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From "First in Family" to "First to Finish": Does College Graduation Vary by How First-Generation College Status is Defined?

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From "First in Family" to "First to Finish":

Does College Graduation Vary by How First-Generation College Status is Defined?

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Abstract

The purpose of our study was to examine the relationship between alternative definitions of first-generation college students (FGCSs) and graduation from 2- and 4-year colleges. Using Education Longitudinal Study of 2002 data, we constructed eight definitions of FGCSs based on parents' highest level of education and the number of parents at that level. We identified a series of regression models to explain whether the student earned a 2- or 4-year degree, and focused on the association between different definitions of FGCSs and student success. We estimated both unconditional models for all 10th graders in the sample as well as conditional models for only those who enrolled in college, to see if FGCS status mattered even for those who overcame the access hurdle. Furthermore, we examined the relationship between FGCSs and the pathways to college completion for students who have initially enrolled in a 2- versus 4-year colleges.

Introduction

Higher education researchers, administrators, and policymakers are increasingly interested in understanding why some students succeed in college and others do not. Recently, policy conversations have shifted from expanding access to increasing completion among students who have already enrolled (Ma, Pender, & Welch, 2016). Several national organizations, such as Complete College America and the Lumina Foundation, have made college completion a priority, with Lumina establishing a specific goal of 60% of adults with a degree or certificate by 2025 (Lumina, 2017). This college completion agenda recognizes that although access to higher education is important, so is increasing degree attainment rates, especially for underserved student populations (CCA, 2014; Lumina Foundation, 2017).

One underserved group that has received significant attention as part of the completion agenda is first-generation college students (FGCS). Data has consistently shown that, on average, students whose parents did not attend college are not only less likely to enroll in college (Choy, 2001; Ward, Siegel, & Davenport, 2012), but are also less likely to graduate even if they do enroll (Choy; Engle & Tinto, 2008). However, FGCS often have other characteristics associated with lower rates of college enrollment and graduation, such as coming from lower-income homes and beginning college with less academic preparation (Engle, 2007; Nguyen & Nguyen, 2018; Nunez & Cuccaro-Alamin, 1998; Warburton, Bugarin, & Nunez, 2001). FGCS also differ from their non-FGCS peers in terms of on-campus experiences, with FGCS more likely to enroll part-time and less likely to participate in high-impact practices associated with college success (Billson & Terry, 1982; Chen & Carroll, 2005; Pascarella, Pierson, Wolniak, & Terenzini, 2004). Viewed differently, researchers have called attention to the ways in which many colleges' structures, policies, and practices presume students arrive with the social skills and "college

knowledge" necessary to navigate the college environment, presumptions that disadvantage FGCS (Nguyen & Nguyen, 2018; Rosenbaum, Deil-Amen, & Person, 2006). Thus, it remains difficult to distinguish the effects of parental education from the effects of other characteristics on outcomes for FGCS and non-FGCS students.

Complicating our understanding of how and why FGCS tend to be less successful than their peers is a lack of consensus on how to define FGCS. First-generation college status can vary depending on who is counted as a parent, how many of their parents did not attend college, whether parents started or completed college, and the type of institution attended. Some researchers have defined FGCS as neither parent having earned a bachelor's degree, which is consistent with the language in the U.S. government's Higher Education Act (Auclair et al., 2008; Spiegler & Bednarek, 2013; U.S. Department of Education, 1998). Other studies have categorized FGCS as only students whose parents never attended college (Auclair et al.; Spiegler & Bednarek). Further, there are inconsistencies in how first-generation is defined on campuses with programs for this population of students (Ward, Seigel, & Davenport, 2012). A recent national landscape report on first-generation college student programs in the country revealed more than six different definitions of first-generation used in practice today (NASPA, 2018).

Inconsistencies in definitions of FGCS and reliance on simple binary constructions are problematic for several reasons. It is difficult to generalize across research using vastly different samples, and we know less about certain key groups, such as students enrolled in two-year colleges whose parents have associate's degrees. This also limits our understanding of the exact nature of the relationship between parental education and college outcomes. For example, if social and cultural capital are the mechanisms through which FGCS status affects college success, as often argued (Lohfink & Paulsen, 2005; Padgett, Johnson, & Pascarella, 2012;

Pascarella, Pierson, Wolniak, & Terenzini, 2004; Peralta & Klonowski, 2017), then simple binary definitions might overlook the effects of differences in the amounts of these resources. In policy and practice, definitions of FGCS can affect who receives and does not receive services and interventions designed to improve their success in college. Students with only one non-college educated parent are often not considered to be FGCS, and yet they may be at a similar disadvantage as students with two parents without a college education. Clearly, how we define FGCS can have significant implications, especially if we do not understand the differences between alternative definitions.

Prior research also indicates the need for a granular analysis of student outcomes under alternative definitions of FGCS that consider a variety of differences in parental education and in student pathways. Recent work suggests that definition matters for understanding FGCS' access to higher education (Toutkoushian, Stollberg, & Slaton, 2018). The few studies that have used multiple levels of parental education or considered the number of college-educated parents found differences in graduation depending on whether parents had no college, some college, or a bachelor's degree (e.g., Redford & Mulvaney Hover, 2017), and between those with one versus two parents with bachelor's degrees (e.g. Ishitani, 2003, 2006). Yet only a few such studies exist; among these most considered only a limited set of options for parental education and limited their analysis to students enrolling in four-year colleges. These findings suggest the importance of jointly analyzing a variety of definitions and pathways with a single dataset.

