with frog pond theory, a decrease in relative standing may diminish one's academic self-concept, due to attending college

in an effectively bigger pond. In addition to increased doubt about one's abilities or aspirations, one may struggle to receive academic attention or mentorship relative to high school, due to heightened academic competition for instructor time or expertise (Andersen and Jaeger 2015). Either mechanism would be consistent with lowered mental well-being, due to a sudden decrease in the self-concept or in institutional social support for one's academic success. In general, social stress diminishes mental well-being whenever an environment exceeds the adaptation capacity given by one's psychosocial coping resources (Pearlin and Bierman 2013:326-27).

On the other hand, gains in mean ability across the transition also represent gains in the social prestige of one's peers, and an opportunity to bask in their glory (i.e. "reflected-glory effect"; Marsh, Kong and Hau 2000). That is, as the prestige of one's social affiliations increase, individuals may find it more rewarding to identify with their peers rather than strive for distinction against them (Abrams and Hogg 1988; Brewer, Manzi and Shaw 1993). Positive identification with one's peers may either diminish or cancel out the "frog pond" effect, as one's peers become viewed as an asset to the self rather than as a source of competition or social comparison (Bassis 1977; McFarland and Buehler 1995).

Other Perspectives on Mental Well-Being across Socioeconomic Transitions

In addition to the well-being mechanisms proposed above, prior research focused on socioeconomic mobility among working adults gives reasons to expect no unique contributions of college transitions to mental well-being (i.e. a null effect of the college transition, once origin and destination are statistically controlled), or to expect unconditionally detrimental effects of college transitions on well-being. Although young adults and working adults of course differ fundamentally in terms of their social roles and experiences, research on socioeconomic transitions still puts forth key guiding principles about social status and well-being. Indeed, differences in perceived social standing are linked to well-being inequalities among children, adolescents, and adults alike (Demakakos et al. 2008; Quon and McGrath 2014).

A prediction of null transition effects follows from an acculturation hypothesis, which predicts that individuals acclimate well to new social standings regardless of their originating environments. In particular, social mobility research on working adults has demonstrated that mental well-being is predicted best by current social standing, irrespective of prior standing or any transitions experienced (Blau 1956; Houle 2011). We are unaware of any empirical research that has attempted to isolate well-being changes linked to college transitions while also statistically controlling for the origin and destination academic environments in their own right.

In contrast to the acculturation hypothesis, strain theory predicts that students transitioning into dissimilar academic settings fail to adjust to their new environments and experience unconditionally detrimental effects on their mental health. As hypothesized in classic social mobility research, such an unconditionally negative effect occurs if large changes in academic environments create a permanent sense of "strain" or not fitting in (Houle 2011; Sorokin 1959). Not fitting in, regardless of how one does not fit in, may be what matters for psychological well-being. If this is true, then only the extent of change in mean ability should matter for psychological well-being, not whether ability increases or decreases. A focus on strain is consistent with the research finding that transitioning college students often experience lessened well-being regardless of their originating circumstances (Conley et al. 2014).

Method

We use the National Longitudinal Study of Adolescent Health (Add Health; Udry, 2003) to examine the relationship between changes in peer academic ability across the college transition and mental well-being during college. Approximately 20,700 adolescents were sampled from the school rosters and were administered the Wave I in-home questionnaire in 1995. Approximately 15,000 Wave I students were reinterviewed in 1996 (Wave II), 2001-2002 (Wave III), and 2008-2009 (Wave IV). Wave III interviews transpired when respondents were between the ages of 18 and 26, providing information about mental well-being during college and early adulthood. Wave III contains information on the colleges attended for the individuals who are currently enrolled. We merge this information with individual cognitive test data and family background characteristics from Wave I and baseline mental well-being measures from Wave II. We use multiple imputation on 10 multiply imputed datasets to replace missing data on any of the covariates[1]. Our final analytic sample contains individuals who attended high school in Wave I, did not change high schools from Wave I to II, are enrolled in a four-year college in Wave III and are not missing values on sampling weights, high school and college selectivity, or any of the outcome variables.

Dependent Variables: Mental Well-Being

We employ two available measures of mental well-being: depressive symptoms and self-esteem. Each is commonly used in studies of college or academic adjustment (e.g., Conley et al. 2014; Falci and McNeely 2009; Rosenberg et al. 1995; Ueno 2005). In Add Health, depressive symptoms and self-esteem are moderately correlated ($r = -0.38$).

