ANNENBERG
BROWN UNIVERSITY

EdWorkingPaper No. 21-441

School-based Mentoring Relationships and Human Capital Formation

Matthew A. Kraft
Brown University

Alexander Bolves
Brown University

Noelle M. Hurd
University of Virginia

We document a largely unrecognized pathway through which schools promote human capital development – by fostering informal mentoring relationships between students and school personnel. Using longitudinal data from a large, nationally representative sample of adolescents, we explore the frequency, nature, and consequences of school-based natural mentorships. Estimates across a range of fixed effect (FE) specifications, including student FE and twins FE models, consistently show that students with school-based mentors achieve greater academic success and higher levels of post-secondary attainment. These apparent benefits are evident for students across a wide range of backgrounds but are largest for students of lower socioeconomic status.

VERSION: July 2021

Suggested citation: Kraft, Matthew A., Alexander Bolves, and Noelle M. Hurd. (2021). School-based Mentoring Relationships and Human Capital Formation . (EdWorkingPaper: 21-441). Retrieved from Annenberg Institute at Brown University: https://-doi.org/10.26300/96bs-6m26

School-based Mentoring Relationships and Human Capital Formation

Matthew A. Kraft
Brown University

Alexander J. Bolves
Brown University

Noelle M. Hurd
University of Virginia

July 2021

Abstract

We document a largely unrecognized pathway through which schools promote human capital development – by fostering informal mentoring relationships between students and school personnel. Using longitudinal data from a large, nationally representative sample of adolescents, we explore the frequency, nature, and consequences of school-based natural mentorships. Estimates across a range of fixed effect (FE) specifications, including student FE and twins FE models, consistently show that students with school-based mentors achieve greater academic success and higher levels of post-secondary attainment. These apparent benefits are evident for students across a wide range of backgrounds but are largest for students of lower socioeconomic status.

JEL Codes: I21, I24, I26, J24

Formal education is the principal investment societies make in the human capital of their youth. Decades of evidence now document the large returns to additional years of schooling (Gunderson and Oreopolous, 2020). However, we still have a limited understanding of why schools serve as engines of human capital development. As Oreopoulos and Salvanes (2011, p.159) explain, much of the economics literature treats schools as a black box where "individuals enter, something happens, and productivity increases." More recent studies have begun to look inside the black box of schooling, focusing on the role of instructional inputs in the education production process such as teachers, curricular materials, and remedial classes (e.g. Chetty et al., 2014; Jackson, 2018; Cortes et al., 2015).

In this paper, we propose and explore a new lens for understanding how formal education promotes human capital formation – one that views schools as incubators of natural mentoring relationships. This framework bridges two largely distinct research traditions in developmental psychology and labor economics to examine the role of relationships in the education production process. The psychology literature defines natural mentorships as caring relationships between nonparent adults and youth that arise out of existing social networks (Rhodes et al., 1992; Zimmerman et al., 2005). Mentors step outside of the boundaries of their primary roles to develop a unique and sustained relationship with individual youth. Studies find that approximately 70-80% of adolescents can identify at least one natural mentor in their life (Beam et al., 2002; Dubois and Silverthorn, 2005a; Hurd et al., 2016; Hurd and Zimmerman, 2014).

Natural mentors can fill a diverse range of roles in students' lives from role models and caring adults to advisors and advocates. Research suggests that natural mentoring relationships can benefit youth through cognitive, social-emotional, and identity development (Miranda-Chan et al., 2016; Rhodes, 2005; Rhodes and Dubois, 2006). Mentors may broaden students' cognitive

frameworks by exposing them to new ways of thinking and alternative perspectives. Positive relationships with mentors can help develop social-emotional skills by modeling effective communication and serving as a sounding board to help youth better regulate their emotions (Deutsch et al., 2020; Hurd and Sellers, 2013; Sánchez et al., 2008; Van Dam et al., 2018). Mentors can expand adolescents' self-perceptions and aspirations of who they might become by exposing them to a greater range of "possible selves" (Hurd, et al., 2012; Rhodes and Dubois, 2006).

There is good reason to think that schools are primary sites where informal mentoring relationships develop. Outside of family members, school personnel such as teachers, counselors, and coaches often have the most regular contact with youths' day-to-day lives. These frequent interactions forge bonds that can lead to natural mentoring relationships. Moreover, school-based mentors are uniquely positioned to help students overcome obstacles in school and guide them towards higher education. School personnel may also play an important role in expanding the social capital of underserved youth by increasing access to job opportunities and exposing them to broader social networks that they might not otherwise have access to within their familial, neighborhood, and social circles (Granovetter, 1973).

We leverage longitudinal data from a large, nationally representative sample of adolescents to document the frequency, nature, and school-level correlates of school-based mentoring relationships and to explore their potential consequences for students' human capital formation. Understanding the distribution and effects of these mentoring relationships across students and schools has important implications for educational equity and opportunity. While natural mentoring relationships could be equally advantageous to all students, they may not be equally accessible to students attending, for example, under-resourced or over-crowded schools.

Natural mentors might also serve as a compensatory resource, yielding greater benefits to students facing economic or structural disadvantages, or as a complementary one, adding to the privilege and resources enjoyed by more advantaged students (Erickson et al., 2009).

Experimental evidence from formal youth mentoring programs documents meaningful effects on academic performance, educational attainment, and social-emotional skills for students from socioeconomically disadvantaged backgrounds (Grossman and Tierney, 1998; Herrera et al, 2011; Kosse et al., 2020; Resnjanskij et al., 2021). However, identifying the causal effect of informal mentorships poses a greater empirical challenge. Unlike studies of formal mentorship programs such as Big Brothers/Big Sisters, randomized field trials are infeasible for natural mentorships because – by definition – they occur organically. The existing literature on natural mentoring is limited to correlational studies and those that make strong conditional independence assumptions based on observable characteristics (Van Dam et al., 2018). Such estimates are subject to large potential biases given the well-documented, non-random selection processes through which mentees and mentors mutually reciprocate these relationships (Gowdy et al., 2020).

We approach this challenge by fitting a collection of fixed effects models where each approach rules out different potential sources of selection bias that have been previously unaddressed in the literature. We first develop a conceptual framework for the key selection mechanisms involved in the formation of natural mentorships based on the psychology and sociology literatures. This framework motivates our series of FE models that leverage variation either within students over time, within pairs of students (twins, best friends, and romantic partners), or within schools. Although this collective approach does not afford the unambiguous causal warrant of an experimental design, it does provide the most robust empirical evidence to

date on the relationship between school-based natural mentors and adolescents' human capital development.

Natural mentorships between students and school personnel are relatively common and long-lasting. We find that over 15% of adolescents identify a K-12 teacher, counselor, or coach as their most important mentor, with 80% of these relationships persisting after students graduate from high school. Our descriptive analyses illustrate how the frequency of school-based natural mentorships varies meaningfully across students and schools. Similar to prior research, we find that adolescents who are Black, Latinx, and from lower socioeconomic (SES) backgrounds are less likely to report having a school-based natural mentor. We also document for the first time that the prevalence of school-based mentorships ranges considerably across high schools, with mentoring rates more than twice as high in some schools compared to others. Features of the school environment such as smaller class sizes and a culture where students have a strong sense of belonging are important predictors of this variation across schools.

We find remarkably consistent positive relationships between school-based natural mentorship and student outcomes across our range of FE model. In the short-run, having a school-based mentor is related to lower rates of course failure in high-school, more credits earned, and higher GPA. In the long-run, we find that students who benefit from school-based natural mentors are 15 percentage points more likely to attend college and complete almost an entire year more of formal education. These results are not proof positive of a causal effect, but they are consistent with both theory, causal evidence on formal mentoring programs, and the wisdom of many individuals' lived experiences that suggest there is an underlying causal relationship.

Our findings are also consistent with previous research suggesting that natural mentoring relationships can play a compensatory role for youth facing disadvantages due to structural or economic factors (Erickson et al., 2009). Heterogeneity analyses suggest that high school (HS) natural mentors benefit students of all backgrounds, but are most beneficial for students from lower-SES backgrounds. While these results are not always precisely estimated, the general pattern is consistent across short- and long-run education outcomes. With the exception of consistently larger apparent benefits for Asian male students, we find little evidence of heterogeneity across other aspects of student identity, such as race/ethnicity, gender, and their intersections.

We build on and contribute to several literatures with this work. First, our paper conceptualizes and develops original evidence in support of a largely unrecognized mechanism through which schools promote human capital development. Second, we provide the most credible evidence to date on the relationship between natural mentorships and adolescents' human capital formation. Third, we focus specifically on school-based natural mentorships, while the natural mentorship literature largely focuses on mentors as a general group with a few important exceptions (DuBois and Silverthorn, 2005b; Erickson et al., 2009; Fruiht and Wray-Lake, 2013). This distinction is important because prior evidence suggests that selection mechanisms and affected outcomes differ substantially across natural mentor types (e.g., familial vs. non-familial; Raposa et al., 2018). Fourth, we contribute to the teacher and counselor effects literature by illustrating an important pathway through which school personnel may affect students' outcomes outside of their traditional roles and job responsibilities (Chetty et al., 2014; Mulhern, 2020). Finally, our exploratory analyses point to specific ways in which policymakers and principals might facilitate the formation of natural mentoring relationships in schools.

I. The Natural Mentorship Formation Process

We characterize natural mentoring relationships as a voluntary and informal two-way matching process where students can seek out and be receptive to mentoring, and school personnel can offer and respond to invitations to be a mentor. Consider a stylized selection model such that:

$$P\left(Mentor_{ijt} = 1\right) = f(I_i^{Fixed}, I_{it}^{Varying}, S_j). \quad (1)$$

Here, the probability that student *i* in school *j* at time *t* has a school-based natural mentor is a function of students' individual fixed and time varying characteristics, I_i^{Fixed} and $I_{it}^{Varying}$, as well as the characteristics of the schools they attend, S_j.

Volition to seek out and willingness to reciprocate an informal mentoring relationship differ across a range of individual student characteristics. Attachment theory posits that strong bonds with parents provide a psychosocial basis upon which future relationships are formed (Allen and Land, 1999; Cassidy and Shaver, 2002; Bowlby, 1988). Previous research documents how students with stronger bonds to a parent are more likely to form natural mentoring relationships (Zimmerman et al., 2005; DuBois and Karcher, 2013). Research has also shown that time-invariant individual characteristics – e.g. family background, race/ethnicity, gender, and native language – influence the probability of engaging in these relationships (Christensen et al., 2019; DuBois and Silverthorn, 2005a; Raposa et al., 2018; Zimmerman et al., 2005). Adults are also more likely to seek out or be receptive to mentoring relationships with adolescents whom they perceive as being academically gifted, physically attractive, gregarious, and easy to get along with (Erickson et al., 2009).

Evidence suggests the natural mentor formation process is a common phase of adolescent development for most students rather than a response to specific life events or other time-varying

shocks. Among a sample of eleventh graders who identified having a very important non-parental adult in their lives, only 23% reported that these relationships arose when they were experiencing a significant event (Beam et al., 2002). Among those students who were experiencing an important life event, nearly all of them reported navigating a negative experience like family or personal problems. These types of negative time-varying shocks at the onset of natural mentorship formation would, if anything, cause estimates to understate any positive relationships between mentorships and students' outcomes.

Prior research has focused less on how environmental contexts such as school characteristics influence the natural mentorship formation process. We hypothesize that opportunities for forming these relationships might vary systematically based on a range of factors that shape interactions between students and staff such as school size, class size, school culture, the types of teachers employed, student-counselor ratios, and the number and type of extra-curricular clubs and sports teams offered. Forming natural mentoring relationships in schools also likely depends on the degree to which students' background characteristics match the characteristics and social identities of school personnel. Previous research suggests that school staff may be more likely to form mentoring relationships with young people when they share common demographics (e.g., race/ethnicity, gender) or life experiences such as poverty-related stressors or adversity stemming from structural inequality (Ensher and Murphy, 1997; Stanton-Salazar and Dornbusch, 1995). The U.S. high school teacher workforce is overwhelmingly white (79%), female (59%), and from middle and upper-middle class SES backgrounds (Hussar et al., 2020; Jacinto and Gershenson, 2021). Given this demographic makeup, we might expect students of color, students from economically disadvantaged

backgrounds, and male students to be less likely to develop informal mentorships with school personnel.

Our conceptual framework highlights how school contexts as well as students' own backgrounds, personalities, preferences, and lived experiences shape the natural mentoring formation process. It also motivates the set of FE models we develop below, where each model is intended to account for a key endogenous selection pathway.

II. Data

We draw on the National Longitudinal Study of Adolescent to Adult Health (Add Health), a study that began following a nationally representative sample of middle- and high-schoolers (ages 12-19) in the 1994-95 academic year. Over the ensuing three decades, these individuals participated in five waves of intensive in-home interviews as they transitioned into adulthood (Harris et al., 2013). Critical for our focus on school-based mentors, Add Health implemented a stratified sampling design, selecting 105 schools from a stratified list of more than 26,000 high-schools across the nation.[1] Schools were then further stratified by grade level and gender, and a random sample of about 20 students was taken from each stratum resulting in a final sample of over 20,000 students in grades 7-12 in the 1994-95 school year (Chen and Harris, 2020). The response rate exceeded 80% across all five survey waves, providing a consistent analytic sample across the 25-year span.

We report summary statistics for the weighted nationally representative core sample in Table 1 column 1. The majority of students are white (65%), with Black students comprising 15%, Latinx students comprising 12%, and Asian students comprising 3% of the sample. More than 90% of students were born in the U.S. and approximately one-third have at least one parent

[1] Candidate schools were stratified by region, urbanicity, school type (public, private, parochial), ethnic mix, and size. The probability of being selected was proportional to a school's enrollment.

who completed college. Participants tended to reside in neighborhoods (census tracts) that were mostly white with roughly a quarter of residents not having earned a high school diploma by age 25 and another quarter having earned a college degree by that same age.