Purpose of the Study and Research Questions

The purpose of our study was to examine the relationship between alternative definitions of FGCS and graduation from two- and four-year colleges. Drawing on findings from prior research employing complex definitions of FGCS and theories of human, cultural, and social

capital, we hypothesized that both the highest level of parental education in a student's household and the number of parents at that level might influence graduation. We thus used both dimensions to construct eight alternative definitions of FGCS. Using these definitions and data from the nationally representative Education Longitudinal Study of 2002, we addressed three research questions:

1) What is the relationship between FGCS status and students' graduation from college? Does this relationship differ under alternative definitions of FGCS?
2) Do results differ for students initially enrolling in two- versus four-year colleges?
3) Do results differ for the subsample of students who successfully enrolled in college versus a sample of all 10th graders?

This study adds to the literature on FGCS by comparing results of different definitions of FGCS. Many prior studies have used only one definition and these definitions have varied substantially. A study focusing on outcomes for FGCS under different definitions provides context for interpreting the results of studies using each definition, insight into diversity within the FGCS population, and guidance for future research on FGCS. This study also has implications for the ways in which we define FGCS in policies and programs aimed at improving these students' college success.

Literature Review

Defining a "First-Generation College Student"

Policymakers and researchers have employed a variety of definitions of "first-generation college student" (Auclair et al., 2008; Nguyen & Nguyen, 2018; Peralta & Klonowski, 2017; Spiegler & Bednarek, 2013; Toutkoushian, Stollberg, & Slaton, 2018). According to the Higher Education Act of 1965, a first-generation college student is:

> (a) An individual both of whose parents did not complete a baccalaureate degree; or (b) In the case of any individual who regularly resided with and received support from only one parent, an individual whose only such parent did not complete a baccalaureate degree (U.S. Department of Education, 1998, para. f1).

Through the Higher Education Act, several college access programs were developed specifically to help FGCS, and this definition has had significant policy implications. Some examples of federal programs that serve first-generation college students include Upward Bound, Educational Talent Search, and Student Support Services. The majority of university programs for first-generation students use this federal definition of first-generation college student (NASPA, 2018). Some university programs for FGCS also use the federal definition, while others only consider a student to be FGCS if neither parent attended college at all (Ward, Seigel, & Davenport, 2012). Likewise, community colleges may define students as FGCS if their parents have less than an associate's degree (Ward et al., 2012).

Researchers vary in how they have defined FGCS, and, more often than not, they have differed from the federal definition. A majority of studies focusing on FGCS persistence and graduation employed the stricter definition, which considered a student to be FGCS only when neither parent attended any postsecondary institution (e.g., Billson & Terry, 1982; DeAngelo & Franke, 2016; Dumais & Ward, 2010: Lohfink & Paulsen, 2005; Ishitani, 2006; Redford & Mulvaney Hover, 2017). Fewer studies followed the federal government's lead and defined students as FGCS when neither parent has a bachelor's degree but either or both might have some college experience (e.g. Ishitani, 2003; Ishitani, 2016; Wolinak, Mayhew, & Engberg, 2012). Policymakers and researchers thus seem to differ in their understanding of how much

parental education is necessary to provide students with an advantage in accessing and progressing through higher education.

Another problem with the most common definitions of FGCS is that they overlook the great deal of variation possible in the total "amount" of parental education in a student's home. Only a few studies have explicitly analyzed outcomes of students whose parents have "some college," and none of these distinguished between students whose parents earned only a few credits, those whose parents attained an associate's degree, and those whose parents completed most of a bachelor's degree (Cragg, 2009; Ishitani, 2006; Nunez & Cuccaro-Alamin, 1998; Redford & Mulvaney Hover, 2017; Warburton, Bugarin, & Nunez, 2001). Additionally, few studies have considered two parents' levels of education (in two-parent households), most often using only the highest level of education of either parent (e.g., Cragg, 2009; Fike & Fike, 2008; Hahs-Vaughn, 2004; Ishitani, 2003, 2006, 2016; Wolniak, Mayhew, & Engberg, 2012). Most studies employing these more complex definitions found differences in student outcomes. This suggests the need for a systematic analysis of these differences that jointly explores the effects of both level of parental education and number of college-educated parents. Given that a large number of FGCS first enroll in two-year colleges (Arbona & Nora, 2007; Redford & Mulvaney Hover, 2017), it may be especially important to understand whether having parent(s) with an associate's degree confers an advantage in this context.