Depressive Symptoms. We use an abridged version of the Center for Epidemiologic Studies - Depression Scale (Radloff, 1977; Ali, Minor and Amialchuk, 2013; Cesur, Sabia, and Tekin, 2013). The full CES-D consists of 20 questions that ask respondents to ascertain how often they experienced a variety of depressive symptons during the past week (0 = "Never/rarely"; 3 = "Most/all of the time."). Of the 20 items, nine were asked in both Waves II and III of the survey. The symptoms include "bothered by things that usually don't bother you," "had the blues," "felt that you were just as good as other people" (reverse-coded, RC), "had trouble keeping your mind on what you were doing," "felt depressed," "felt too tired to do things," "enjoyed life" (RC), "felt sad," and "felt that people disliked you." Responses to each item were added, such that the final CES-D scale ranges from 0 to 27 ($\propto = 0.80$ in Wave II, $\propto = 0.80$ in Wave III). Due to its extreme right skewness, the CES-D scale was transformed using a started logarithm, ln(CES-D) + k, where k is a constant that maximizes normality (MacLean and Hauser, 2000; Miech and Shanahan, 2000). For ease of interpretation, we standardized the log-transformed CES-D score (Mean =0, Standard Deviation =1).

Self-Esteem. Add Health offers an abridged version of Rosenberg's self-esteem scale (Rosenberg, 1965). The four items used to assess self-esteem ask respondents to indicate how much they agree on a 5-point Likert scale (1 = Strongly agree; 5 = Strongly disagree) with the following statements: "you have many good qualities," "you have a lot to be proud of," "you like yourself just the way you are," and "you are doing things just about right." The individual items were

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[1] We use Stata's mi program to impute for missing values. We use R's mitools package to combine results from the 10 multiply imputed samples and adjust standard errors to account for uncertainty across the imputations (Rubin, 1987).

reverse coded such that larger values indicate greater self-esteem. Individual responses on each item were summed, resulting in a scale ranging from 4 to 20 ($\propto = 0.80$ in Wave II and $\propto = 0.78$ in Wave III). Similar to the depression measure, the self-esteem scale was first transformed using a natural logarithm to correct for skewness, and then standardized.

Independent Variable: Change in Peer Academic Ability

Our key independent variable, the college transition, is defined as the difference between high school and collegiate average peer ability.

We utilize Peabody Picture Vocabulary Test (PPVT) mean scores to measure average peer academic ability in high school at Wave I. The PPVT, a commonly used indicator of cognitive skill, assesses an individual's receptive vocabulary for Standard American English and provides, at the same time, an estimate of scholastic ability (Dunn & Dunn, 1981). School-level PPVT scores are converted to quintiles (i.e. rank-ordered from 1 to 20, where 20 indicates a high school in the top 5% of mean academic ability). Since PPVT scores are available only in Wave I, we exclude students not enrolled in high school in Wave I.

It is not feasible to calculate PPVT means at the college level because Add Health samples on secondary, not collegiate, institutions. Instead, we use college selectivity to measure peer academic ability during college. Selectivity is measured using the college's national ranking, in terms of Scholastic Aptitude Test (SAT) quantiles (i.e. an institutional rank of 1 to 20, corresponding to the median SAT score of matriculating students)[2]. Here again, a higher quantile rank indicates a higher-ability school (e.g. a rank of 20 indicates a top 5% school).

Before determining changes in mean peer ability across the college transition, we used the "cut" command in Stata to consolidate measures of high-school and college academic ability into quintiles, or five approximately equally-sized ability groupings. Results pertaining to mental well-being during college are unchanged when other formats, including the original quantile format, are used (available on request).

Thus a college academic transition (T) is defined as

$$T = Ach_C - Ach_{HS} \tag{1}$$

where Ach_j refers to the mean academic ability of one's high school (HS) or college (C) peers (Dai and Rinn 2008; Marsh et al. 2007). Because ability is measured here in a five-category (quintile) format, T ranges from -4 to +4.