Natural Mentors. The third wave of data (when respondents were 18-26 years old) included a question about natural mentoring relationships during adolescence. Specifically, participants were asked "*other than your parents or step-parents, has an adult made an important positive difference in your life at any time since you were 14 years old?"* Respondents were only allowed to identify one individual and were directed to recall the *most* impactful non-parental adult in their lives. Respondents who identified a natural mentor answered a series of follow-up questions aimed at characterizing the relationship. These items captured information about a mentor's gender, how the two met, how long the relationship lasted, the level of closeness in the relationship, how frequently the two interact, and other features.[2]

Add Health also asked how respondents knew their natural mentors prior to forming the mentorship. We categorize mentors into one of three categories: 1) teachers/guidance counselors and coaches/athletic directors that students met before their expected on-time high school graduation date (to distinguish K-12 mentors from those developed in higher education), 2) non-school-based mentors met before expected on-time high school graduation, and 3) mentors met after high school. Our analyses focus exclusively on the first category of K-12 school-based mentors, but we include indicators for the other two natural mentor categories as controls in some models.

Another key survey question asked respondents to describe in an open-ended manner "What did [your natural mentor] do to help you?" Add Health coded responses as describing

[2] Respondents provide the integer age when they first met their mentor which we use to identify the grade students meet their mentors. We assume students and mentors meet in the earliest academic year for a given age.

behaviors of mentors and *domains* of mentoring.[3] There are eight categories of mentor behaviors which describe the specific interactions between mentors and mentees: giving guidance and advice, providing emotional nurturance, giving practical/tangible help, providing a parental figure, providing a friend figure, providing a role model figure, spending time together, and other responses which do not fit into the primary categories. The seven domains describe the broad areas of students' lives that were influenced by the natural mentorship: personal development family and household, religion, finances, employment, education, and quality-time in leisure and/or sports, and other responses which mention a domain that is not characterized by these primary categories.

Twin Subsample. Add Health oversampled identical and fraternal twins by always including both siblings. The full Add Health sample of twins includes 1,565 students (one set of triplets), which we restrict to an analytic sample of 1,213 students with valid outcomes and demographics. The response rate for twins exceeds 90% across all five waves of interviews (Chen and Harris, 2020; Harris et al., 2013). In Appendix Table A1, we provide summary statistics for the core sample and twins subsample, and in columns 1-3 we compare twins to non-twins. These two groups are similar with small differences in racial representation. Compared to non-twins, twins are more likely to be Black and Latinx and less likely to be white.

Friend Networks. Add Health asked students to nominate their closest friends from each gender, one male best friend and one female, in Waves I and II. If nominated friends went to a school in the Add Health sample, then friends were added to the core sample.[4] Of the nearly

[3] Add Health developed a coding scheme where responses were coded into all applicable behaviors and domains. We provide more information on the coding process including inter-rater reliability measures in Appendix A.
[4] Roughly one-third of respondents were asked to name up to 5 friends from each gender. Respondents were asked to rank these nominations such that the first nomination is one's closest friend. Following Duncan et al., 2001., we only use the top nominated friend from each gender for individuals who nominated five ranked friends.

62,000 friendship nominations from Waves I and II, we drop just under one-third because the nominated friend goes to a school outside of the Add Health sample. Next, we create requited best-friend pairs by identifying friends who mutually nominated one another. Our final best friends analytic sample includes 1,378 students. In Appendix Table A1, columns 4-6 we describe the sample of requited best friends compared to students not in requited best friendships. These samples are similar to one another along observable characteristics with the exception of more Asian students and fewer white students in requited best friendships.

Romantic Partner Networks. Add Health Waves I and II also asked students to identify up to three individuals they had a romantic relationship with in the previous 18 months. Respondents were not asked to order romantic partnership nominations in any systematic way (e.g., recency, closeness, duration, etc.). Partners who attended Add Health sample schools were added to the core sample. We conduct an iterative matching process for assigning students to a single requited romantic partnership.[5] This iterative process allows students to be associated with, at most, one romantic partnership. Our final analytic sample of romantic partners contains 548 individuals. Much like best-friend pairs, Appendix Table A1 columns 7-9 show that students with romantic partners are quite similar to the remaining student sample.

Socioeconomic Status. We create a broad measure of student socioeconomic status using Wave I data on individual and neighborhood characteristics. Individual characteristics include household income, highest education of either parent, whether either parent is employed full-time, and whether students were covered by health insurance. Census tract measures include 1) average household income, 2) unemployment rate, and the proportions of households that are 3) receiving welfare assistance, 4) without a high school diploma by age 25, 5) with a college

[5] Our iterative process is a modified Gale-Shapley algorithm, described further in Appendix B.

degree by age 25, and 6) owner occupied. We construct our SES composite measure by reversing scales with negative valences, standardizing each measure to have a mean of one and unit variance, and taking individual student averages across these measures. Finally, we standardize this average across the full Add Health sample to arrive at our SES measure.

Outcomes. Our primary outcomes of interest are students' educational achievement and attainment. We use detailed data from student transcripts to measure several academic outcomes in each year of high school. These include annual GPA, course failure rate, and the number of length-adjusted year-long courses passed. We also examine educational attainment by Wave IV (ages 24 to 32) using indicators for whether a student attended college, attended a college with a selective admission process, and a measure of total years of education.[6,7] In addition, we conduct exploratory analyses for labor market outcomes given the well-established relationships between human capital, employment, and earnings (Gunderson and Oreopolous, 2020). These measures captured in Wave IV include annual income and whether an individual was employed for at least ten hours a week.[8] Appendix Table A2 provides nationally representative summary statistics and descriptions for all our outcomes.

Data Limitations. The timing and nature of the questions asked by Add Health about students' natural mentors present two key limitations to our analyses. First, Add Health's decision to restrict respondents to naming only the single-most influential non-parental adult in

[6] Our measure of college selectivity is based on Barron's selectivity index.
[7] We identify years of educational attainment based on respondents' highest reported level of attained education. We code the highest attained levels as follows: "8th grade or less" we code as 8 years; "some high school" as 11 years; "high school graduate" as 13 years; "some vocational/technical training (after high school) as 13.5 years; "completed vocational/technical training (after high school)" as 14; "some college" as 15; "completed college (bachelor's degree)" as 17 years; "some graduate school" and "some post baccalaureate professional education (e.g., law school, med school, nurse)" as 18 years; "completed a master's degree" as 19 years; "some graduate training beyond a master's degree" and "completed post baccalaureate professional education (e.g., law school, med school, nurse)" as 20 years; and "completed a doctoral degree" as 22 years.
[8] When values are missing for Wave IV, we use values from Wave III.

their lives shapes the interpretation and external validity of our findings. Recent studies show that students who can identify one natural mentor in their lives can usually identify two or more (Gowdy et al., 2020; Hurd, et al., 2018). Thus, our descriptive data provide a lower-bound estimate of the share of students who develop mentoring relationships with K-12 school personnel. Our model-based estimates are also best interpreted as the relationships we might expect to find for the most impactful school-based natural mentors.

Second, the retrospective nature of the question identifying natural mentors asked in Wave III, when respondents are ages 18 to 26, presents the possibility of recall bias. This could bias our analyses if individuals' likelihood of identifying a natural mentor is systematically influenced by their experienced life outcomes. For example, our pair FE and school FE models described below would be biased upwards if respondents who experience more academic or labor market success in life are more likely to view their relationships with school personnel as meaningful mentorships. Our student FE models are less sensitive to this type of recall bias as these models compare outcomes within students. If recall bias exists, we might expect it to be stronger for older respondents who are farther removed from high school and who have more revealed information about their life outcomes. Encouragingly, we find qualitatively similar results for the analyses described below when we split our sample into evenly-sized subsamples of younger (Wave III ages 18-22.5) and older (Wave III ages 22.5-26) cohorts (see Appendix Tables A3 and A4).

III. Nationally Representative Patterns of School-Based Natural Mentorships

III.a. The Frequency of School-Based Natural Mentorships

We find that school based natural mentorships are relatively common among youth in our nationally representative sample, with 15.2% of respondents reporting their most impactful

natural mentor was a teacher, counselor, or coach. These school-based mentors compose a quarter of all reported natural mentorships and are the second largest source of natural mentors behind only family members which comprise 34% of all mentorships. About 90% of school-based natural mentors are teachers or guidance counselors, and the remaining are coaches or athletic directors. Students were most likely to meet the school-based mentors they identified towards the end of 9th or beginning of 10th grades (see Appendix Figure A1).

We find that students from both genders are similarly likely to report a HS mentor, although there are more pronounced selection patterns by student gender across specific types of school personnel. Students who identify a teacher or counselor as a mentor are more likely to be female (61%), while students who identify a coach as their mentor are more likely to be male (71%). These patterns likely reflect the different gender compositions of teachers and counselors verses coaches and aligns with prior research on the salience of similar backgrounds (Ensher and Murphy, 1997; Stanton-Salazar and Urso Spina, 2003). Women comprise 41% of nominated HS teacher/counselor mentors, but only 13% of HS coach/athletic director mentors. Overall, male school personnel are more likely to be identified as natural mentors (59%) and are more likely to develop cross-gender natural mentorships with female students (36% of all relationships with male mentors) compared to female personnel with male students (24% of all relationships with female mentors).

We also find that white students and Asian male students are substantially more likely to report having a HS natural mentor than their Black and Latinx peers. As shown in Figure 1, Black and Latina female students each had rates of HS mentorship of about 10%, while Black and Latino males reported slightly higher rates of about 12%. Comparatively, white students

reported having school-based mentors about 15% of the time, and more than 20% of Asian male students identified having a HS natural mentor.

When we compare students with school-based mentors to those with no mentor along a range of characteristics, we find clear patterns of privilege-based selection. In Table 1 columns 2-4, we compare students who identified a school-based natural mentor during adolescence to individuals who identified no natural mentor. School-based natural mentorships are systematically more common among students from economically advantaged families and neighborhoods. Additionally, identifying no mentor at all is more common among students from homes and communities with less educational attainment. In Figure 2, we depict the likelihood of identifying a school-based natural mentor using binned averages of our SES measure and predicted values from a bivariate logistic regression of mentorship on SES. Students with SES values 1 SD above the median are 40% more likely to report a school-based natural mentor compared to students with SES scores about 1 SD below the median (17.5% and 12.5% predicted likelihood, respectively).

These patterns highlight predictions from our conceptual model and elucidate the most relevant selection pathways underpinning these relationships. Apart from gender, the prevailing trend is that students with backgrounds and experiences similar to school personnel are more likely to form natural mentoring relationships. Namely, white and Asian students from more affluent families and neighborhoods with higher levels of formal education are most likely to report having a school-based natural mentor.

III.b. The Nature of School-Based Natural Mentoring

Respondents characterized natural mentorships with school personnel as long-lasting, close relationships where mentors guide, advise, and encourage student development and self-

realization, with an emphasis on academic support and attainment. Those who identified a school-based mentor reported that the relationship was important in their lives for more than five years on average. In fact, 80% reported that the relationship remained actively important in their lives in Wave III when respondents were between 18 and 26 years old. This highlights how HS mentors develop relationships that extend well beyond their formal roles within classrooms, counseling offices, and sports fields.

As we report in Table 2 Panel A, the hallmark behaviors of school-based mentors were providing guidance and sharing wisdom. Typical student descriptions of school-based mentors' actions included "gave me good advice," "taught me things," "gave me direction in life," "helped me stay out of trouble," and "helped me grow up." We also find that school-based mentors were frequently thought of as role models compared to other types of natural mentors.[9] Perhaps unsurprisingly, school-based natural mentors were unlikely to provide tangible help (e.g., financial support, transportation, fixing things) and were also rarely seen by their mentees as taking on the role of a family figure or friend.

We also find school-based mentors routinely participated in the academic and developmental domains of mentees' lives. Table 2 Panel B reflects how these school personnel were uniquely positioned to engage with students' academic lives and inform their decisions regarding post-secondary education. School-based natural mentors often shaped students' identities, notions of self-worth, and moral values.[10] On the contrary, we find that HS mentors seldom inserted themselves into the religious, financial, and home lives of their mentees.

[9] Typical responses from this category included mention of the mentor being looked up to by the mentee, setting an example, being someone the mentee wants to be like, inspiring the mentee, and providing a positive influence.
[10] Typical responses from the developmental domain include the following: helped bring out true qualities; increased self-esteem; improved moral character; helped set goals; instilled confidence; gave direction; encouraged the right priorities; provided support during life crises; changed life; unspecified reference to decision-making or decisions.

Although research suggests that informal mentorship is tailored to student-specific needs and can have broad-based benefits, these descriptive patterns motivate our primary focus on the relationship between school-based natural mentoring and students' academic achievement and attainment.

III. Econometric Approach

The selection patterns described above which influence the informal, organic formation process of natural mentoring relationships present a substantial challenge for identifying the causal effect of HS natural mentors. We approach this challenge by fitting a range of models where each approach is meant to address different potential sources of selection bias. Each model relies on different identifying variation, samples, and assumptions. Together, these approaches account for a wide range of selection mechanisms although we cannot say that our collective empirical approach definitively rules out all forms of potential selection bias.

III.a. Student Fixed Effects

Our first model exploits variation within students over time to examine the relationship between HS mentors and student outcomes. This removes all forms of selection bias stemming from students' fixed characteristics. As we describe in our conceptual framework, these are primary factors that influence the formation of school-based natural mentorships.