Recent research has called attention to these inconsistencies and their implications. Auclair et al. (2008) and Spiegler and Bednarek (2013) both summarized the range of definitions used in literature on college access, experiences, and outcomes for FGCS, and discussed the importance of a consistent definition. Nguyen and Nguyen (2018) argued that, by treating studies using different definitions as if they applied to the same population, researchers may have made

incorrect generalizations and comparisons as well as overlooking potentially important differences among students with different parental education backgrounds. Studies employing different definitions sometimes even yielded conflicting results, especially in terms of college experiences associated with positive outcomes. Ward, Seigel, and Davenport (2012) and Peralta and Klonowski (2017) not only described variations in definitions, but also advocated to define FGCS as students for whom neither parent has any college experience. They argued that any college experience increases the social and cultural capital parents can share with their children, and thus advantages them in the college environment. However, this fails to consider whether and to what extent parents with more education have more capital and the implications of this extra capital. While these studies called for a better understanding of the FGCS construct and an appropriate, consistent definition, they did not relate definitions to differences in outcomes. We thus have little information with which to make an informed decision about who "should" be considered FGCS and whether these decisions "should" vary in two- versus four-year contexts.

FGCS and College Success

Most prior research on FGCS' persistence and graduation has found that FGCS are less likely than their non-FGCS peers to persist and graduate from college. For example, a recent descriptive study analyzing nationally representative data found that both students whose parents did not attend college and those whose parents had some college earned bachelor's degrees at lower rates than those with at least one parent with a bachelor's degree (Redford & Mulvaney Hover, 2017). Other studies using national-level data and controlling for other characteristics correlated to college outcomes yielded similar findings for persistence (e.g., Dowd, 2004; Ishitani, 2006, 2016; Lohfink & Paulsen, 2005; Warburton, Bugrain, & Nunez, 2001) and bachelor's degree attainment (e.g., Arbona & Nora, 2007; Cragg, 2009; Dumais & Ward, 2010;

Hahs-Vaughn, 2004; Ishitani, 2006, 2016; Nunez & Cuccaro-Alamin, 1998; Warburton et al., 2001), across a range of FGCS definitions.

In contrast to the wealth of literature on FGCS' bachelor's degree attainment, only a few studies have examined FGCS and associate's degree attainment (Auclair et al., 2008). Defining FGCS as those whose parents did not earn bachelor's degrees, Engle and Tinto (2008) found that, compared to non-FGCS, FGCS less likely to earn a bachelor's degree, but more likely to earn an associate's degrees. Other studies found students to be equally likely to earn an associate's degree regardless of parental education (Nunez & Cuccaro-Alamin, 1998; Roksa, 2011). Note that none of these studies examined whether there was a relationship between having a parent with an associate's degree and student associate's degree attainment comparable to the relationship between having a parent with a bachelor's degree and student bachelor's degree attainment. The minimal research, mixed findings, and lack of complexity in operationalization of parental education for students attending two-year colleges suggests the need for research that considers both two- and four-year pathways. This is especially important given the large proportion of FGCS who begin their education in two-year colleges (Redford & Mulvaney Hover, 2017).

Similarly, only a few studies have employed more complex variables for parental education. Ishitani (2003) examined persistence of students with neither parent with bachelor's degrees, one parent with a bachelor's degree, and two parents with bachelor's degrees. Students with two parents with bachelor's degrees were significantly more likely to persist, and differences in persistence increased over time, suggesting that the number of parents who attended college may be important. Chen and Carroll (2005) and Ishitani (2006) both found significant differences in graduation between students whose parents never attended college,

attended college but did not graduate, and graduated with a bachelor's degree. While these studies provide initial evidence for differences based on several levels of parental education and the number of parents at a given level, further research is necessary to explore both dimensions at the same time.

Clearly, despite substantial prior research on the relationship between parental education and student outcomes, our knowledge is incomplete. Few studies have operationalized parental education in appropriately complex ways, and those that have done so have at most examined either three levels of parental education or one versus two parents have bachelor's degrees. We thus do not know whether the advantages associated with college-educated parents accrue incrementally or at a threshold, which has implications for how we operationalize parental education in our research and where programs and policies set thresholds for service. We also understand little about FGCS in two-year colleges, including both FGCS who attend two-year colleges and children of parents with two-year degrees. Until we examine these issues simultaneously, we cannot begin to resolve discrepancies in definitions or resolve disagreements about which definition might be most appropriate.

Moreover, many studies of FGCS have relied on single-institution data with small numbers of students of color and students from low-income backgrounds. In their review of studies of FGCS, Nguyen and Nguyen (2018) noted that such data are especially problematic for studying FGCS given the strong correlations between FGCS status and these other characteristics. Among studies employing nationally representative data with larger numbers of students of color and those from low-income backgrounds, only one descriptive study (Redford & Mulvaney Hover, 2017) has employed the most recent complete national dataset. Most studies using the national longitudinal datasets also fail to take full advantage of these datasets' abilities

to track students from high school into and through postsecondary education. Examining pathways beginning in high school can help us better understand whether parental education is more significant for access, persistence, or both.

Conceptual Frameworks

The complexity of students' pathways to graduation suggests the need to examine them through the lenses of several different conceptual frameworks. Those especially relevant to understanding FGCS' outcomes include human capital, social and cultural capital, and college persistence theories. All three forms of capital relate to the notion of social reproduction in education, in that students who come from families with higher levels of capital are themselves more successful in education (Bourdieu, 1977). College persistence theories view persistence as a longitudinal process and emphasize the effects of academic and social interactions on campus (Tinto, 1993). They provide a framework for understanding the ways in which various forms of capital not only directly affect student persistence, but may also indirectly affect persistence through their effects on student-institution interactions.