While the available measures of academic ability differ across high school and college, PPVT scores have been found to correlate strongly with other standardized achievement test scores such as the SAT (Smith et al., 1991). Further, using quintiles should help minimize any artifactual instances of environmental change, or change brought about by using differing scales

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[2] Our sample is restricted to students attending four-year colleges since median SAT scores are not available for two-year and proprietary institutions. More importantly, the influence of the academic environment is likely more applicable in four-year institutions relative to two-year colleges, given the high turnover rates in two-year colleges and the stronger peer affiliations seen in four-year colleges, where residence at school and frequent academic and informal social interactions with peers typify undergraduate life (Strauss and Volkwein, 2004).

of ability. Put another way, it is unlikely that change of one or more quintiles in academic ability across the college transition would be due simply to differing scales of ability measurement.

Pre-College Control Variables (Covariates Measured Before College Entry)

Because a successful transition to college is shaped by diverse processes and background factors that precede college entry, we control for available personal, demographic and school-related variables from Waves I and II, before respondents had begun college.

Personal Variables. To ensure that the observed effects of changes in peer ability are not conflated with individual ability differences (and thus represent a contextual effect; see Marsh et al. 2007 for specific details), we control for individual cognitive ability during high school (Wave I PPVT score). Next, to address well-being prior to college entry, we took into account self-reported physical health during high school (Wave II; five-point scale, where 1 = poor and 5 = excellent), and mental well-being measured at Wave II (also prior to college; depression or self-esteem, depending on the well-being model being fitted).

Then, to help address broad individual-level differences in general inclination toward academic environments (also at Wave II), we control for student attachment to school, which is assessed by the three items: "you feel close to people at your school," "you feel like you are a part of your school," and "you are happy to be at your school" (for all items, 1=strongly disagree and 5=strongly agree). These three indicators were summed to form an index of school attachment. Finally, to help equalize any between-student differences in expressed desire to obtain a college degree, we controlled for expectations for college graduation (ranging from 0 = "no chance" to 3= "about 50-50" to 5 = "it will happen").

Demographic Variables. Assessed at Wave I, demographic control variables include gender, age, self-reported race and ethnicity (non-Hispanic white (reference), non-Hispanic black, other race/ethnicity), highest parental educational attainment (less than high-school degree (reference), high school diploma or some college, four-year college degree, graduate degree), household income (thousands of dollars), and residence with both biological parents (0=no, 1=yes). To expand our assessment of socioeconomic background, we also considered whether one or both parents received public income assistance at Wave II as reported by the student (0=no, 1=yes).

School-Level Controls (High School). Because school-level peer ability differences in part reflect socioeconomic differences at the school level (Marsh et al. 2007), we took into account high school type (private or public) and school socioeconomic standing (SES). School SES is measured here as the student mean parental education and the percent of students living with both biological parents (Owens 2010). Because of the high correlation between these two variables, we used principal components analysis to combine them into a single SES index.

Method: Lagged Diagonal Mobility Models (DMMs) of College Mental Well-Being

To estimate associations between peer ability changes and changes in mental well-being, we use a longitudinal or lagged application (see Houle 2011) of Sobel's Diagonal Mobility Model (DMM; Sobel 1981, 1985). A conventional regression framework that models mental well-being as a function of college transitions (i.e. peer ability changes) fails to control for the independent effect of origin (high school) and destination (college) levels of mean peer ability. However, a

model including origin and destination is unidentified since a transition is, by definition, the difference between origin and destination (see Clifford and Heath, 1993 and Hendrickx et al., 1993 for a discussion of these issues). The DMM overcomes this linear dependency by assuming that students who experience changes (i.e. mobility) in average peer ability from high school to college resemble nonmobile students who nonetheless originate from or end up in schools of similar ability quintiles.

More specifically, the DMM controls for origin and destination average peer ability by estimating their effects on the basis of nonmobile cases. In our design, nonmobile cases are those students who did not experience any quintile change in mean peer ability across the college transition. The model simulates the mental well-being of mobile individuals had they not been mobile, by assuming they would have well-being outcomes similar to the nonmobile individuals possessing similar origins and destinations. The mental well-being of students experiencing a change in peer academic ability is modelled as the weighted sum of the mental well-being of the immobile students in their respective high school and college quintiles.