Our design is analogous to a two-way fixed effect (TWFE) estimator. We construct our analytic sample using student-level panel data with annual HS outcomes which we restrict to include only two groups of students: treated students who identified a school-based mentor starting after their freshman year and never-treated students who report never having had a natural mentoring relationship during adolescence. Specifically, we fit the following model:

$$y_{it} = \beta NM_{it}^{Sch} + \varphi_i + \gamma_t + \lambda_g + \varepsilon_{it} \quad (2)$$

where y_{it} represents a high school transcript outcome for student *i* in year *t*. The first term on the right-hand side, NM_{it}^{Sch}, is an indicator variable which takes a value of 1 in all periods *t* in which a student had a HS natural mentor, and 0 otherwise. Individual student FEs (φ_i) focus our comparisons within students over time, while year (γ_t) and grade (λ_g) FEs control for any idiosyncratic shocks over time and across grade levels.[11] For all outcomes, we cluster standard errors at the individual level.[12]

The strength of this model is that it removes all observed and unobserved fixed student characteristics which may influence engagement in school-based mentoring. The identifying variation comes from the differential timing of when students meet their natural mentors. The model assumes no other shocks to students' outcomes were concurrent with the timing of when they met their natural mentors, and that outcomes for students who report never having a mentor provide a valid counterfactual for the trends we would have otherwise observed among students with HS mentors. There are two key limitations of this model. First, the short nature of our panel (effectively 4-years) creates a fundamental missing data problem. Our sample is highly unbalanced in event-time, limiting our ability to directly examine the parallel trends assumption. Second, we can only apply this method to short-term high-school transcript outcomes for which we have repeated measures.

Recent research illustrates how TWFE estimators such as ours can be biased in the presence of treatment effect heterogeneity (de Chaisemartin and D'Haultfoeuille, 2020;

[11] In all models, grade FEs are based on a count of the number of years a student has been in high school.
[12] We also drop singleton observations from our analytic sample to improve our precision (Correia, 2015).

Goodman-Bacon, 2021). The specific nature of our data and empirical tests, however, suggest that this is unlikely to be a substantial concern within the context of our analysis. We remove from our panel students who report meeting their school-based natural mentors before or during their freshman year. This prevents "always-treated" students from serving as a comparison group, which can produce negatively weighted treatment effect parameters (Callaway and Sant'Anna, 2020). Our short panel also minimizes the potential for bias due to variance-weights (Goodman-Bacon, 2021). The majority of our sample (74%) are from never-treated students, and a Bacon decomposition shows that treated groups vs. never-treated groups – the canonical 2x2 TWFE estimator – constitutes 88% of the total weight across estimators (Goodman-Bacon, 2021). We also confirm in Appendix C that there are no negatively weighted group-time treatment parameters and show that our primary estimates are robust to fitting a "stacked" regression where we restrict comparisons to only a single treated cohort and never-treated students (e.g. Cengiz et al, 2019; Baker et al., 2021).

III.b. Pair Fixed Effects

We complement our student FE approach by fitting three separate models comparing outcomes between pairs of students who are twins (fraternal and identical), best-friends, or romantic partners. These models address selection on unobservable fixed characteristics – although to a lesser degree than the student FE model – by controlling for all fixed characteristics that are shared by best friends or romantic partners. Unlike the student FE model, they also control for selection on unobserved time-varying events or characteristics that pairs of students experience or develop in common. We maximize each sample by including all paired students, regardless of their natural mentor type. As shown in Figure 3, these three samples are largely

distinct from one another with relatively few students included in more than one type of peer-pairing. Across each sample, we fit the following common structural FE specification:

$$y_{ijb} = \beta NM_{ijb}^{Sch} + \sum \delta_z NM_{ijb}^{z} + \gamma_j + \theta_b + \varepsilon_{ijb} \quad (3)$$

where y_{ijb} represents a given long-run outcome of interest for student *i* in pair *j* from birth-year cohort *b*. We include indicators for having a school-based natural mentor, NM_{ijb}^{Sch}, as well as two indicators for students identifying the two other categories of non-K12-based natural mentors that we describe above, NM_{ijb}^{z}. The coefficient, β, captures our parameter of interest: the relationship between a given outcome and having a school-based natural mentor relative to no mentor. We include FEs for each pair, γ_j, as well as birth cohort FEs, θ_b, to account for the fact that long-run outcomes are captured for respondents at different ages.[13] We use robust standard errors when estimating long-run outcomes. For short-run outcomes that we observe in each year of HS, we estimate the model using panel data with repeated outcomes and include year and grade FEs similar to equation 2, clustering standard errors at the student level. This allows for more direct comparisons across our student FE and pair FE models for high school outcomes.[14]

The strength of our pair FE models is that they control for a range of unobserved fixed and time-varying individual characteristics that influence students' likelihood of exposure to school-based natural mentors. For twins, this includes all time-invariant, unobserved features of twins' shared family influences (e.g., attachment bonds to parents), neighborhood contexts, and

[13] Birth cohort FEs drop out in our twin models because this does not vary within twins.
[14] We drop freshman year outcomes to minimize attenuation bias resulting from most students meeting their natural mentor by sophomore year. About 1-in-3 students with school-based mentors had met their mentor in freshman year whereas nearly 75% had met their mentor by the end of sophomore year.

any inherited attributes which form the basis of students' personalities and preferences. For best friends and romantic partners, these models control for unobserved sets of shared fixed and time-varying individual characteristics that are hard to measure, such as affability or engagement in school, to the degree that pairs engage in assortative matching. A large literature documents the ways in which adolescents' social networks and relationships reflect selection on shared phenotypes, interests, personalities, and backgrounds (Shin and Ryan, 2014). These models also control for school-level characteristics that influence mentorship opportunities as all pairs of students in our peer FE samples happen to attend the same school. The key limitations of these models are their reliance on small samples which constrain statistical power, and their strong assumption that selection into natural mentorship is as good as random within pairs.

III.c. School Fixed Effects and Covariates

We next fit models that employ high school FEs and include a rich set of control variables. As with our prior FE models, this approach accounts for selection related to the schools adolescents attend. We also include, for the first time, direct controls for a wide range of observable time-varying and time-invariant student characteristics, which our conceptual model and descriptive analyses suggest influence students' likelihood of participating in a natural mentoring relationship. Our sample consists of all students, irrespective of their natural mentor type, who have valid data for the rich set of covariates we include. We fit the following model:

$$y_{isb} = \alpha + \beta NM_{isb}^{Sch} + \sum \delta_z NM_{isb}^{z} + \eta S_{isb} + \tau P_{isb} + \varphi C_{isb} + \pi_s + \theta_b + \varepsilon_{isb} \qquad (4)$$

where y_{isb} represents a student-level outcome of interest for student *i* in school *s* in birth cohort *b*. This model replaces the pair FEs from equation 3 with school FEs (π_s) and adds covariate

vectors for student characteristics (S_{isb}), parents (P_{isb}), and census-tract communities (C_{isb}). Student variables include race, gender, interaction terms for race and gender, age, disability status, birthweight, whether or not a student was born in the U.S., ever moved/relocated homes, ever separated from a caregiver, lived in a two-parent biological household, number of times nominated as a friend, and interviewer perceptions of student physical and personality attractiveness. Parent variables include race, age, smoker status, disability status, educational attainment of the primary care provider and the primary care provider's partner, and whether or not the primary care provider was born in the U.S. Census-tract variables include population, population density, median household income, racial demographics, and the share of the population that is unemployed, without a high school diploma by the age of 25, without a college degree by the age of 25, owns their occupied homes, and receiving welfare. For short-run academic outcomes which are measured annually, we include calendar year and grade FEs and cluster our standard errors at the student level.

This model has two distinct strengths. First, we directly control for a wide range of student, family, and neighborhood characteristics that are important predictors of who forms natural mentoring relationships (Erickson et al., 2009). Second, the analytic sample is substantially larger than those from other models, allowing us to test for potential heterogeneity with far greater precision. The key limitation is the strong identifying assumption that HS mentoring relationships arise quasi-randomly within schools, conditional on our set of controls.

IV. Findings

IV.a. High School Academic Outcomes

Across all five of our fixed effect specifications, we find consistent evidence of strong positive relationships between having a HS natural mentor and students' short-run academic

outcomes. This common pattern of results emerges despite each model employing substantially different analytic samples, identifying variation, and assumptions. Table 3 column 1 contains estimates from our student FE specification, columns 2-4 contain estimates from our peer FE models (twins, best-friends, and romantic partners), and column 5 contains estimates from our school FE specification. Estimates for the association with annual GPA range between 0.06 to 0.48 GPA points – a 2% to 20% increase compared to students who identify no mentor – and are significant across all models. Our most conservative estimate suggests that having a school-based mentor for all 4 years of high school is associated with an increase of 0.24 GPA points or roughly the difference between a C+ and a B-.

We find striking evidence of the relationship between school-based mentorships and the rate of annual course failure, with decreases ranging between 1.7 to 3.4 percentage points – an 18% to 35% reduction in the rate of course failure compared to unmentored students. Results are again significant across all models. Complementing this reduction in failure rates, we also find that school-based mentors are associated with students earning an additional 0.17 to 0.33 year-length credits per year – a 3% to 5% increase. These estimates are similar in magnitude and significant in most models. Our most conservative estimate suggests that having a HS mentor for all 4 years of high school is associated with earning at least one additional semester-length credit.

IV.b. Long-Run Academic Outcomes

We find compelling evidence of the relationship between having a HS natural mentor and students' human capital development. In Table 4 columns 1-4, we report the parameter estimates for having a HS natural mentor from our peer FE and school FE specifications. Compared to unmentored students, we estimate that having a natural mentor teacher, counselor, or coach is associated with an increase in the likelihood a mentee attends college by between 10 to 25

percentage points – a 19% to 46% increase. Estimates are significant across all but our least well-powered model with romantic partners FEs. Evidence on the role of HS mentors in helping students attend more selective colleges is mixed. All estimates are positive, while those from our twins FE models are near zero and those from our best friends, romantic partners, and school FE models are of sizable magnitude, 9 percentage points or greater. Estimates for the association between natural mentoring and total years of educational attainment are uniformly significant and strikingly similar in magnitude across models. These results reveal that HS mentoring is associated with nearly a full year of additional education. If we were to interpret these results as causal, they imply that school-based mentorships raise the mean present value of lifetime earnings for HS freshmen by $60,600 to $92,400.[15]

We next examine which specific level of students' higher education trajectories appears to drive this relationship with attainment. In Figure 4, we report estimates from a flexible, non-parametric modeling approach commonly called a distribution regression (Chernozhukov et al., 2013). Using our twin sample, we estimate relationships at discrete levels of educational attainment and find that school-based natural mentors have the strongest relationship with students' college-going.

IV.c. Heterogeneity across Academic Outcomes

The natural mentor literature offers theoretical rationales for why these relationships might dually compensate for a lack of access to resources for some students while also complementing resources among others. We conduct a range of exploratory analyses using our most well-powered specification, the school FE model, to examine how different facets of student identity might moderate the relationship between school-based mentorships and students'

[15] These values assume a 9% annual rate of return per additional year of education (Gunderson and Oreopoulos, 2020) and a median undiscounted lifetime earnings of $1,037,000 in 2009 dollars (Carnevale et al., 2011).

human capital development. We find some evidence consistent with the compensatory hypothesis based on students' SES, but our results largely confirm that students of different races, gender, and SES – and the various intersections of these characteristics – benefit similarly from school-based mentorship.

We test for heterogeneity across SES by interacting our indicator for having a HS natural mentor in equation 4 with our composite measure of SES (results in Appendix Table A6). We find that having a HS mentor is a stronger predictor of reductions in course failure rates for students from lower SES backgrounds. As shown in Figure 5, the associated failure rate reduction among lower-SES students (1 SD below the median) is 3.9 percentage points, almost twice the 2.0 percentage point reduction associated with higher-SES students (1 SD above the median). For students' long-run educational attainment, our results suggest that school-based natural mentors are associated with a 16.7 percentage point increase in the probability of attending college for low-SES students and an 11.5 percentage point increase for high-SES students. This translates to a 31% higher college-going rate among lower-SES students and a 14% higher rate among higher-SES students, suggesting a compensatory effect of mentorship. Estimates across other outcomes have a similar valence, but are smaller and statistically insignificant.

Estimates disaggregated by race and gender reveal few significant or systematic differences in our findings across the intersections of student characteristics we explore. The key exception is that HS mentors appear particularly beneficial for Asian male students, the group for which we find the highest rate of reported HS mentoring relationships. As reported in Appendix Table A7, having a HS mentor is associated with a full letter grade improvement in GPA and 1.23 additional years of education for Asian male students.

IV.d. Long-run Labor Market Outcomes

Evidence suggests that interventions to increase students' human capital can have positive returns in the labor market (Gunderson and Oreopolous, 2020). Based on our estimates of an associated increase of 0.66 to 0.91 years of education, we would expect a HS mentor to be associated with an increase in annual earnings of approximately $1,750 to $2,700 dollars.[16] As shown in Table 5, our direct estimates of the association between HS natural mentorship and Wave IV earnings (respondents aged 24-32) are in line with these calculations, but none of the estimates are statistically significant. Ranging from $1,780 to $5,337 across models, these point estimates represent a 6.0% to 17.9% increase in average annual income. Estimates for whether a student was employed at least ten hours a week are relatively small, inconsistent in sign, and statistically insignificant.