Human capital theory views the pursuit of a college degree as an investment in oneself, and suggests that individuals will make the investment when the expected benefits outweigh the costs (e.g., Becker, 1993). There are several reasons why students with college-educated parents may be more likely to perceive the benefits of completing college as outweighing the costs. Because of their own educational attainment, college-educated parents are likely to have greater financial resources to support their children's college education, and thus reduce the cost of a degree. Such financial resources may also enable college-educated parents to invest in their children's pre-college academic preparation and abilities, which in turn may make them more likely to persist in college. Additionally, college-educated parents are in a better position to

communicate to their children the economic and social benefits of a college degree. Therefore, first-generation students might have lower levels of academic preparation and fewer financial resources when they enter college, compared to their peers with college-educated parents.

Two related but distinct concepts, cultural and social capital, offer additional explanations for differences in FGCS' and non-FGCS' college outcomes. Cultural capital includes knowledge and skills for navigating the college experience from application to graduation (Berger, 2000; Bourdieu, 1977, 1986; Jaeger & Karlson, 2015; Mollegaard & Jaeger, 2015; Tan, 2017). Parents who have experience in college settings may be better able to share this knowledge with their children, improving their ability to navigate the college environment. Social capital refers to the way in which college-educated parents and their networks of friends and associates are more likely to realize and transfer information about the importance of a college degree to their children (Bourdieu, 1977, 1986; Coleman, 1988; Field, 2017; Lin, 2002; Mollegaard & Jaeger, 2015; Moschetti & Hudley, 2015). As with cultural capital, this social capital provides students of college-educated parents with important resources to support them in graduating from college. Likewise, an FGCS student may not be able to go to their parents or their parents' networks for help in navigating college.

Students enter college with variation in these three forms of capital, or what Tinto (1993) describes as pre-entry attributes, that play a role in postsecondary persistence to completion. Tinto's (1993) Theory of Student Departure focuses on student integration into their institutions, and has been one of the most widely cited explanations of college student persistence (Braxton et al., 2013; Mayhew et al., 2016). Tinto suggests that student background characteristics, including parental education, influence students' educational goals and commitment to these goals. Parents that went to college might plausibly place a higher value on their child going to college

and ultimately earning a degree; this may be especially important when students encounter setbacks or obstacles to persistence. All three forms of capital also shape students' academic and social integration into college and likelihood to persist. For example, an FGCS with lower levels of cultural and social capital might have trouble navigating and integrating into a college campus that was likely not designed with their needs in mind. Alternatively, FGCS may be less likely to participate in high-impact practices, especially extracurricular activities, associated with persistence due to limited financial capital and a lack of information on the value of such activities, which is often transferred from parent to child as a form of cultural capital as well as through social networks (Billson & Terry, 1982; Chen & Carroll, 2005; Lohfink & Paulsen, 2005; Pascarella, Pierson, Wolniak, & Terenzini, 2004).

Some scholars have argued that Tinto's (1993) emphasis on integration into college inherently disadvantages underserved students, including FGCS (Attinasi, 1989; Braxton et al., 2013; Cabrera, Nora, & Castaneda, 1993; Hurtado & Carter, 1997; Melguizo, 2011; Museus, 2014; Tierney, 1991, 1992, 1993). According to these arguments, requiring students to separate from their home environments in order to integrate into their college environments may be problematic for students from some cultural and family backgrounds, including many FGCS (Museus, 2014; Tierney, 1992). Recent critiques have also challenged the way in which Tinto's model asks students to adapt to institutional culture rather than asking institutions to modify their environments and structures (Museus, 2014). Still, alternative models explaining persistence for FGCS and other underserved students often modify rather than reject Tinto's work (Berger, 2000; Cabrera, et al., 1993; Stuart, Rios-Aguilar, & Deil-Amen, 2014). Recent FGCS studies have often incorporated constructs from Tinto's model as well as from other models in order to account for the variety of factors that may affect this population's persistence decisions (e.g.,

Lohfink & Paulsen, 2005; Martinez, Sher, Krull, & Wood, 2009). Therefore, this study still acknowledges the tenets of Tinto's (1993) model, while focusing on the variation in capital that is passed on to students based on parent education level.

Data and Methods

Data

For the purpose of this study, we relied on the Education Longitudinal Study of 2002 (ELS:02). Conducted by the National Center for Education Statistics (NCES), ELS:02 is a national study of 10th graders who were first surveyed during their 10th grade year in 2002 and completed follow-up surveys in 2004, 2006, and 2012. We restricted our sample to students who indicated in 2002 that they were living full-time with two parents (whether biological, step, foster, or adoptive) who each reported their highest level of educational attainment which is roughly half of the ELS sample. This restriction enabled us to examine the relationship between the number of college-educated parents and whether a student graduates from college. After deleting cases with missing data on the dependent variable, our final weighted sample consisted of approximately 7,800 students (all sample sizes are rounded per NCES requirements).