The lagged DMM is specified as follows:

$$Y_i = q\mu_j + (1 - q)\mu_k + \beta_1 Inc + \beta_2 Dec + \gamma X + \varepsilon_{ij} \qquad (2)$$
$$q + (1 - q) = 1, \qquad (3)$$

where Y is mental well-being during college (Wave III; depression or self-esteem), μ_j is the mean outcome for nonmobile members of their college quintile rank j, μ_k is the mean outcome for nonmobile members of their high school quintile rank k, and *Inc* and *Dec* are mobility indicators capturing students who experienced an increase or decrease, respectively, in peer academic ability from high school to college, where no quintile change in ability represents the reference group. *X* is the vector of pre-college covariates, which includes a lagged measure of mental well-being.

Since we control for the pre-college value of *Y,* we interpret βs as mental well-being change or growth coefficients. In other words, βs are estimated *changes* in *Y* from high school to college linked to experiencing mobility (increase or decrease) in peer academic ability. By estimating net changes in mental well-being, we focus on the unique role of the college transition in evolving well-being differences among young adults.

In Equation 3, the parameter *q*, known as the destination weight, ranges from 0 to 1 such that values approaching 1 indicate that mobile individuals' mental well-being increasingly resembles that of nonmobile individuals in the same college quintile rank. Alternatively, values of *q* approaching 0, which increase the value of $1 - q$, refer to an increasing resemblance in well-being between mobile individuals and nonmobile individuals from the same high school ability quintile. Therefore, $q = 0.5$ denotes that the well-being of mobile individuals is an even balance between high-school and college quintile peers.

For each well-being outcome, we estimate two sequential DMMs. First, we first estimate an "empty" model without the transition indicators, in order to determine the degree to which mobile individuals resemble nonmobile individuals in their high school (origin) or college (destination) quintile ability rank with regard to the outcome (Houle 2011). Origin and destination resemblances are captured through the parameters *q* and *(1-q)*. In a second model, we

enter the mobility indicators, to estimate the well-being effects of changes in peer ability, controlling for pre-entry covariates and high school and college peer academic ability.[3]

Results

Descriptive Results: Sample Overview

Table 1 shows descriptive statistics for the analytic sample. Overall, about two-thirds (70%) of the sample experienced an increase or decrease of one or more quintiles in peer ability across the college transition, with increases and decreases being equally likely (35%).

Most (72%) of the students who experienced a peer ability decrease came from a high-ability secondary school (i.e. high school in top two quintiles). In comparison, three of five students (59%) from lower-ability secondary schools (i.e. bottom two quintiles) experienced a peer ability increase. Thus, upward movement from lower-ability secondary schools is a bit less likely than downward movement from higher-ability schools.

Descriptive Results: Cross-Tabulations of Well-Being by School Ability Quintiles

To provide a descriptive summary of mental well-being, as indexed by the extent and nature of peer ability change experienced across the college transition, Table 2 shows mean standardized depression by high school and college peer ability quintile. The shaded boxes display mean levels of depression for students exposed to no change in peer ability across the college transition. In general, nonmobile (on-diagonal) students report levels of depression near or below average (depression score of 0). Meanwhile, students exposed to higher-ability colleges relative to their high school (increase in peer ability; above the shaded diagonal) report lower levels of depression (mean depression = -0.058) compared to students transitioning into lower-ability colleges (below diagonal; mean depression = 0.135; raw depression difference = 0.193).

Table 3 similarly gives a descriptive overview of self-esteem scores. Among nonmobile students on the shaded diagonal, we observe a negative association between self-esteem and peer academic ability, with those remaining in the lowest quintile reporting mean self-esteem levels that are higher (0.144) than students remaining in the highest quintile across the college transition (-0.132). Similar to depression, students exposed to increases in peer academic ability (above diagonal) report greater self-esteem (mean self-esteem = 0.033) than students exposed to lesser peer ability relative to high school (mean = -0.038), though here the raw difference in standardized scores is considerably smaller (.072). Overall, these trends suggest that transitioning into a college with higher mean ability relative to one's high school benefits mental well-being, relative to transitioning into a lower-ability college.