IV.e. School-level Correlates of HS Natural Mentor Relationships

The apparent importance of natural mentorships raises the question, "What can schools do to promote these relationships?". We explore this question by first documenting that the rate of HS natural mentorship varies considerably across schools. As shown in Figure 6, we estimate that schools at the 10th percentile of the distribution had 10% of students reporting a HS natural mentor while schools at the 90th percentile of the distribution had students reporting mentorships at more than double that rate. Next, we examine the degree to which school organizational and environmental factors predict students' likelihood of reporting a HS natural mentor versus no natural mentor at all using a linear probability model. In Table 6, we report results from simple bivariate regressions as well as a joint multivariate model. We also include a parsimonious set of

[16] Calculations based on a 9% annual rate of return and an average annual income of approximately $30,000 among respondents at Wave IV in 2008.

individual student controls to hold constant differences in the student populations schools serve.[17]

Our results reveal three significant school-level predictors of the likelihood students form school-based natural mentorships. First, schools in which students have a stronger sense of collective belonging have higher rates of school-based mentorships.[18] We estimate that a one SD increase in school-level peer average sense of belonging is associated with a 1.7 percentage point increase in the probability of having a HS natural mentor – an 11% increase. Second, smaller average class sizes predict higher rates of natural mentorship in schools. Our estimates suggest that for every ten fewer students in a classroom, on average, the probability a student forms a school-based natural mentorship increases by 3 percentage points, about a 20% increase. Third, we find that schools that offer more sports teams have higher rates of school-based natural mentorships. We find having one additional sports team at a school is associated with a 1.9 percentage point (12.5%) increase in the likelihood students develop a mentoring relationship with a school staff member. We do not find evidence that the formation of natural mentorships is correlated with other school environmental features such as the number of clubs, urbanicity, or the average tenure of teachers in a school.

V. Conclusion

Schools serve as cornerstone institutions in society, generating substantial benefits for both individual students and the general public. Inside schools, students develop academic skills and content knowledge that have large returns in the labor market. Classroom learning, however, is not the only benefit schools provide. They also serve as social institutions where students

[17] Student controls include race, gender, SES, disability status, language spoken at home, the BIG 5 personality measures, and self-reported closeness to mother.
[18] We construct our belonging measure as a jackknife school-level mean of students' self-reported perceptions of belonging in school based on responses to 7 survey items (see Appendix D for details).

interact with adults on a daily basis. Our paper highlights how these interactions can lead to the development of naturally occurring mentoring relationships, which appear to promote students' accumulation of human capital in long-lasting ways.

We find that having a school-based natural mentor is linked with higher educational performance and attainment even after accounting for a host of key selection pathways through which these relationships form. The consistency of our findings across models based on disparate assumptions, identifying variation, and samples is suggestive of an underlying causal relationship. If we were to take the lower bound of our college enrollment estimates at face value, it would suggest that HS mentors have long-run effects that are comparable or even larger than those of high-quality preschools (Gray-Lobe et al., 2021), no excuses charter schools (Angrist et al., 2016), double-dose remedial courses (Cortes et al., 2015; Ozek, in press), and class size reductions (Chetty et al., 2011). Our findings also build on prior studies that document teacher effects on non-test-score outcomes (Jackson, 2018; Kraft, 2019; Petek and Pope, 2016) and suggest teachers, counselors, and coaches can affect students through mentoring relationships that extend well beyond when students leave their classrooms.

Our analyses also reveal that there is meaningful variation in the share of students reporting these relationships across schools, with mentorships occurring in some schools more than twice as often as others. This wide variation suggests that not all students have equal opportunity to develop school-based mentoring relationships. In particular, Black and Latinx students as well as low-SES students are meaningfully less likely to report having a school-based natural mentor. While this may be explained by the presence of other more impactful mentors in their lives, we expect that the lack of representation of these groups among school personnel contribute to the patterns we find. These findings add further motivation for efforts to recruit and

retain a more diverse teacher workforce that can better represent and relate to the students they serve. They also highlight the importance of more effectively preparing all teachers with the cultural competencies to form meaningful relationships with students from diverse backgrounds.

Our findings point to several potential areas of future study. We need to better understand the characteristics of school-based natural mentors and whether some teachers, counselors and coaches are more likely to serve in this capacity than others. We also lack a real understanding of the specific pathways through which school-based natural mentors support student mentees. It will also be important to further examine why school-based mentoring relationships may be more prevalent and potentially more impactful among Asian male students. Finally, we should explore how teacher training and school organizational practices might be leveraged to expand equitable access to these relationships. Our exploratory findings suggest that schools might promote these relationships by creating more opportunities for students to have multiple, sustained interactions with school personnel in small-group settings and by engendering school environments where all students feel a sense of belonging.

References

Allen, J.P. and Deborah Land. 1999. Attachment in adolescence. In *Handbook of attachment: Theory, research, and clinical applications*. New York, NY: Guilford Press.

Angrist, Joshua D., Sarah R. Cohodes, Susan M. Dynarski, Parag A. Pathak, and Christopher R. Walters. 2016. Stand and deliver: Effects of Boston's charter high schools on college preparation, entry, and choice. *Journal of Labor Economics* 34(2), 275-318.

Baker, Andrew, David F. Larcker, and Charles CY Wang. 2021. How much should we trust staggered difference-in-differences estimates?. Available at SSRN 3794018.

Beam, Margaret R., Chuansheng Chen, and Ellen Greenberger. 2002. The nature of adolescents' relationships with their "very important" nonparental adults. *American Journal of Community Psychology,* 30(2), 305-325.

Bowlby, John. 1988. *A secure base: Parent-child attachment and healthy human development.* New York, NY: Basic Books.

Callaway, Brantly, and Pedro H.C. Sant'Anna. 2020. Difference-in-differences with multiple time periods. *Journal of Econometrics.*

Carnevale, Anthony. P., Ban Cheah, and Stephen J. Rose. 2011. The College Payoff. The Georgetown University Center on Education and the Workforce.

Cassidy, Jude, and Phillip R. Shaver, eds. 2002. *Handbook of attachment: Theory, research, and clinical applications*. New York, NY: Guilford Press.

Cengiz, Doruk, Arindrajit Dube, Attila Lindner, and Ben Zipperer. 2019. The effect of minimum wages on low-wage jobs. *The Quarterly Journal of Economics*, *134*(3), 1405-1454.

Chen, Ping, and Kathleen M. Harris. 2020. Guidelines for analyzing Add Health data. Carolina Population Center, University of North Carolina at Chapel Hill, 1-53.

Chernozhukov, Victor, Iván Fernández-Val, and Blaise Melly. 2013. Inference on counterfactual distributions. *Econometrica* 81(6), 2205–2268.f

Chetty, Raj, John N. Friedman, Nahaniel Hilger, Emmanuel Saez, Diane W. Schanzenbach, and Danny Yagan. 2011. How does your kindergarten classroom affect your earnings? Evidence from Project STAR. *The Quarterly Journal of Economics* 126(4), 1593-1660.

Chetty, Raj, John N. Friedman, and Jonah E. Rockoff. 2014. Measuring the impacts of teachers II: Teacher value-added and student outcomes in adulthood. *American Economic Review,* 104(9), 2633-79.

Christensen, Kirsten M., Elizabeth B. Raposa, Matthew A. Hagler, Lance Erickson, and Jean E. Rhodes. 2019. Role of athletic coach mentors in promoting youth academic success: Evidence from the add health national longitudinal study. *Applied Developmental Science,* 1-11.

Correia, Sergio. 2015. Singletons, cluster-robust standard errors and fixed effects: A bad mix. *Technical Note, Duke University*.

Cortes, Kalena E., Joshua S. Goodman, and Takako Nomi. 2015. Intensive math instruction and educational attainment long-run impacts of double-dose algebra. *Journal of Human Resources,* 50(1), 108-158.

De Chaisemartin, Clément, and Xavier d'Haultfoeuille. 2020. Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review* 110(9), 2964-96.

Deutsch, Nancy L., Victoria A. Mauer, Haley E. Johnson, Anita A. Grabowska, and Miriam R. Arbeit. 2020. "[My counselor] knows stuff about me, but [my natural mentor] actually knows me": Distinguishing characteristics of youth's natural mentoring relationships. *Children and Youth Services Review* 111, 104879.

DuBois, David L., and Michael J. Karcher, eds. 2013. *Handbook of youth mentoring*. Thousand Oaks, CA: Sage Publications.

DuBois, David L., and Naida Silverthorn. 2005a. Natural mentoring relationships and adolescent health: Evidence from a national study. *American Journal of Public Health* 95(3), 518-524.

DuBois, David L., and Naida Silverthorn. 2005b. Characteristics of natural mentoring relationships and adolescent adjustment: Evidence from a national study. *Journal of Primary Prevention* 26(2), 69-92.

Duncan, Greg J., Johanne Boisjoly, and Kathleen Mullan Harris. 2001. Sibling, peer, neighbor, and schoolmate correlations as indicators of the importance of context for adolescent development. *Demography* 38(3), 437-447.

Elder, Glen H., Jr., Pavalko, Eliza K., and Clipp, Elizabeth C. 1993. *Working with archival data: Studying lives.* Newbury Park, CA: Sage.

Ensher, Ellen A., and Susan E. Murphy. 1997. Effects of race, gender, perceived similarity, and contact on mentor relationships. *Journal of Vocational Behavior* 50(3), 460-481.

Erickson, Lance D., Steve McDonald, and Glen H. Elder Jr. 2009. Informal mentors and education: Complementary or compensatory resources? *Sociology of Education* 82(4), 344-367.

Fruiht, Veronica M., and Laura Wray-Lake. 2013. The role of mentor type and timing in predicting educational attainment. *Journal of Youth and Adolescence* 42(9), 1459-1472.

Goodman-Bacon, Andrew. 2021. Difference-in-differences with variation in treatment timing. *Journal of Econometrics*.

Gowdy, Grace, Daniel P. Miller, and Renée Spencer. 2020. Expanding and deepening our understanding of which young people are most likely to have an informal mentor. *Children and Youth Services Review*, 108, 104490.

Gunderson, Morley, and Philip Oreopolous. 2020. Returns to education in developed countries. In *The Economics of Education*, ed Steve Bradley, and Colin Green. Academic Press.

Granovetter, Mark S. 1973. The strength of weak ties. *American journal of sociology* 78(6), 1360-1380.

Gray-Lobe, Guthrie, Parag A. Pathak, and Christopher R. Walters. 2021. The long-term effects of universal preschool in Boston NBER Working Paper w28756, National Bureau of Economic Research, Cambridge, MA.

Grossman, Jean Baldwin, and Joseph P. Tierney. 1998. Does mentoring work? An impact study of the Big Brothers Big Sisters program. *Evaluation review* 22(3), 403-426.

Harris, Kathleen Mullen, Carolyn Tucker Halpern, Brett C. Haberstick, and Andrew Smolen. 2013. The national longitudinal study of adolescent health (Add Health) sibling pairs data. *Twin Research and Human Genetics* 16(1), 391-398.

Herrera, Carla, Jean Baldwin Grossman, Tina J. Kauh, and Jennifer McMaken. 2011. Mentoring in schools: An impact study of Big Brothers Big Sisters school-based mentoring. *Child development* 82(1), 346-361.

Hurd, Noelle M., Jamie Albright, Audrey Wittrup, Andrea Negrete, and Janelle Billingsley. 2018. Appraisal support from natural mentors, self-worth, and psychological distress: Examining the experiences of underrepresented students transitioning through college. *Journal of Youth and Adolescence* 47*,* 1100-1112.

Hurd, Noelle M., Bernadette Sánchez, Marc A. Zimmerman, and Cleopatra H. Caldwell. 2012. Natural mentors, racial identity, and educational attainment among African American adolescents: Exploring pathways to success. *Child Development* 83(4), 1196-1212.

Hurd, Noelle M., and Robert M. Sellers. 2013. Black adolescents' relationships with natural mentors: Associations with academic engagement via social and emotional development. *Cultural Diversity and Ethnic Minority Psychology* 19(1), 76-85.

Hurd, Noelle M., Joseph S. Tan, and Emily L. Loeb. 2016. Natural mentoring relationships and the adjustment to college among underrepresented students. *American Journal of Community Psychology* 57*,* 330-341.

Hurd, Noelle M., and Marc. A. Zimmerman. 2014. An analysis of natural mentoring relationship profiles and associations with mentees' mental health: Considering links via support from important others. *American Journal of Community Psychology* 53(1-2), 25-36.

Hussar, Bill, Jijun Zhang, Sarah Hein, Ke Wang, Ashley Roberts, Jiashan Cui, Mary Smith, Farrah Bullock Mann, Amy Barner, and Rita Dilig. 2020. The condition of education. NCES 2020-144, National Center for Education Statistics, Washington DC.

Jacinto, Alberto, and Seth Gershenson. 2021. The intergenerational transmission of teaching. *American Educational Research Journal* 58(3), 635-672.

Jackson, Kirabo C. 2018. What do test scores miss? The importance of teacher effects on non–test score outcomes. *Journal of Political Economy*. 126(5), 2072-2107.

Kosse, Fabian, Thomas Deckers, Pia Pinger, Hannah Schildberg-Hörisch, and Armin Falk. 2020. The formation of prosociality: causal evidence on the role of social environment. *Journal of Political Economy* 128(2), 434-467.

Kraft, Matthew A. 2019. Teacher effects on complex cognitive skills and social-emotional competencies. *Journal of Human Resources* 54(1), 1-36.

Miranda-Chan, Thomas, Veronica Fruiht, Valeska Dubon, and Laura Wray-Lake. 2016. The functions and longitudinal outcomes of adolescents' naturally occurring mentorships. *American Journal of Community Psychology* 57(1-2), 47-59.

Mulhern, Christine. 2020. Beyond teachers: Estimating individual guidance counselors' effects on educational attainment. Institute of Education Sciences, Harvard University, Cambridge, MA.

Oreopoulos, Philip, and Kjell G. Salvanes. 2011. Priceless: The nonpecuniary benefits of schooling. *Journal of Economic Perspectives* 25(1), 159-84.

Ozek, Umut. Forthcoming. The effects of middle school remediation on postsecondary success: Regression discontinuity evidence from Florida. *Journal of Public Economics*.