We selected ELS:02 for this study for several reasons. First, ELS:02 is a nationally representative dataset, and thus allows us to generalize findings to the broader U.S. student population. Second, the survey collected information from students during high school and throughout college, enabling us to examine their pathways through both K-12 and postsecondary education. Third, ELS:02 included both student and parent surveys with the latter providing a more reliable measure of parental educational attainment and their relationship to the student.

Dependent Variables

The primary dependent variable used in this study was whether or not a student had graduated from college as of 2012. The ELS:02 data further allowed us to determine the highest

level of educational attainment completed by each student as of 2012. Accordingly, the dependent variable was categorical with three possible values: (1) highest degree earned was at least a bachelor's degree, (2) highest degree earned was an associate's degree, and (3) did not earn either a bachelor's or an associate's degree.

Explanatory Variables

We created several groups of explanatory variables that theory and prior literature suggest may be associated with college completion. The first group (***E***) was the main focus of our study, namely, the parental education level of each student's parents. We created twelve different measures of parental education, where each variable depended on the level of education needed for a parent to be labeled college-educated and the number of parents meeting the education criteria, as depicted in Figure 1. We used four levels to determine whether a parent was college-educated: (1) enrolled in any postsecondary institution, (2) earned an associate's degree or more, (3) attended a 4-year institution or more, or (4) earned a bachelor's degree or more. These education levels were constructed so that they would be nested within each other. We used three values for the number of college-educated parents: zero, one, or two. When combined, these criteria gave rise to 4 x 3 = 12 different variables. Finally, we labeled a student being a FGCS when either zero or at most one parent met the designated criteria for being college-educated, resulting in eight possible definitions of FGCS status.

---------- Insert Figure 1 Here ----------

The next group of explanatory variables (***P***) were the student's personal characteristics, including the student's gender, race/ethnicity, ninth grade GPA, and PISA:2003 concordance test scores in reading and mathematics. The decision to include these variables was based on prior research identifying significant differences in persistence by gender and race/ethnicity, and

especially strong effects of prior academic preparation (Adelman, 2006; Mayhew et al., 2016; Perna & Thomas, 2008). Most models of student persistence, including Tinto's (1993) model, likewise emphasize the importance of these attributes (Perna & Thomas, 2008).

The third group of explanatory variables (***F***) represents family measures such as whether the student lived with their biological parents, their number of siblings, number of dependents, and family income (four categories). The fourth group of explanatory variables (***S***) capture the following high school measures for each student: urbanicity of high school, percentage of students on free lunch, percentage of students who took at least one Advanced Placement (AP) course, public/private status, and Census region where the school is located. Perna and Thomas (2008) summarized research on the role of both family and high school characteristics not only on enrollment in college, but also on longer-term college outcomes. Controlling for family income is an especially important control given the high correlations between family income and FGCS status (e.g. Engle & Tinto, 2008) and the ways in which financial resources can inform the cost/benefit analysis resulting in persistence decisions (Long, 2007; Perna & Thomas, 2008).

Finally, the college-level factors for the first institution attended (***C***) include whether the student enrolled in college full time, the type of college attended (public, private not-for-profit, private for-profit), the student's planned major (STEM, business, other), and whether the student relied on grants or loans to help pay for college. Full-time enrollment has been found to be an especially strong predictor of college completion, perhaps by increasing integration in ways consistent with Tinto's (1993) model (Braxton et al., 2013). Although the mechanism by which financial aid influences persistence remains somewhat unclear, research has at least established a clear, significant connection between these variables (Long, 2007; Mayhew et al., 2016).

Methods

To examine college completion, we relied on multinomial logistic regression. The dependent variable of interest in our study had three possible values: (1) highest degree earned was a bachelor's degree or more, (2) highest degree earned was an associate's degree, and (3) did not earn either an associate's or bachelor's degree. In each of the following models, we converted the coefficients into marginal effects so that they could be interpreted as the effect of each variable on the probability of the given educational attainment levels. In all models, we clustered the standard errors at the high school level to account for possible non-independence of the errors for students within schools. We also weighted the data to account for the complex sampling design NCES used in the ELS:02 survey.

In the first set of models, we focused on all 10th graders in our sample ($N \sim 7{,}800$). The multinomial logistic regression model was of the general form:

$$Y = \alpha + \beta_1 E_1 + \beta_2 E_2 + \gamma \boldsymbol{P} + \delta \boldsymbol{F} + \theta \boldsymbol{S} + \varepsilon \ , \ N = \text{all } 10^{\text{th}} \text{ graders} \qquad (1)$$

where Y = college outcome, $\boldsymbol{P}$ = personal characteristics, $\boldsymbol{F}$ = family characteristics, and $\boldsymbol{S}$ = high school characteristics. We included two dummy variables in the equation to capture parental education, where $E_1 = 1$ if exactly one parent was college educated, and $E_2 = 1$ if neither parent was college educated. Accordingly, the coefficients β_1 and β_2 measure the difference in the rates at which these students earned college credentials relative to other 10th grade students with two college-educated parents, holding constant their personal, family, and high school characteristics. We estimated equation (1) four times for the sample of 10th graders, where each time we varied the education level needed for parents to be labeled college educated. In addition, we repeated the analysis after replacing the two dummy variables E_1 and E_2 with a single dummy variable for whether at least one parent was not college educated since this corresponds to our second

definition of FGCS. Taken together, this gave us 12 different multinomial logistic regression models for the 10th grade sample.