Lagged Diagonal Mobility Models (DMMs) of College Mental Well-Being

Depressive Symptoms (CES-D)

The second and third columns in Table 4 display parameter estimates from lagged DMMs of

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[3] Models are estimated using the Diagonal Reference (DREF) command from the General Nonlinear Models (GNM) package in R (Turner and Firth, 2007).

depression during college. Model 1 shows results for the baseline diagonal mobility model, which includes only the origin (high school) and destination (college) weights and the control variables from prior to college entry (including the lagged mental well-being measure). Here, the estimated college weight ($q = 0.817$) is close to one and much larger than the high school weight ($1-q = 0.183$), which itself does not differ statistically from 0. Overall, these weights reveal that college, not high school, mean peer ability predicts variation in depressive symptoms among college students.

Model 2 adds the transition indicator variables (increase or decrease in peer ability) to the equation. This model tests whether ability transitions matter for well-being change net of high school and college peer ability. Estimates for the transition indicators reveal that a peer ability decrease is associated with increased depression (about one-fifth of a standard deviation; $b = 0.208$, $p < .001$) while an ability increase is not significant ($b = -0.053$, *ns*).

Meanwhile, students who report stronger high school attachment also report decreases in depressive symptoms during college ($b = -0.026$, $p < .001$). We also find that blacks experience a lesser increase in depression relative to whites ($b = -0.242$, $p < .001$), while students with highly educated parents report an increase in depression compared to students whose parents did not earn a high school degree ($b = .302$, $p < .05$). To place the importance of changes in peer ability in the context of these other background variables, the effect of a downward ability transition (0.208) is comparable to that of racial background (-0.242) and parental education (0.302) and more than twice as large as the effect of moving from the 25th (10) to the 75th (13) percentile on high school attachment ([13 - 10] x -0.026 = -0.078).

Self-Esteem

The final two columns in Table 4 display parameter estimates from lagged DMMs of self-esteem. Similar to depression, weights in the baseline self-esteem model (Model 1) demonstrate that college students report levels of self-esteem more closely resembling those of their collegiate peers ($q = 0.607$). However, in this case, the origin (high school) weight significantly differs from zero ($1-q = 0.393$), which indicates that college students continue to resemble their high school peers to some extent.

Model 2 reveals no significant effects of peer ability transitions on self-esteem (ability decrease $b = -0.016$, *ns*; ability increase $b = -0.028$, *ns*). Among control variables, blacks relative to whites ($b = 0.353$, $p < .001$) experienced higher self-esteem across the transition. Meanwhile, students whose parents earned a high school degree ($b = -0.302$, $p < .05$) show a decrease in self-esteem.

Discussion

Many studies have illuminated student adjustment and mental well-being during the transition to college, but explicit attention to change in peer ecology has been missing. Transitioning to college is, at its core, an act of school mobility – of movement between two academic environments. Certainly, high school or college environments matter in their own right for preparing students to excel or for setting the cultural, social and academic standards for academic success. However, transitions, rather than either environment taken alone, may be contributing to differences in mental well-being observed among today's college students.

Our study is among the first to investigate peer social comparison in the context of school change or mobility, and is perhaps the first to focus on peer ability change using nationally representative data on transitioning adolescents. The dynamics of school mobility are distinct from school-specific influences on mental well-being (e.g., a so-called pressure for "effortless perfection" at some elite universities; Landphair 2007), much in the same way that dynamics linked to social class transitions among middle-aged working adults differ from influences of originating or destination social classes taken alone (Houle 2011; Weber [1922] 1978). In prior work, mobility or movement between schools has been shown to predict social and academic adjustment among children (e.g., Dupere et al. 2015; Pribesh and Downey 1999), and yet the well-being consequences of differing types of school mobility have yet to be examined among adolescents entering college.

Based on lagged diagonal mobility models controlling for pre-college selection factors, we obtain a number of important findings regarding mental well-being among college students. First, we find that students transitioning into higher-ability colleges experience no significant change in depression levels relative to nonmobile students. Moreover, we find no evidence that changes in the academic environment from high school to college influence self-esteem. The diagonal mobility weights provide some insight into these null effects. The weights indicate that college students show levels of mental well-being resembling those of students in similar collegiate environments rather than former high-school peers, though this holds more strongly for depressive symptoms than for self-esteem. These findings suggest that the more time that college students spend in their postsecondary academic environment, the more their mental well-being comes to resemble that of others attending colleges with similar academic ability. In this regard, the nonsignificant effects should not be understood as null findings, but rather as evidence for what is already known: namely, that the college transition is a complex process by which students become acclimated to and navigate the rigors of a new academic environment.