Petek, Nathan, and Nolan Pope. 2016. The multidimensional impact of teachers on students. University of Chicago Working Paper, Chicago, IL.

Raposa, Elizabeth B., Lance D. Erickson, Matthew Hagler, and Jean E. Rhodes. 2018. How economic disadvantage affects the availability and nature of mentoring relationships during the transition to adulthood. *American Journal of Community Psychology* 61(1-2), 191-203.

Resnjanskij, Sven., Jens Ruhose, Simon Wiederhold, and Ludger Woessmann. 2021. Can mentoring alleviate family disadvantage in adolescence? A field experiment to improve labor-market prospects. CESifo Working Paper 8870, Munich, Germany.

Rhodes, Jean E. 2005. A model of youth mentoring. *Handbook of Youth Mentoring* 30-43.

Rhodes, Jean E., and David L. DuBois. 2006. Understanding and facilitating the youth mentoring movement. *Social policy report*, 20(3), 1-20.

Rhodes, Jean E., Lori Ebert, and Karla Fischer. 1992. Natural mentors: An overlooked resource in the social networks of young, African American mothers. *American Journal of Community Psychology* 20, 445-461.

Sánchez, Bernadette, Patricia Esparza, and Yarí Colón. 2008. Natural mentoring under the microscope: An investigation of mentoring relationships and Latino adolescents' academic performance. *Journal of Community Psychology* 36(4), 468-482.

Shin, Huiyoung, and Allison M. Ryan. 2014. Early adolescent friendships and academic adjustment: Examining selection and influence processes with longitudinal social network analysis. *Developmental Psychology* 50(11), 2462.

Stanton-Salazar, Ricardo D., and Sanford M. Dornbusch. 1995. Social capital and the reproduction of inequality: Information networks among Mexican-origin high school students. *Sociology of education* 116-135.

Stanton-Salazar, Ricardo D. and Stephanie Urso Spina. 2003. Informal mentors and role models in the lives of urban mexican-origin adolescents. *Anthropology and Education Quarterly* 34, 231–54.

Van Dam, L., D. Smit, B. Wildschut, S.J.T. Branje, J.E. Rhodes, M. Assink, and G.J.J. Stams. 2018. Does natural mentoring matter? A multilevel meta-analysis on the association between natural mentoring and youth outcomes. *American Journal of Community Psychology* 62(1-2), 203-220.

Zimmerman, Marc A., Jeffrey B. Bingenheimer, and D.E. Behrendt. 2005. Natural mentoring relationships. In *Handbook of Youth Mentoring,* eds David L. DuBois and Michael J. Karcher. Thousand Oaks, CA: Sage Publications.

Tables

Table 1. Sample characteristics

	(1)	(2)	(3)	(4)
	Add Health	HS NM	No NM	p-value
Panel A: Student Characteristics				
Asian/Pac. Isl.	0.03	0.04	0.04	0.61
Black	0.15	0.11	0.17	0.00
Latinx	0.12	0.10	0.15	0.00
white	0.65	0.70	0.59	0.00
Male	0.51	0.48	0.53	0.00
Age in 1994 (years)	15.96	15.51	15.99	0.00
Students with disabilities	0.15	0.09	0.18	0.00
English spoken at home	0.92	0.94	0.89	0.01
US Born	0.92	0.91	0.90	0.44
At least very good health	0.79	0.83	0.75	0.00
Birthweight (oz.)	119.0	119.5	118.5	0.20
Always lived in same home	0.22	0.23	0.22	0.52
Biological father present	0.87	0.91	0.87	0.00
Panel B: Parent Characteristics				
Age in 1994 (years)	41.42	41.47	40.98	0.07
Disabled	0.06	0.05	0.07	0.02
US Born	0.88	0.89	0.84	0.01
Recently accepted welfare	0.10	0.07	0.12	0.00
Neither parent has HS diploma	0.15	0.09	0.20	0.00
HS diploma highest deg. earned	0.24	0.22	0.28	0.00
Attended some college	0.31	0.31	0.29	0.29
Highest degree is bachelors	0.17	0.18	0.15	0.02
Graduate schooling	0.13	0.20	0.09	0.00
Household income in 1994 ($)	45,190	49,595	40,427	0.00
At least very good health	0.48	0.56	0.43	0.00
Smoker in household	0.48	0.44	0.50	0.00
Panel C: Census Tract Characteristics				
Population	5,633	5,892	5,578	0.13
Asian/Pac. Isl.	0.03	0.03	0.03	0.77
Black	0.14	0.12	0.15	0.00
Latinx	0.08	0.07	0.10	0.03
white	0.79	0.82	0.78	0.00
Pop. without HS diploma by 25	0.27	0.25	0.30	0.00
Pop. without coll. degree by 25	0.23	0.24	0.21	0.00
Household income ($)	29,704	31,852	27,803	0.00
Pop. on welfare	0.09	0.08	0.10	0.00
Owner occupied dwelling	0.68	0.69	0.66	0.01
Unemployment rate	0.08	0.07	0.08	0.00
n(students)	18,924	2,185	3,702	

Note. Values represent portion of data unless otherwise noted. P-value compares students with a school-based mentor to those with no mentor. Add Health provided weights are used to achieve national representativeness.

Table 2. Percent of respondents who mention a behavior or domain when asked "what did your mentor do to help you?"

	School-based mentors	Teachers & counselors	Coaches & athletic directors	Rank among all mentor types (1-5)
Panel A: Behaviors of Mentor				
Guidance, advice, shared wisdom	69.5	70.0	66.7	1
Emotional nurturance	38.7	39.5	34.9	4
Practical, tangible help (labor performed)	3.9	3.9	4.0	5
Like a parent, mother figure, father figure	1.9	1.6	3.2	5
Like a friend	5.2	4.5	8.4	4
Role model	14.6	13.8	18.4	2
Spend time together	1.5	1.2	3.2	4
Other	2.0	2.0	1.7	4
Panel B: Domains of Mentoring				
Developmental outcomes (life & self)	64.4	61.4	78.7	2
Family and household	2.5	2.5	2.3	5
Religion	2.3	1.8	5.1	5
Finances, money issues	1.5	1.7	0.7	5
Work, job	9.2	10.4	3.5	4
School, college	33.8	38.4	11.9	1
Time together, leisure, sports, social	11.4	8.3	25.8	2
Other	26.4	26.9	24.2	5
n(students)	2,185	1,761	424	

Note. Other categories include responses that identify a behavior and/or domain of mentoring which does not fit in any of the other categories. The ranking column provides the 1 to 5 ranking of how frequently a behavior or domain is mentioned about school-based mentors relative to other mentor types including family members, friends, non-familial adults, and mentors met after HS (1 being most frequent). See Appendix A for a description of the Add Health response coding scheme.

Table 3. The relationship between school-based natural mentorship and students' short-run education outcomes

	Mean of unmentored students	Student FE	Twin FE	Best friend FE	Romantic partner FE	School FE
		(1)	(2)	(3)	(4)	(5)
Panel A: Annual Cumulative GPA (0-4.0)						
HS Mentor	2.47	0.056**	0.265***	0.200***	0.478***	0.215***
		(0.022)	(0.086)	(0.066)	(0.120)	(0.028)
n(student-years)		14,310	2,872	3,406	1,384	17,595
Panel B: Annual Percent of Courses Failed						
HS Mentor	9.56	-1.696***	-3.360**	-2.243**	-3.360	-2.734***
		(0.501)	(1.422)	(1.016)	(2.349)	(0.497)
n(student-years)		14,310	2,872	3,406	1,384	17,595
Panel C: Annual Year-long Courses Passed						
HS Mentor	5.82	0.167***	0.334***	0.134	0.206	0.224***
		(0.058)	(0.121)	(0.083)	(0.205)	(0.042)
n(student-years)		14,433	2,901	3,425	1,388	17,713
Periods included		All	Post-Freshman Year			
Calendar year FE		Yes	Yes	Yes	Yes	Yes
Grade FE		Yes	Yes	Yes	Yes	Yes
Birth year FE				Yes	Yes	Yes
Controls						Yes

Note. * p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered within individuals for all specifications. Controls include student, family, and neighborhood characteristics. Student variables include race, gender, an interaction term for race and gender, age at wave 1, SWD status, birthweight, general health assessment, whether a student was born in the US, the number of times a student was nominated as a close friend by others, extracurricular participation, and interviewer ratings of student physical and personality-based attractiveness. Family variables include primary caregiver's race, highest education attained, general health, age, US born status, household income in 1994, and whether or not a smoker lives in the household, English is the primary language at home, the biological father was ever present in childhood, and the present household includes both biological parents. Neighborhood variables are based on census tracts and include population, population density, the portion of the population that is white, Black, Asian/Pacific Islander, Latinx, earned a high school diploma by age 25, earned a college degree by age 25, receives welfare, owns the house they occupy, is unemployed, and average household income.

Table 4. The relationship between school-based natural mentorship and students' long-run academic outcomes

	Mean of unmentored students	Twin FE	Best friend FE	Romantic partner FE	School FE
		(1)	(2)	(3)	(4)
Panel A: Attended College					
HS Mentor	0.54	0.154**	0.247***	0.102	0.136***
		(0.065)	(0.056)	(0.084)	(0.017)
n(students)		1,025	1,082	426	6,663
Panel B: Attended a Selective College					
HS Mentor	0.18	0.025	0.090*	0.168	0.079***
		(0.059)	(0.055)	(0.105)	(0.017)
n(students)		1,025	1,082	426	6,663
Panel C: Lifetime Educational Attainment in Years					
HS Mentor	14.53	0.725**	0.913***	0.772*	0.638***
		(0.329)	(0.262)	(0.392)	(0.074)
n(students)		1,025	1,082	426	6,660
Birth year FE			Yes	Yes	Yes
Controls					Yes

Note. * p<0.10, ** p<0.05, *** p<0.01. Controls include student, family, and neighborhood characteristics and the full list of variables can be found in Table 3. Long-term educational outcomes are measured in Wave IV (respondents age 24-32).

Table 5. The relationship between school-based mentorship and students' long-term labor market outcomes

	Mean of unmentored students	Twin FE	Best friend FE	Romantic partner FE	School FE
		(1)	(2)	(3)	(4)
Panel A: Personal Income in USD					
HS Mentor	29,890	5,337	4,324	1,325	2,141
		(5,910)	(4,823)	(5,306)	(1,638)
n(students)		1,194	1,366	540	7,225
Panel B: Employed 10+ hours/week					
HS Mentor	0.77	0.060	-0.000	-0.060	0.013
		(0.061)	(0.050)	(0.083)	(0.016)
n(students)		1,148	1,354	536	7,187
Birth year FE			Yes	Yes	Yes
Controls					Yes

Note. * p<0.10, ** p<0.05, *** p<0.01. Controls include student, family, and neighborhood characteristics and the full list of variables can be found in Table 3. Personal income and employed 10+ hours per week are measured in Wave IV (respondents age 24-32) and in the case of missing values Wave III (respondents age 18-26) values are used.

Table 6. Student and school correlates of having a school-based natural mentor

	Bivariate	Multivariate
Panel A: Student Characteristics		
SWD status	-0.056***	-0.048***
	(0.012)	(0.011)
English spoken at home	0.037***	0.002
	(0.012)	(0.013)
SES (SD units)	0.029***	0.013**
	(0.005)	(0.006)
White male	0.014	-0.009
	(0.012)	(0.012)
Black female	-0.035***	-0.119**
	(0.011)	(0.050)
Black male	-0.042***	-0.126**
	(0.013)	(0.052)
Asian/Pac. Isl. female	-0.004	-0.077
	(0.033)	(0.058)
Asian/Pac. Isl. male	0.034	-0.035
	(0.037)	(0.050)
Latina	-0.045***	-0.114**
	(0.012)	(0.051)
Latino	-0.026*	-0.098*
	(0.014)	(0.051)
Extraversion (SDs)	0.005	-0.004
	(0.004)	(0.004)
Neuroticism (SDs)	-0.010**	-0.002
	(0.004)	(0.004)
Agreeableness (SDs)	0.021***	0.010***
	(0.004)	(0.004)
Conscientiousness (SDs)	-0.004	-0.007
	(0.004)	(0.004)
Openness (SDs)	0.029***	0.020***
	(0.004)	(0.004)
Very close to mom (binary)	-0.002	0.004
	(0.007)	(0.007)
Panel B: School Characteristics		
Enrollment (100 students)	-0.001	0.000
	(0.001)	(0.001)
Class size	-0.004***	-0.003**
	(0.001)	(0.001)

Number of student clubs	0.002	0.003
	(0.003)	(0.003)
Number of student sports	0.009	0.019**
	(0.010)	(0.009)
Student sense of belonging (SDs)	0.017**	0.017***
	(0.006)	(0.005)
Suburban setting	0.001	0.004
	(0.018)	(0.011)
Rural setting	-0.007	0.005
	(0.015)	(0.012)
Observations	9,955	

Note. * p<0.10, ** p<0.05, *** p<0.01. Suburban and rural setting indicators are relative to an urban default category. SWD status refers to students with disabilities. Belonging refers to the standardized jackknife mean of school level average responses to survey items asking about student perceptions of belonging/safety/trust at school, see Appendix D for more details.