The effects of FGCS on college graduation for 10th graders, however, entails two hurdles: first a student must enroll in college and then graduate from college conditional on enrollment. Accordingly, we also estimated the model for only those students who initially enrolled in college ($N \sim 6{,}300$) to determine if FGCS were still at a greater risk of failure even after getting to college. These models were of the form:

$$Y = \alpha + \beta_1 E_1 + \beta_2 E_2 + \gamma \boldsymbol{P} + \delta \boldsymbol{F} + \theta \boldsymbol{S} + \tau \boldsymbol{C} + \varepsilon \quad , \; N = \text{college enrollees} \qquad (2)$$

where all variables are defined as before, and $\boldsymbol{C}$ = college-specific variables defined earlier. The coefficients for the variables E_1 and E_2 now capture whether those FGCS who enrolled in college were less likely than their peers to earn a degree. Taken together, equations (1) and (2) allow us to determine if the lower college graduation rate for FGCS is due to their being less likely to go to college or graduate once they have enrolled or both.

Finally, we examined whether FGCS graduation rates varied depending on whether they initially enrolled at a two- or four-year institution. To do this, we partitioned the sample into those who reported initially enrolling at a two-year institution ($N \sim 1{,}600$) or a four-year institution ($N \sim 3{,}900$) and estimated separate conditional multinomial logistic regression models for each group.

Results

In Figure 2 we provide a breakdown of 10th grade students by the parental education categories used in our study. Each column represents a different definition of a college-educated parent, ranging from “attend any college” to “earned a bachelor’s degree.” Within each column, we report the percentage of students with zero, one, or two college-educated parents according to

the designated criteria. As expected, the percentage of students with no college-educated parents increased as we raised the level of education required to be labeled college-educated. The bottom two portions of each column represent FGCS. If we adhere to a strict definition where FGCS are only those for whom neither parent is college educated, then these are shown as the bottom section of each column. Alternatively, if we loosen the criteria to also include students with exactly one non-college-educated parent as FGCS, then the sum of the bottom two sections of each column represents their proportions. Accordingly, the share of FGCS in our 10th grade sample could range from as low as 22% to a high of 76%.

---------- Insert Figure 2 Here ----------

Table 1 contains the descriptive statistics for the various explanatory variables used in our statistical models. More specific details on how we constructed the dependent and other explanatory variables are provided in the Appendix. In the interest of space we only present the descriptive statistics for the full sample of 10th graders.

---------- Insert Table 1 Here ----------

In Table 2, we present breakdowns of college completion rates by the various definitions of parental education used in our study. The first column denotes whether the student graduated from a four-year, two-year, or either type of college. The second column describes the level of education needed for a parent to be categorized as college educated. Columns three through five show the percentages of students achieving each outcome broken down by the number of college-educated parents. The last three columns show differences in college completion rates between students with two college-educated parents (non-FGCS) and either one or no college-educated parents.

Our results document that there are large gaps in four-year and overall college completion rates by parental education. For example, Table 2 shows that the four-year college completion gap between students with two college-educated parents and no college-educated parents range from 34% to 42% depending on how we defined college-educated parents. However, the 4-year college completion gaps were also quite large between students with one and two college-educated parents (18% to 23%). As we increased the level of education required for a parent to be labeled college educated, the gaps in four-year and overall college completion rates for students with one versus two college-educated parents fell. We found the opposite pattern, however, when comparing students with no versus two college-educated parents. Overall, the four-year college completion gaps increased along with the difference in the number of parents meeting the definition of college educated. Finally, we noted no statistically significant difference in two-year college completion rates for students with different numbers of college-educated parents, and this result held across definitions of college-educated parent.

---------- Insert Table 2 Here ----------

The results from the multinomial logistic regression model for the full (10^{th} grade) sample are shown in Table 3. Recall that the dependent variable has three possible values: (1) highest degree earned was at least a bachelor's degree, (2) highest degree earned was an associate's degree, and (3) did not earn either a bachelor's or an associate's degree. As noted earlier, the values in the table represent the marginal effect of each variable on the college completion alternatives. Collectively, the independent variables accounted for approximately 25% of the variation in college completion outcomes.

---------- Insert Table 3 Here ----------

Beginning with parental education, we found that 10th grade students with at least one parent who did not have more than a high school education were significantly less likely than students with two college-educated parents to have earned a bachelor's degree, even after controlling for a range of personal, family, and school characteristics. The differentials were larger for students who had two non-college-educated parents than they were for those with exactly one non-college-educated parent. However, even those with one college-educated parent completed college at lower rates than their peers with two college-educated parents.

Although not the focus of our study, the findings among several non-parental education variables are also worth noting. Female students were more likely than comparable male students to earn a college degree. Black students were 6.6% more likely than similar white students to earn a four-year degree. Not surprisingly, academic performance and aptitude in high school was positively and strongly associated with a student's chance of earning a bachelor's degree. Family characteristics also seemed to matter for 10th graders, in that those who lived with both biological parents and/or resided in higher-income families were more likely to complete four-year degrees.