However, we do find evidence for detrimental mental health consequences when students transition into lower-ability academic environments in particular. These students show an increase in depressive symptoms. Socioeconomic obstacles to elite college attendance may keep students from rigorous high schools from attending a college where most peers are similarly high in their academic ability, perhaps leading to unmet expectations. As the costs of attending private and selective colleges continue to rise (Hout 2012), this mental health mechanism may become more relevant to public health.

Unmet expectations, a recent application of self-discrepancy theory (Higgins 1987; see Hardie 2014; Reynolds and Baird 2010), offer a relevant theoretical lens for explaining these increases in symptoms. Following this work, levels of mental well-being reflect one's ongoing pursuit of personal goals. Applying this perspective, if a student leaps from a high school where peer ability is strong and expectations for college rigor are similarly high, to a college with considerably lower average levels of ability, this may well lead to unmet or frustrated expectations for achieving personal success and affiliating with peers who share similar interests, habits and goals. In contrast, students from lower-ability high schools entering more selective colleges may not have unmet expectations, since their expectations for academic rigor may be lower, and thus may be more easily matched or exceeded by entering a higher achieving college.

While students entering lower-ability academic environments experience increases in depressive symptoms, their self-esteem does not change. To help understand the differences in results

between depression and self-esteem, the distinction between psychosocial resources and mental health is useful. Psychological resources include self-esteem and personal mastery, both of which anchor one's sense of effectiveness during difficult times and underlie effective coping techniques (Taylor and Stanton 2007). Role adjustment difficulties may lead to diminishment of self and thus to diminishment of self-esteem and other psychological resources. Losses in self-esteem leave individuals more vulnerable to experiencing depression and other forms of mental illness (for reviews, see Pearlin and Bierman, 2013; Taylor and Stanton 2007; Wheaton et al. 2013). However, depressive symptoms may fall or rise depending on a multitude of factors other than fluctuations in self-esteem. For instance, other psychosocial resources, such as friendships, family social support, neighborhoods, and access to teacher assistance or guidance, shift dramatically during the college transition and thus may also underlie evolving differences in depressive symptoms (e.g., Brissette et al. 2002; Conley et al. 2014; Hunt and Eisenberg 2010; Pascarella and Terenzini 2010). Therefore, students matriculating into a lower-ability college still should regard themselves as academically competent, but at the same time they may become frustrated with suddenly restricted access to the types of academic resources and relationships they experienced while in high school.

It is important to outline several limitations of our study. First, our measures of school characteristics are limited, especially at the college level. As a consequence, the observed associations between peer ability and mental well-being could be due to attendance at particular kinds of colleges, such as universities as opposed to smaller institutions (e.g., liberal arts colleges), or universities with relatively high average student SES. While the correlation between school-level SES and student achievement is considerable, it usually is not extremely high (Jonsson and Mood 2008). Meanwhile, while controlling for high school racial composition does not change our results, we do not have access to college-level racial diversity measures. Perceived racial climates may be related to other school-level contextual factors (Hurtado and Carter 1997). Second, the implications of our findings for academic achievement at college remain unclear. It repeatedly is found that high-ability academic settings tend to increase academic achievement, despite the negative effects of unfavorable social comparisons (Hanushek et al. 2003; Vardardottir 2013). In our analysis, we do not attempt to explain associations between changes in mental well-being and changes in peer ability from high school to college, but rather we simply seek to document these important associations using a rigorous estimation strategy that controls for a variety of school- and individual-level factors.

We see a number of promising directions for future research. First, while higher education enrollment is more common than ever, students still show differing educational pathways, with some students delaying college entry after high school and other students transitioning between colleges or between two- and four-year institutions (Goldrick-Rab and Pfeffer 2009). According to this research, timing of college entry matters for eventual graduation and educational achievement more generally, which in turn suggests that frog pond phenomena may be different among nontraditional college students. More generally, subgroups of students may differ in terms of their desire for mastery or self-improvement versus self-enhancement via downward social comparison (see Dai and Rinn 2008 for more details). And, over time, unfavorable social comparisons may prompt individuals to diversify their view of self, by accumulating or emphasizing other social identities such as athlete, sibling, worker, spouse, or group or club member (Owens, Robinson, and Smith-Lovin 2010), a coping process worth examining.