Figures

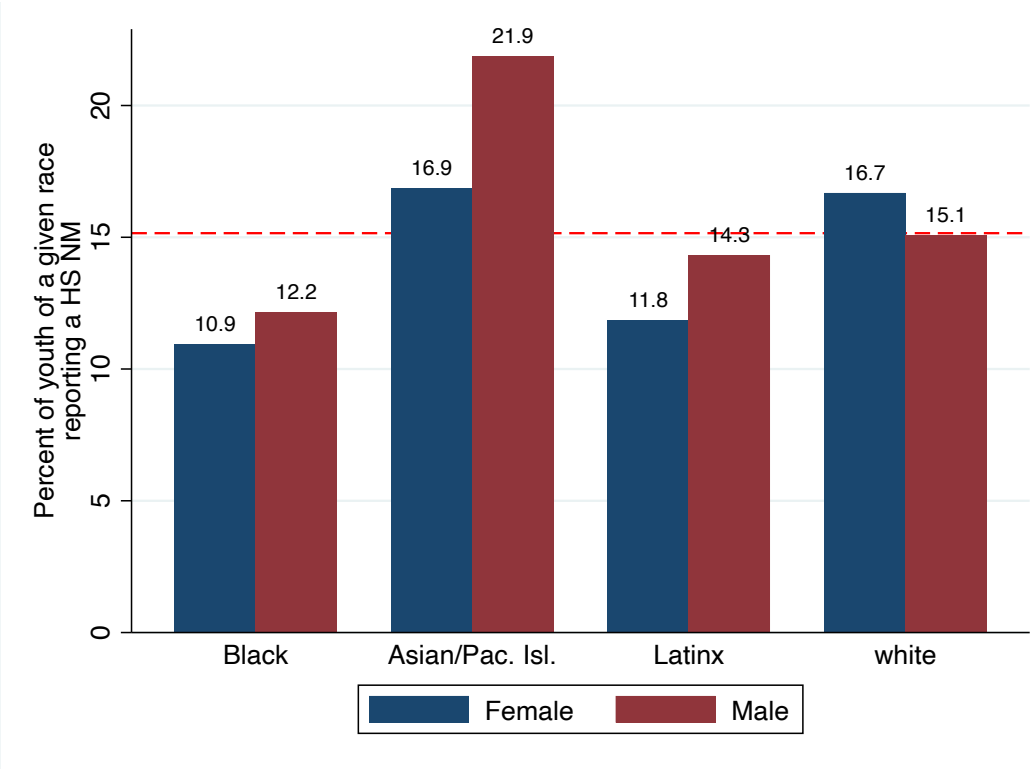


Figure 1. The frequency of school-based natural mentor relationships by race and gender

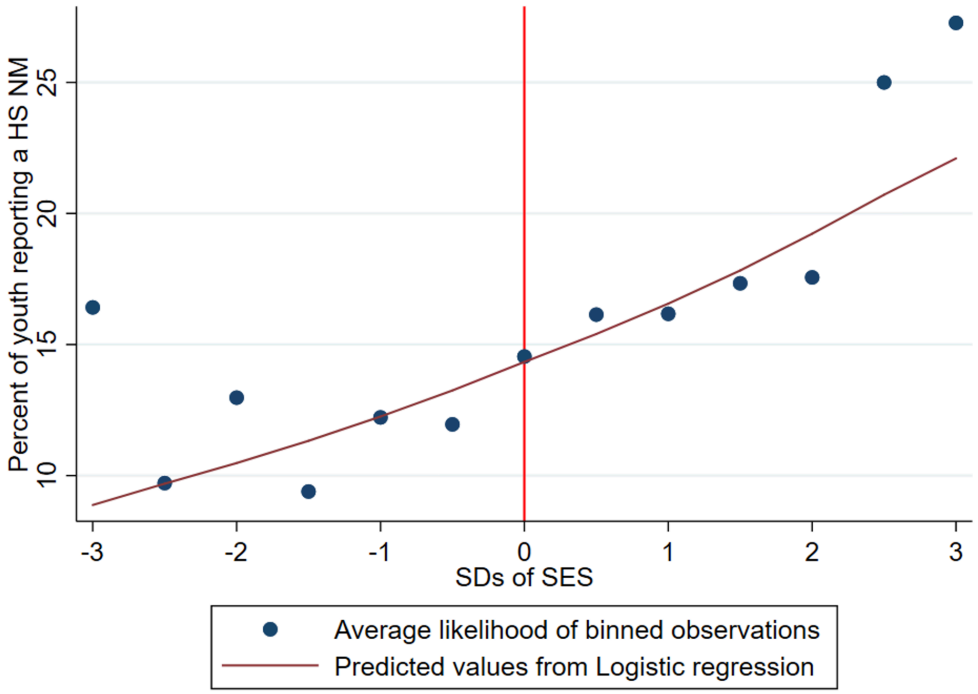


Figure 2. The likelihood of identifying a school-based natural mentor based on socioeconomic status

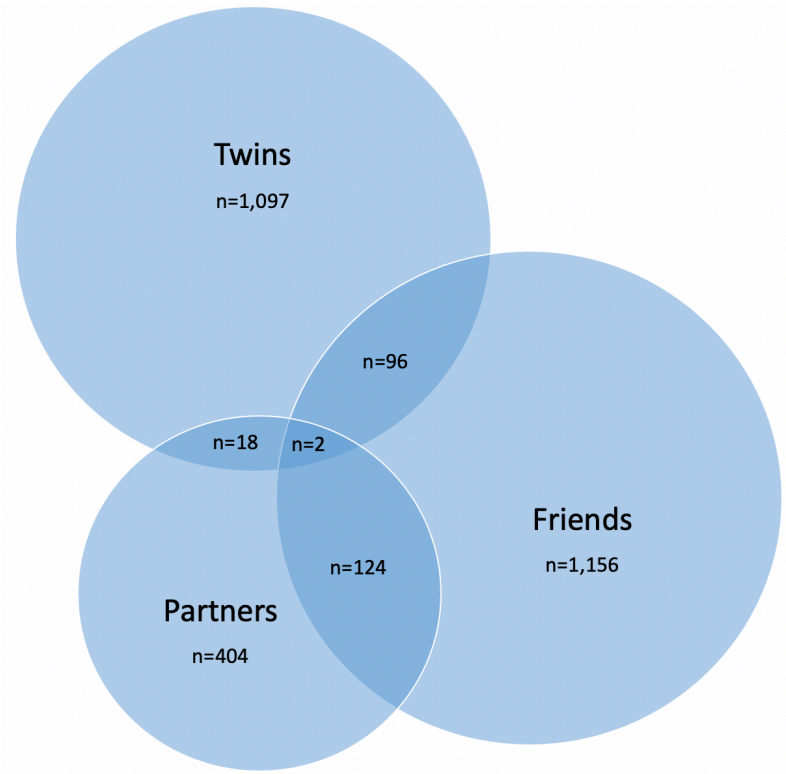


Figure 3. Sample sizes and overlap for analytic samples in twins, friends, and partner FE samples

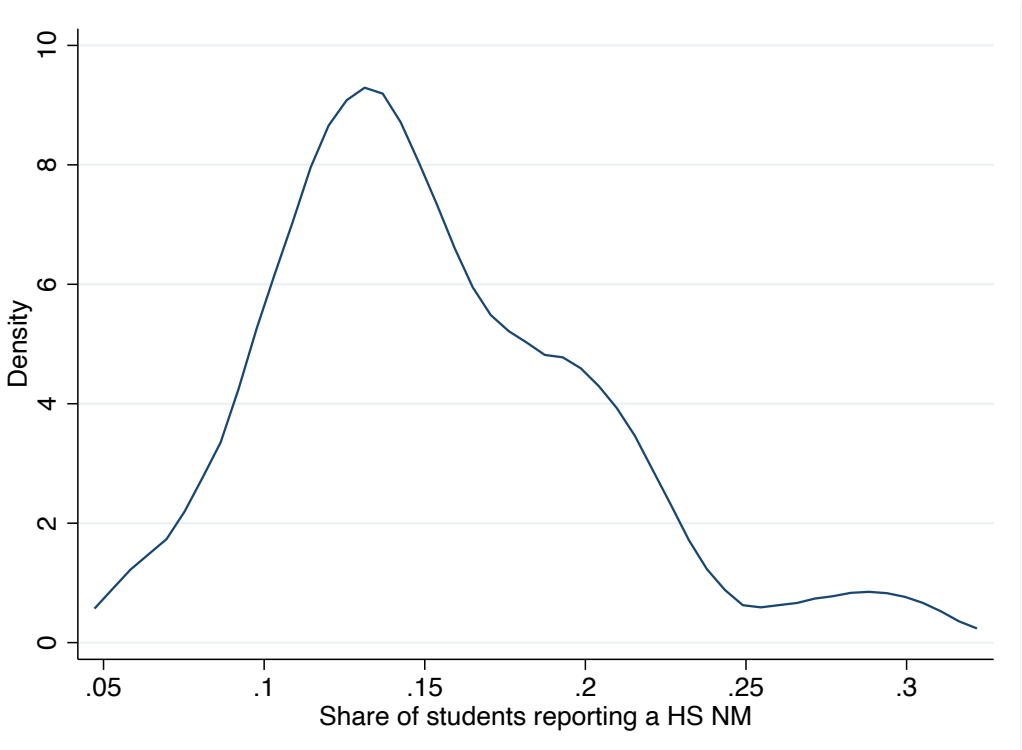


Figure 4. Kernel density of the portion of students in a school who identify a school-based mentor among schools with at least 10 respondents (n=85)

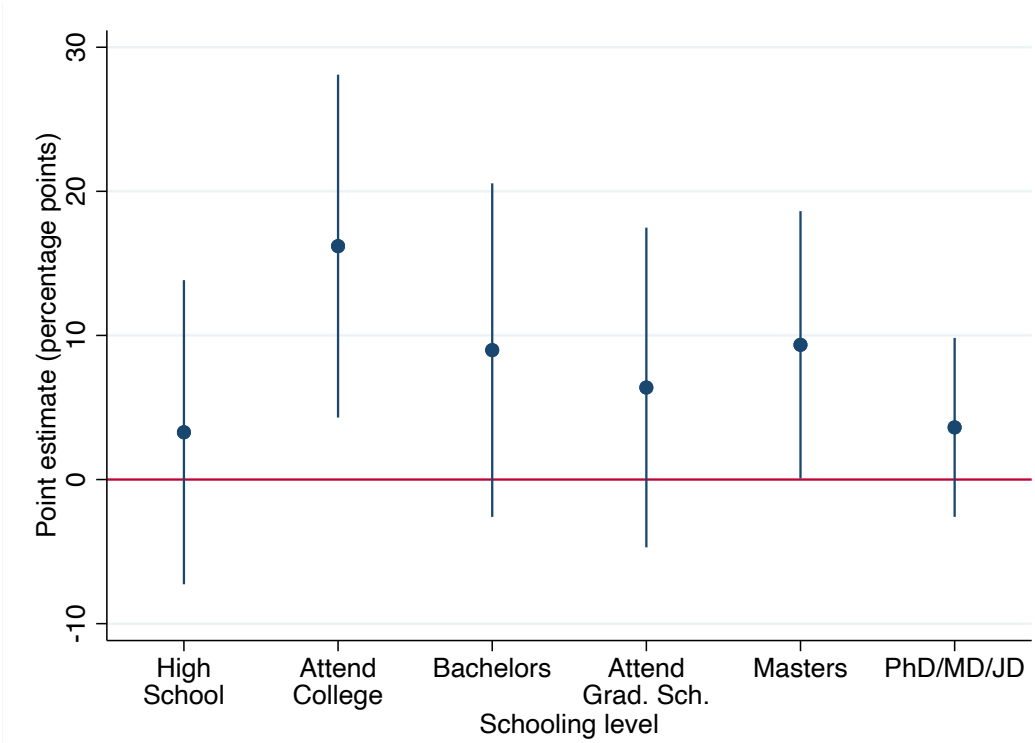
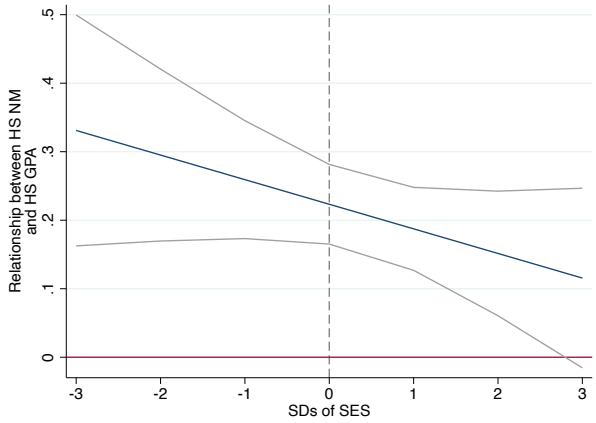
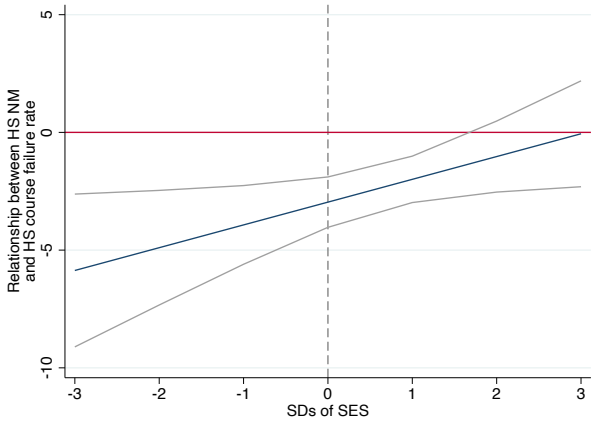


Figure 5. Point estimates from a distribution regression of the association between identifying a school-based natural mentor and educational attainment