In Table 4, we present the results for the 12 alternative parental education variables for the full 10th grade sample. Recall that the first four rows (zero college-educated parents) and the last four rows (zero or one college-educated parents) correspond to definitions that could be used for "first-generation college students". In every instance, we found that students without two college-educated parents were significantly less likely than their counterparts to earn a four-year degree. The estimated marginal effects, however, varied considerably by definition from a low of 5.4% to a high of 11.4%. This also means that students with only one college-educated parent were at greater risk of not graduating from college relative to their peers with two college-

educated parents. The results were mixed with regard to the connection between parental education and completion of a two-year degree, with roughly half of the models showing a positive and significant association and the rest having insignificant marginal effects. As a result, in most models FGCS were more likely to not earn any type of postsecondary credential.

---------- Insert Table 4 Here ----------

Our next step was to reestimate the multinomial logistic regression models for only those students who enrolled in college. Accordingly, the marginal effects show the relationship between each factor and college completion conditional on the student enrolling in college. College enrollees represent approximately 80% of the sample of 10th graders in our dataset. The complete results are shown in Table 5 for the case where we defined a non-college-educated parent as someone who never enrolled in college at any level. We found that students without two college-educated parents were still significantly less likely than their peers to earn a bachelor's degree. The marginal effects for students with exactly one college-educated parent in Table 5 were virtually the same as for the full sample (Table 3). This finding means that the disadvantage these students face in terms of completion are driven mostly by their being less likely to graduate once they enrolled in college. In contrast, the marginal effects for students with two non-college-educated parents were negative and significant for only college enrollees, but these effects were several percentage points smaller than for the full sample of 10th graders. For them, the disadvantage in terms of college completion is thus driven by both access and completion conditional on enrollment.

---------- Insert Table 5 Here ----------

Table 6 is structured in the same way as Table 4, where we present only the results for the 12 parental education variables across multiple ways of defining this construct. Overall, the

results were very similar to what we observed for the full sample, except that the marginal effects in the conditional models in Table 5 were about one percentage point smaller than for the full sample. As before, the marginal effects for FGCS (first four and last four rows) varied substantially across definitions, further emphasizing the importance of being specific about how one defines FGCS in empirical studies. Regardless, the results show that overall FGCS were less likely than non-FGCS to earn a four-year degree, even among those who had successfully navigated the college search process and enrolled in college. Across many definitions, students with exactly one college-educated parent were less likely to graduate than were students with two college-educated parents. It is also worth noting that out of those students who enrolled in college, FGCS were often found to be more likely than non-FGCS students to earn a two-year degree depending on how we defined FGCS.

---------- Insert Table 6 Here ----------

In Table 7, we repeated the analysis in Table 6 after further limiting the sample to only those students who reported that their first postsecondary institution attended was a four-year college. Overall, the results in Table 7 parallel what we found in Table 6, which in large part reflects the fact that the majority of students in this dataset who enrolled in college chose a four-year institution. Regardless of how we defined parental education, students without two college-educated parents were less likely than other students to earn a bachelor's degree.

---------- Insert Table 7 Here ----------

Finally, we estimated the multinomial logistic regression model for only those students who initially enrolled at a two-year institution (Table 8). Unlike the four-year sector, for this subset of students we found relatively few differences between FGCS and non-FGCS that were statistically significant. FGCS were equally likely to not earn any degree or to earn a two-year

degree. Depending on how FGCS was defined, however, we did note several instances where FGCS who began at a two-year institution were less likely than their non-FGCS counterparts to earn a four-year degree.

---------- Insert Table 8 Here ----------

Discussion

Researchers have long been interested in the role of parental education in their children's postsecondary outcomes, especially for FGCS. However, definitions of FGCS have varied across studies, limiting our understanding of how and why outcomes vary for different students. The primary goal of this study was to examine whether the relationship between FGCS and college graduation differed with different definitions of FGCS. We created a series of alternative definitions of FGCS based on the level of parental education and the number of parents with this level of education. In addition, we were interested in whether results differed for FGCS and non-FGCS beginning in the two-year versus four-year sector and whether differences persisted even among those who successfully enrolled in college.

We found that FGCS were less likely to graduate from a four-year college than were non-FGCS across most definitions; however, the magnitude of the effect varied with each definition. In general, the likelihood of four-year college graduation increased along with the level of parent education and the number of parents at that level. These results are consistent with prior research on FGCS, but provide additional insight into the outcomes of students who fall somewhere in the middle of the spectrum of zero parents attending college and two parents with bachelor's degrees. It is important to note that students with one college-educated parent also face

challenges in completing a college education. They are often overlooked, however, in terms of support and attention because they are not typically included in definitions of FGCS.

The lower likelihood of graduation for students whose parents have less than bachelor's degrees indicates an important difference between students whose parents attended but did not complete college and those whose parents completed college. Definitions of FGCS often use college attendance as the threshold, which our results suggest may be problematic. Perhaps parents who complete bachelor's degrees better understand the full range of benefits of a college degree, and can pass this on to their children. Their children may also benefit from parents' greater social, cultural, and human capital that can translate to resources to support their children in attending and completing college. Their understanding of the benefits of completing college and access to the resources necessary to support college completion may also encourage and enable their children to devote more time and effort to college, which researchers have identified as an important factor in persistence (Mayhew et al., 2016; Tinto, 1993). On the contrary, FGCS, who may lack this social and cultural capital even though many campuses assume students possess it, might be less academically and socially integrated into college, which according to theory can lead to higher student attrition (Rosenbaum, Deil-Amen, & Person, 2006; Tinto, 1993).