By examining changes in peer academic ability, we focus on a particularly narrow, albeit

important, aspect of the college transition. Future research examining changes in other ecological characteristics is needed in order to further illuminate the relationship between environmental change during the college transition and mental well-being. Meanwhile, nontraditional academic careers, motivated analysis of student subgroups, changes in other ecological characteristics, and adjustment across the duration of the undergraduate career are important avenues for further empirical study.

On the whole, our study of school mobility breaks new ground by bringing attention to the important role that shifting social environments may play in influencing adjustment among today's college students. A key insight of our approach is that academic environments matter for adjustment net of the individuals composing them. Of course, the college transition reflects an intermingling of environmental and individual-level inputs for student adjustment. However, because change is defined by environments as well as by differences between environments, future research should continue to utilize diagonal mobility techniques to gain greater insights into the transition to college and mental well-being.

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Table 1. Descriptive Statistics (National Longitudinal Study of Adolescent Health, Add Health)

	Wave	**Mean**	**SD**
Mental Well-Being			
Wave 2 Self-Esteem	2	0.009	1.000
Wave 3 Self-Esteem	3	0.016	1.000
Wave 2 Depressive Symptoms (CES-D)	2	0.006	1.000
Wave 3 Depressive Symptoms (CES-D)	3	-0.002	1.000
College Transitions: Change in Mean Peer Ability			
Reference: No Change in Peer Ability	1, 3	0.301	
Decrease in Peer Academic Ability ($\geq$ 1 Quintile)	1, 3	0.353	
Increase in Peer Academic Ability ($\geq$ 1 Quintile)	1, 3	0.347	
Controls			
Race - Non-Hispanic White	1	0.593	
Race - Non-Hispanic Black	1	0.165	
Race - Other	1	0.241	
Parental Education - No HS degree	1	0.045	
Parental Education - HS degree	1	0.383	
Parental Education - College degree	1	0.277	
Parental Education - Graduate degree	1	0.295	
Parental/Household Income ($1,000s)	1	60.027	60.820
Lived with Biological Parents	1	0.687	
Female	1	0.556	
Age (Min: 13, Max: 20)	1	15.257	1.326
PPVT[1] Score (Min: 17, Max: 138)	1	107.873	12.739
High School SES (Min: -2.008, Max: 2.496)	1	0.289	0.859
Attended private high school	1	0.127	
Either parent on public income assistance	2	0.037	
Self-reported physical health (Min: 1, Max: 5)	2	4.148	0.779
School Attachment (Min: 3, Max: 15)	2	11.635	2.433
Expect to graduate college (Min: 1, Max: 5)	2	4.487	0.731

Note. N = 1,404
[1] Peabody Picture Vocabulary Test

Table 2. Depressive Symptoms (CES-D) in College (Add Health Wave 3), By Changes in Peer Academic Ability

		College Ability Quintile					Row Means
		1 (Low)	2	3	4	5 (High)	
High School Ability Quintile	1 (Low)	0.058 (91)	0.016 (48)	-0.054 (15)	-0.363 (26)	0.278 (38)	0.029 (218)
	2	0.096 (45)	-0.025 (54)	-0.215 (56)	-0.107 (54)	0.047 (50)	-0.048 (259)
	3	0.409 (52)	0.152 (46)	-0.201 (80)	-0.109 (50)	0.059 (77)	0.037 (305)
	4	0.111 (31)	0.063 (77)	-0.155 (64)	-0.039 (56)	-0.133 (73)	-0.045 (301)
	5 (High)	0.444 (23)	-0.114 (22)	-0.214 (60)	0.270 (75)	-0.047 (141)	0.026 (321)
	Column Means	0.184 (242)	0.035 (247)	-0.188 (275)	-0.010 (261)	0.003 (379)	N = 1,404

Note. Depression scores are logged then standardized (M=0, SD=1). Numbers in parentheses indicate number of respondents in each cell of the mobility table. Shaded cells (on diagonal) indicate mean for nonmobile students.