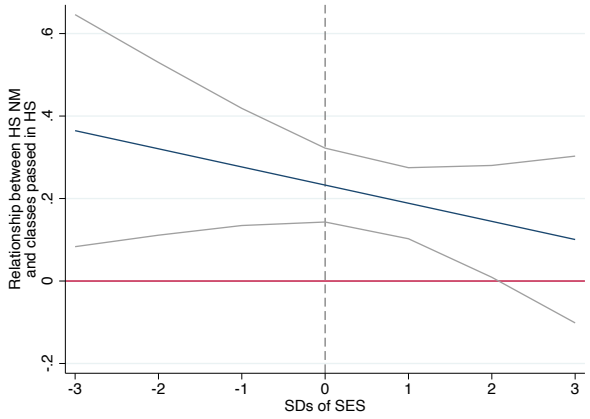
Panel A: Annual high school GPA



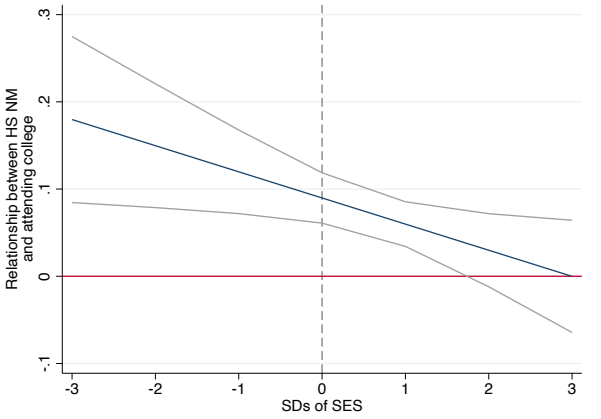
Panel B: Annual rate of course failure



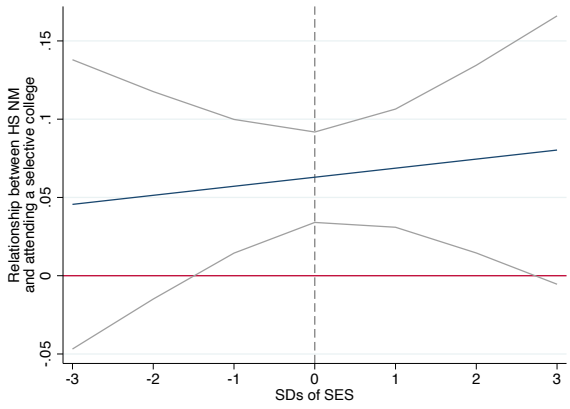
Panel C: Annual year-length courses passed



Panel D: College Attendance



Panel E: Attending a college with a selective admissions process



Panel F: Lifetime educational attainment

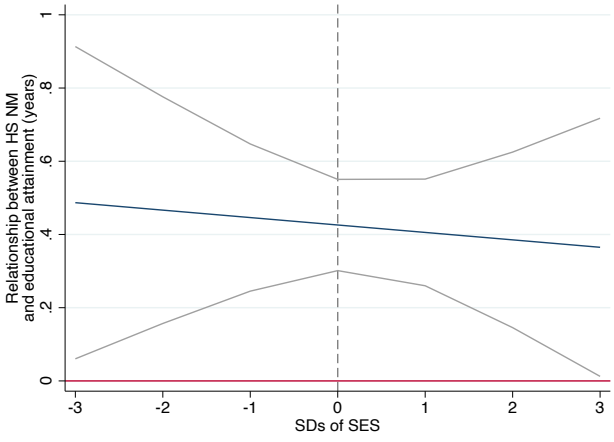


Figure 6. Linear estimates of heterogeneity in the relationship between having a school-based natural mentor and outcomes based on student SE

Appendix A

The following excerpt is taken from the Add Health Wave III codebook:

At Wave III, Add Health respondents were asked if they had a mentor. Respondents who reported a mentor were asked about their mentor's functional role by responding to an open-ended question, "What did [your mentor] do to help you?" A coding scheme was inductively developed from their responses based on a group of randomly selected cases. All code development work was done using an approximate 10% random sample (N=1048) of responses.

Responses to the mentor item were divided into 12 sets of 1,000 and one set of 489 responded. Coding was done by two researchers and each one was given 550 responses, in which 100 of the same responses were given to both researchers to calculate kappas. This resulted in 10 percent of the cases being coded by both researchers, where were used to calculate inter-rater reliability. This method to calculate Kappa is reviewed in Elder, Pavalko, Clip (1993). Intermediate kappa's were calculated within each set of 100 using the 100 cases given to both researchers and for each category (variable). When all responses had been assigned codes, a pooled Kappa was calculated for all the items both researchers coded. Kappas ranged from .79 to .96 for [all behaviors and domains], indicating a high degree of coder agreement (Elder et al., 1993).

The responses were coded into categories that described the behavior of the mentor and the domain of mentoring. The categories were not mutually exclusive—an individual's response would be coded in more than one category. Each element of the response was coded for both behavior and domain.

Appendix Table A1. Characteristics for different peer-pair analytic samples

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Twins	Non-twins	p-value	Friends	Non-Friends	p-value	Partners	Non-partners	p-value
Panel A: Student Characteristics									
Asian/Pac. Isl.	0.03	0.03	0.00	0.09	0.03	0.00	0.08	0.03	0.17
Black	0.25	0.15	0.06	0.16	0.15	0.00	0.13	0.15	0.00
Latinx	0.16	0.12	0.27	0.13	0.13	0.00	0.16	0.12	0.78
white	0.53	0.65	0.01	0.58	0.64	0.00	0.59	0.65	0.00
Male	0.50	0.51	0.59	0.38	0.52	0.00	0.50	0.51	0.88
Age in 1994 (years)	16.03	15.97	0.38	16.12	15.98	0.39	16.56	15.95	0.00
Students with disabilities	0.14	0.15	0.56	0.07	0.15	0.00	0.06	0.15	0.00
English spoken at home	0.92	0.92	0.02	0.91	0.92	0.01	0.92	0.92	0.01
US Born	0.93	0.92	0.00	0.90	0.92	0.13	0.92	0.92	0.03
At least very good health	0.82	0.79	0.00	0.81	0.78	0.02	0.82	0.79	0.03
Birthweight (oz.)	92.10	119.41	0.00	117.80	118.98	0.15	119.11	118.97	0.02
Always lived in same home	0.24	0.22	0.00	0.26	0.22	0.00	0.25	0.22	0.17
Biological father present	0.87	0.87	0.00	0.90	0.87	0.00	0.90	0.87	0.00
Panel B: Parent Characteristics									
Age in 1994 (years)	42.40	41.41	0.00	42.21	41.43	0.14	41.78	41.42	0.55
Disabled	0.06	0.06	0.03	0.04	0.06	0.00	0.06	0.06	0.50
US Born	0.86	0.88	0.05	0.83	0.88	0.67	0.85	0.88	0.24
Recently accepted welfare	0.10	0.10	0.08	0.06	0.10	0.00	0.06	0.10	0.00
Neither parent has HS diploma	0.16	0.15	0.59	0.12	0.15	0.00	0.11	0.15	0.00
HS diploma highest deg. earned	0.17	0.24	0.00	0.22	0.24	0.82	0.22	0.24	0.94
Attended some college	0.31	0.31	0.64	0.30	0.31	0.54	0.30	0.31	0.80
Highest degree is bachelors	0.21	0.17	0.00	0.19	0.17	0.18	0.23	0.17	0.00
Graduate schooling	0.14	0.13	0.02	0.17	0.13	0.00	0.15	0.13	0.81
Household income in 1994 ($)	47,446	45,187	0.06	49,251	44,817	0.02	50,620	45,032	0.05
At least very good health	0.49	0.48	0.09	0.51	0.48	0.00	0.48	0.48	0.21

Smoker in household	0.44	0.48	0.00	0.44	0.48	0.33	0.44	0.48	0.53
Panel C: Census Tract Characteristics									
Population	5,823	5,640	0.00	5,284	5,665	0.00	5,213	5,650	0.02
Asian/Pac. Isl.	0.04	0.03	0.00	0.06	0.03	0.00	0.06	0.03	0.06
Black	0.19	0.14	0.47	0.14	0.14	0.00	0.12	0.14	0.00
Latinx	0.11	0.08	0.22	0.10	0.08	0.01	0.11	0.08	0.82
white	0.72	0.79	0.63	0.75	0.79	0.00	0.77	0.79	0.00
Pop. without HS diploma by 25	0.27	0.27	0.00	0.28	0.27	0.09	0.28	0.27	0.81
Pop. without coll. degree by 25	0.24	0.23	0.00	0.22	0.23	0.27	0.22	0.23	0.13
Household income ($)	31,158	29,696	0.00	32,477	29,608	0.00	32,321	29,694	0.00
Pop. on welfare	0.09	0.09	0.00	0.09	0.09	0.00	0.08	0.09	0.00
Pop. that owns dwelling	0.67	0.68	0.01	0.72	0.67	0.00	0.72	0.68	0.00
Unemployment rate	0.08	0.08	0.02	0.07	0.08	0.01	0.07	0.08	0.00
n(students)	1,209	17,636		1,384	17,551		554	18,377	

Note. Values are shares unless otherwise noted. Add health weights are used to achieve national representativeness.

Appendix Table A2. Summary statistics for outcomes of interest

Outcome	Outcome type	Mean	Count
Annual GPA (0-4.0)	Measured	2.63	44,554
Annual percent of courses failed	Measured	7.53	44554
Annual semester length classes passed	Measured	5.96	44,871
Years of Education	Self-reported	14.99	14,796
HS completion*	Self-reported	0.83	14,800
Some college*	Self-reported	0.64	14,800
College degree*	Self-reported	0.30	14,800
Grad school*	Self-reported	0.08	14,800
Working 10+ hours/wk*	Self-reported	0.77	16,031
Personal inc. ($)	Self-reported	31,494	16,528

Note. *Indicates binary variable. Measured outcomes are taken from official high school transcripts; Self-reported outcomes are based on Wave IV survey responses or Wave III when missing Wave IV. We achieve nationally representative estimates using Add Health provided weights.

Appendix Table A3. The relationship between natural mentorship and short run academic outcomes for students from older and younger cohorts

	Student FE	Twin FE	Best friend FE	Romantic partner FE	School FE
	(1)	(2)	(3)	(4)	(5)
Panel A: Annual GPA (0-4.0)					
HS Mentor	0.060*	0.363***	0.032	0.509***	0.220***
	(0.034)	(0.132)	(0.089)	(0.178)	(0.041)
Young (age<median)		0.305	0.151	0.368***	-0.038
		(0.206)	(0.117)	(0.112)	(0.055)
Young*HS NM	-0.002	-0.155	0.332**	0.000	-0.005
	(0.043)	(0.174)	(0.131)	(0.232)	(0.055)
n(student-years)	17,840	2,869	3,409	1,384	17,595
Panel B: Annual Percent of Courses Failed					
HS Mentor	-1.133	-3.169	-0.269	-2.671	-2.298***
	(0.730)	(1.966)	(1.286)	(3.806)	(0.746)
Young (age<median)		-4.399	0.431	-2.691	2.039*
		(3.752)	(2.390)	(1.777)	(1.069)
Young*HS NM	-0.720	-0.830	-4.064**	-3.007	-0.920
	(0.950)	(2.816)	(2.005)	(4.205)	(1.006)
n(student-years)	17,840	2,869	3,409	1,384	17,595
Annual Year-length Courses Passed					
HS Mentor	0.073	0.437***	0.012	-0.020	0.155**
	(0.078)	(0.155)	(0.099)	(0.302)	(0.060)
Young (age<median)		0.461	0.0875	0.094	-0.181**
		(0.295)	(0.174)	(0.160)	(0.089)
Young*HS NM	0.173	-0.179	0.214	0.637*	0.134
	(0.109)	(0.246)	(0.171)	(0.374)	(0.084)
n(student-years)	17,969	2,898	3,428	1,388	17,713
Periods included	All		Post-Freshman Year		
Calendar year FE	Yes	Yes	Yes	Yes	Yes
Grade FE	Yes	Yes	Yes	Yes	Yes
Birth year FE			Yes	Yes	Yes
Controls					Yes

Note. Controls include student, family, and neighborhood characteristics and the full list of variables can be found in Table 3. The younger cohort consists of students below the median age.

Appendix Table A4. The relationship between natural mentorship and long run academic outcomes for students from older and younger cohorts

	Twin FE	Best friend FE	Romantic partner FE	School FE
	(1)	(2)	(3)	(4)
Panel A: Attended College				
HS Mentor	-0.0664	0.173**	0.090	0.124***
	(0.093)	(0.077)	(0.107)	(0.024)
Young (age<median)	-0.128*	0.005	0.060	0.000
	(0.066)	(0.096)	(0.099)	(0.032)
Young*HS NM	0.375***	0.141	0.002	0.024
	(0.127)	(0.111)	(0.179)	(0.033)
n(students)	1,025	1,082	426	6,663
Panel B: Attended a Selective College				
HS Mentor	-0.076	0.015	0.211	0.078***
	(0.095)	(0.077)	(0.138)	(0.026)
Young (age<median)	-0.188	0.036	0.324***	-0.032
	(0.159)	(0.076)	(0.113)	(0.028)
Young*HS NM	0.170	0.132	-0.132	0.003
	(0.121)	(0.109)	(0.212)	(0.033)
n(students)	1,025	1,082	426	6,369
Panel C: Lifetime Educational Attainment in Years				
HS Mentor	0.004	0.531	0.854*	0.567***
	(0.560)	(0.359)	(0.492)	(0.114)
Young (age<median)	0.339	0.345	0.741	0.015
	(0.650)	(0.436)	(0.453)	(0.142)
Young*HS NM	1.224*	0.681	-0.328	0.133
	(0.688)	(0.512)	(0.857)	(0.148)
n(students)	1,025	1,082	426	6,366
Birth Year FE		Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Note. * p<0.10, ** p<0.05, *** p<0.01. Controls include student, family, and neighborhood characteristics and the full list of variables can be found in Table 3. The younger cohort consists of students below the median age.

Appendix Table A5. Heterogeneity tests for short- and long-run academic outcomes by SES

Panel A: High School Transcript Outcomes

	Annual HS GPA (0-4.0)			Annual HS Fail %			Annual year-long classes passed		
K12 Mentor	0.215***	0.223***	0.250***	-2.734***	-2.962***	-3.987***	0.224***	0.233***	0.297***
	(0.028)	(0.030)	(0.066)	(0.497)	(0.546)	(1.292)	(0.042)	(0.046)	(0.110)
SES measure		0.092*			-2.503**			0.226***	
		(0.051)			(1.082)			(0.084)	
K12*SES		-0.036			0.968**			-0.044	
		(0.024)			(0.439)			(0.039)	
SES quintile 2			0.084			-0.651			0.037
			(0.087)			(1.598)			(0.136)
SES quintile 3			-0.075			1.957			-0.099
			(0.083)			(1.501)			(0.129)
SES quintile 4			-0.066			1.852			-0.160
			(0.078)			(1.387)			(0.120)
SES quintile 5			-0.072			2.127			-0.082
			(0.074)			(1.324)			(0.117)
n(students)			17,595					17,713	

Panel B: Long-term Educational Outcomes

	Attended College			Attended a Selective College			Educational Attainment in Years		
K12 Mentor	0.136***	0.141***	0.194***	0.079***	0.076***	0.052	0.638***	0.629***	0.702***
	(0.017)	(0.018)	(0.045)	(0.017)	(0.017)	(0.035)	(0.074)	(0.076)	(0.176)
SES measure		0.010***			0.073***			0.611***	
		(0.031)			(0.023)			(0.123)	
K12*SES		-0.026**			0.007			-0.004	
		(0.013)			(0.014)			(0.063)	
SES quintile 2			-0.049			0.039			-0.083
			(0.056)			(0.048)			(0.224)
SES quintile 3			-0.037			0.023			-0.038
			(0.055)			(0.047)			(0.219)

SES quintile 4	-0.096*	0.011	-0.116
	(0.051)	(0.046)	(0.214)
SES quintile 5	-0.077*	0.052	-0.066
	(0.047)	(0.045)	(0.201)
n(students)	6,663		6,660
Primary FE	School FE		
Controls	Yes		

Note. *p<.1, **p<.05, ***p<0.1. All models control for student, family, and neighborhood characteristics. The full list of control variables can be found in Table 3. All models are based on our school FE specification.

Appendix Table A6. Heterogeneity tests for educational outcomes at the intersection of race and gender

Panel A: High School Transcript Outcomes (annual measures)

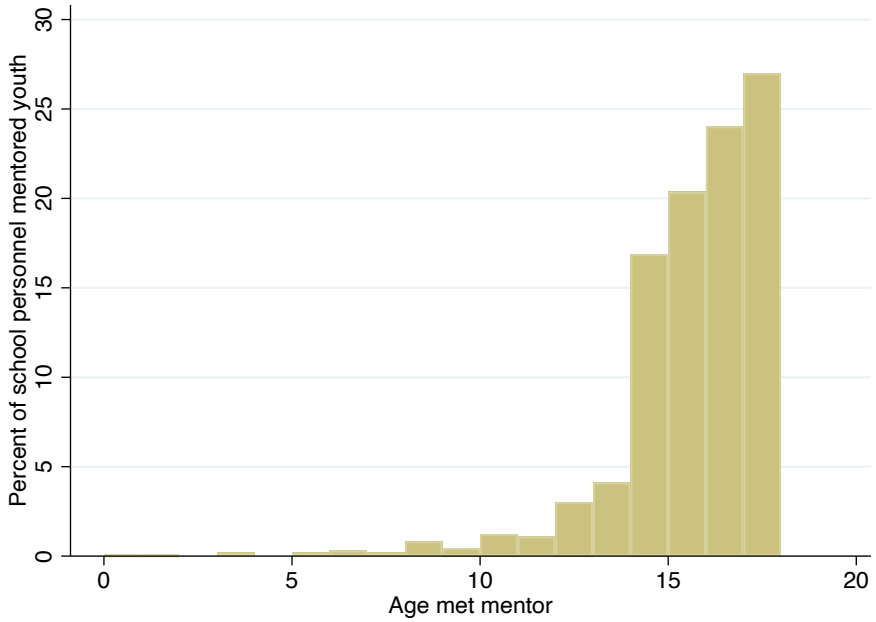
	GPA (0-4)		Course Failure %		Year-long classes passed	
K12 Mentor	0.215***	0.171***	-2.734***	-1.387**	0.224***	0.113**
	(0.028)	(0.041)	(0.497)	(0.648)	(0.041)	(0.057)
K12*white male		0.048		-1.767**		0.104
		(0.055)		(0.810)		(0.074)
K12*Black female		0.054		-1.049		0.399***
		(0.100)		(1.525)		(0.148)
K12*Black male		-0.004		-2.033		-0.029
		(0.104)		(2.210)		(0.187)
K12*Asian female		-0.057		-0.303		0.083
		(0.136)		(1.735)		(0.177)
K12*Asian male		0.351***		-6.097***		0.408**
		(0.131)		(1.799)		(0.168)
K12*Latina		0.087		-1.707		0.134
		(0.089)		(1.524)		(0.143)
K12*Latino		-0.030		-1.436		0.189
		(0.099)		(1.818)		(0.145)
n(students)			17,595		17,713	

Panel B: Long-term Educational Outcomes

	Attended College		Attended a Selective College		Educational Attainment (Yrs.)	
K12 Mentor	0.136***	0.099***	0.079***	0.053**	0.638***	0.512***
	(0.017)	(0.024)	(0.017)	(0.027)	(0.074)	(0.113)
K12*white male		0.091***		0.069*		0.229
		(0.032)		(0.038)		(0.149)
K12*Black female		0.038		0.048		0.0141
		(0.046)		(0.059)		(0.236)

K12*Black male	0.022	-0.076	-0.128
	(0.062)	(0.057)	(0.262)
K12*Asian female	-0.184**	-0.114	-0.155
	(0.085)	(0.097)	(0.442)
K12*Asian male	0.121*	0.112	0.610
	(0.067)	(0.109)	(0.431)
K12*Latina	-0.006	-0.053	0.081
	(0.057)	(0.061)	(0.262)
K12*Latino	0.065	0.065	0.252
	(0.062)	(0.057)	(0.244)
n(students)	6,663		6,660
Model	School FE		
Controls	Yes		

Note. *p<.1, **p<.05, ***p<0.01. All models control for student, family, and neighborhood characteristics. The full list of control variables can be found in Table 3.



Appendix Figure A1. Histogram of the age when a respondent claims to have met a school-based natural mentor

Appendix B

Identifying romantic partner pairs. We make iterative passes through romantic partner nominations by moving from the first to the third romantic partner nominations in a similar fashion to the Gale-Shapley stable marriage problem. First, we exclude students missing data regarding natural mentorship. Next, we conduct our iterative process. Consider student A who nominates students 1, 2, and 3. In our process, we first consider student 1's first nomination. If this results in a matched pair between student A and student 1, then a unique romantic pair ID is assigned to the pair and both students are removed from the sample. Next, the iterative process would begin again with the remaining unreplaced, unmatched sample. If a pair is not created, we then consider if student A is student 1's second nomination and so on. We repeat this process for all of student A's nominated romantic partners in Wave I before repeating the process with student A's romantic partner nominations from Wave II. Whenever a requited pair is established, both students are removed from the sample before the next iteration of matching occurs. Thus, student A may be matched and removed from the sample before an alternative match involving student A could have occurred. There are a few instances where ties occur, in which case we randomly select a pair. Importantly, our sample of romantic pairs is not the unique solution of pairs requited romantic partnerships.

Appendix C

Stacked DD estimator. Issues arise in two-way fixed estimators when treated groups are used as comparison groups in the presence of heterogeneous effects. We test whether our Student FE estimates are robust to restricting our comparison groups to only include students who never receive treatment (i.e., identify a HS natural mentor). We do this by constructing a "stacked" dataset where each stack includes students who are either never treated or for whom treatment began in year *t*=2 of high school (e.g. Cengiz et al, 2019; Baker et al., 2021). We create an indicator variable identifying observations in the stack and then repeat this process for all years (*t* = 3-6) of high school in our data. We do not include students whose treatment onset is in period 1 (freshman year) to avoid using these "always-treated" students to construct a second-difference. Finally, we append these stacks back together in a single data set and estimate the following model:

$$y_{it} = \beta_1 NM_{it}^{Sch} + \varphi_i + \gamma_t + \lambda_g + \delta_s + \beta_2(\varphi_i * \delta_s) + \beta_3(\gamma_t * \delta_s) + \beta_4(\lambda_g * \delta_s) + \varepsilon_{it}$$

This is an augmentation of Model (2) to include stack fixed effects, δ_s, as well as separate terms interacting stack indicators and individual, grade, and calendar indicators, respectively. We cluster standard errors by individual to allow for errors to be correlated over time and across stack.

Table C1. The relationship between school-based natural mentorship and students' short-run education outcomes using a stacked DD estimator

	Mean of unmentored students	Student FE	Stacked Model
		(1)	(2)
	Panel A: Annual Cumulative GPA (0-4.0)		
HS Mentor	2.47	0.056**	0.060***
		(0.022)	(0.020)
n(student-years)		14,315	56,212
	Panel B: Annual Percent of Courses Failed		
HS Mentor	9.56	-1.694***	-1.842***
		(0.501)	(0.446)
n(student-years)		14,315	56,212
	Panel C: Annual Year-long Courses Passed		
HS Mentor	5.82	0.163***	0.181***
		(0.058)	(0.053)
n(student-years)		14,436	56,730
Calendar FE		Yes	Yes
Grade FE		Yes	Yes

Note. * p<0.10, ** p<0.05, *** p<0.01. We include in these samples students who never received treatment and those who became treated after freshman year.

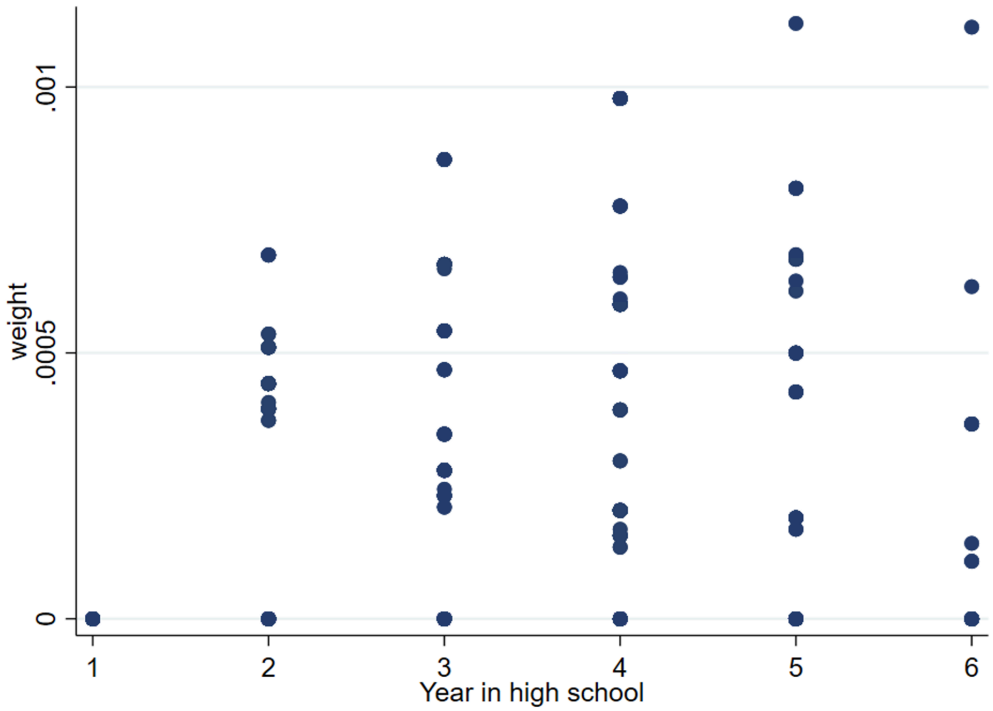


Figure C1. Weights used in Table 4 Column 1 student FE specifications with 0 weight for never-treated units

Appendix D

We create our school-level estimates of students' sense of belonging using a standardized jackknife average of the following five item Likert response survey questions from Wave I:

H1ED18) How often do you have issues getting along with other students? {never; just a few times; about once a week; almost everyday; everyday}
H1ED19) You feel close to people at your school. {strongly agree; agree; neither agree nor disagree; disagree; strongly disagree}
H1ED20) You feel like you are part of your school. {same as above}
H1ED21) Students at your school are prejudiced. {same as above}
H1ED22) You are happy to be at your school. {same as above}
H1ED23) The teachers at your school treat students fairly. {same as above}
H1ED24) You feel safe at your school. {same as above}

We reverse code all items except H1ED21 and H1ED22 such that higher values indicate a greater sense of belonging. Next, we conduct a principal components analysis across these 7 items and take the first component. We standardize this student-level measure of belonging to have a mean of zero and unit variance. We then estimate the leave-one-out school level averages as shown in model 1 below:

$$Belonging_{i,s} = \frac{1}{n_s - 1} \sum_{j=1,\, j \neq i}^{n_s} x_{j,s}$$

Where $Belonging_{i,s}$ is the jackknife estimate of belonging for student *i* in school *s* and $x_{j,s}$ is the first component of the PCA on the 7 belonging items mentioned above for student *j* in school *s.* For students who had not yet entered high school by Wave I, we use the Wave I school-wide belonging average. To create school level estimates of belonging, we average the belonging measure above across all students in a school and then standardize these averages across schools. The resulting school level belonging has mean of 0 and variance of 1.