Table 3. Self-Esteem in College (Add Health Wave 3), By Changes in Peer Academic Ability

		College Ability Quintile					
		1 (Low)	2	3	4	5 (High)	Row Means
High School Ability Quintile	1 (Low)	0.144 (91)	-0.027 (48)	0.117 (15)	0.229 (26)	0.047 (38)	0.099 (218)
	2	-0.015 (45)	0.061 (54)	0.033 (56)	0.070 (54)	0.011 (50)	0.034 (259)
	3	-0.281 (52)	0.153 (46)	0.061 (80)	-0.259 (50)	0.006 (77)	-0.049 (305)
	4	-0.086 (31)	-0.067 (77)	0.170 (64)	-0.055 (56)	0.106 (73)	0.024 (301)
	5 (High)	-0.183 (23)	0.171 (22)	0.021 (60)	-0.058 (75)	-0.132 (141)	-0.070 (321)
	Column Means	-0.037 (242)	0.030 (247)	0.075 (275)	-0.040 (261)	-0.022 (379)	1,404

Note. Self-esteem scores are logged then standardized (M=0, SD=1). Numbers in parentheses indicate number of respondents in each cell of the mobility table. Shaded cells (on diagonal) indicate mean for nonmobile students

Table 4. Lagged Diagonal Mobility Models of Mental Well-Being During College (Add Health Wave 3)

	Depressive Symptoms (CES-D)		Self-Esteem	
	Model 1	Model 2	Model 1	Model 2
High School: Peer Academic Ability Quintile (1 - q)	0.183	0.297***	0.298*	0.302*
	(0.131)	(0.107)	(0.134)	(0.133)
College: Peer Academic Ability Quintile (q)	0.817***	0.703***	0.702***	0.698***
	(0.131)	(0.107)	(0.134)	(0.133)
College Transition: Decrease in Peer Academic Ability[1]		0.208***		-0.016
		(0.075)		(0.074)
College Transition: Increase in Peer Academic Ability[1]		-0.053		-0.028
		(0.074)		(0.073)
Control Variables				
Race[2]: Non-Hispanic Black	-0.225*	-0.242***	0.355***	0.353***
	(0.082)	(0.083)	(0.082)	(0.083)
Race[2]: Other	-0.003	0.005	-0.065	-0.062
	(0.069)	(0.070)	(0.069)	(0.069)
Parental Education[3] - HS degree	0.246	0.254	-0.301*	-0.302*
	(0.141)	(0.140)	(0.151)	(0.151)
Parental Education[3] - College degree	0.258	0.266	-0.230	-0.231
	(0.148)	(0.148)	(0.154)	(0.155)
Parental Education[3] - Graduate degree	0.287	0.302	-0.297	-0.297
	(0.151)	(0.150)	(0.154)	(0.155)
Household Income	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Lived with Biological Parents	-0.019	-0.009	-0.006	-0.006
	(0.058)	(0.058)	(0.057)	(0.058)
Female	-0.020	-0.010	-0.096	-0.097
	(0.053)	(0.053)	(0.053)	(0.053)
High School PPVT Score (Wave I)	-0.003	-0.003	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Age	-0.020	-0.022	0.031	0.031
	(0.020)	(0.020)	(0.020)	(0.020)
Either parent on public income assistance	0.198	0.199	0.007	0.007
	(0.136)	(0.135)	(0.135)	(0.135)
Self-reported physical health	-0.012	-0.013	0.043	0.043
	(0.034)	(0.034)	(0.034)	(0.034)
School Attachment	-0.024*	-0.026**	0.016	0.016
	(0.011)	(0.011)	(0.011)	(0.011)
Expect to graduate college	-0.008	-0.007	0.009	0.009
	(0.037)	(0.036)	(0.036)	(0.036)
Wave 2 Mental Well-Being	0.348***	0.346***	0.366***	0.366***
	(0.029)	(0.029)	(0.029)	(0.029)
Attended private high school	0.091	0.119	0.106	0.106
	(0.094)	(0.094)	(0.095)	(0.096)
High School SES	-0.012	-0.101	-0.055	-0.059
	(0.043)	(0.052)	(0.051)	(0.057)

	(1)	(2)	(3)	(4)
Intercept	0.865	0.941	-0.237	-0.242
	(0.513)	(0.517)	(0.514)	(0.515)
N	1,404	1,404	1,404	1,404

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
1 Reference Group = No Change in Peer Academic Ability
2 Reference Group = Non-Hispanic White
3 Reference Group = Less than High School Degree