There was relatively little prior research on the outcomes of FGCS who initially enrolled in two-year colleges, which was surprising given that FGCS enroll in two-year colleges at higher rates (Redford & Mulvaney, 2017). We found that, under some definitions, FGCS were slightly more likely to graduate from two-year colleges; under other definitions, there no differences in two-year graduation rates for FGCS and non-FGCS. Many students who enroll at community colleges, including FGCS, may view the community college as their only viable option for

higher education due to location, family and community obligations and expectations, lower levels of academic preparation, or concerns about cost (Cohen, Brawer, & Kisker, 2014; Rosenbaum, Deil-Amen, & Person, 2006). Such students may necessarily stop at the associate's degree, thus accounting for the spike in associate's degree attainment among some FGCS students relative to non-FGCS students. As our definitions shifted to include more highly-educated parents, students may have faced fewer of these constraints and been more likely to pursue a bachelor's degree, eliminating the FGCS edge in associate's degree attainment.

When limiting the sample to only students who initially enrolled in two-year college, there was no difference between FGCS and non-FGCS in the likelihood of graduating from a two-year college. We also noted that having a parent with a two-year degree did not increase the likelihood of a student completing a two-year degree even though having a parent with a four-year degree increases the likelihood of completing a four-year degree. These differences between two-year enrollment and attainment and four-year enrollment and attainment may reflect the differences between two- and four-year students. While we controlled for many key differences, such as family income and race/ethnicity, we were not able to control for all factors. For example, two-year college students tend to have a more diverse set of educational goals, are more likely to be unsure of their educational goals, and are more likely to have chosen between a two-year college and no higher education (Cohen, Brawer, & Kisker, 2014; Rosenbaum, Deil-Amen, & Person, 2006). These differences may explain why non-FGCS have no advantage in graduation among students who initially enroll in two-year college. Additional research is necessary to more fully understand the experiences of FGCS on community college campuses. However, regardless of the reason, it is clear that employing different definitions of FGCS can

lead to significantly different results for students attending and graduating from two-year colleges in particular.

FGCS effects were largely similar for both a sample of all 10th graders and a sample of only those who successfully enrolled in college. FGCS who enrolled in college were less likely than non-FGCS to graduate from a four-year college, suggesting that FGCS remain at a disadvantage even after surpassing the access to college hurdle. Again, perhaps college-educated parents are more likely or better able to help their children acclimate to the college environment or take advantage of campus resources, and thus persist to completion. They are also likely in a better position to communicate the benefits of completing a college degree, which may also encourage persistence.

Implications

These findings also have implications for policy and practice. Colleges, government agencies, and non-profit organizations sponsor many programs to support college enrollment and completion of historically underserved students, including FGCS students. When participation is conditional upon FGCS, these organizations must carefully consider an appropriate definition. Limiting services to only students whose parents had no postsecondary experience would overlook students who, according to our findings, may experience difficulties and could benefit from such services. Based on the findings of this study, we suggest that more policies and programs use the federal definition of FGCS, which TRIO programs have always utilized. This more inclusive definition will broaden our conception of an FGCS and expand their access to key services and programs.

If institutions and policymakers have varying definitions, it is also challenging for students to know if they should personally identify as an FGCS. For example, a student might

not apply for TRIO programs, such as Student Support Services or McNair Scholars, because their parent(s) attended some college (did not graduate) and thus they do not perceive themselves to be FGCS. However, the TRIO programs use the federal definition and serve students whose parents have not earned a bachelor's. Definitions of FGCS are also especially important in community college contexts given our finding that students of one or two parents with associate's degrees were still less likely to complete either an associate's or bachelor's degree. When the definition of first-generation status is not clearly defined, it is plausible that students might miss out on services that are dependent on FGCS status.

In addition to streamlining the definition of FGCS, institutions of higher education need to recognize their role in first generation college student success. Our findings indicate that this population is at a unique disadvantage net of the highly correlated financial disadvantage, and higher education professionals need to provide the necessary support to help FGCS persist and graduate. Tinto's (2012) Model of Institutional Action acknowledges the role of pre-entry attributes (e.g. parent education level), but focuses on what the institution can do to improve student success outcomes. A university with a strong institutional commitment to student success "sets the tone for the exceptional climate for success that students encounter their everyday interactions with the institution, its policies, practices, and various members (faculty, staff, administrators, and other students)" (Tinto, 2012, p. 259). Institutions should make a strong commitment to provide services and support for students with lower levels of parental education and invest in their success in college.

This study also has several implications for future research. Currently, researchers are using a variety of different definitions of FGCS. This variation highlights the importance of carefully considering the most appropriate definition of FGCS for a given study, and clearly

articulating this definition. Researchers must consider who is counted as a parent, the threshold at which a parent is considered "college-educated," and the number of parents who are "college-educated." When possible, researchers should determine if their findings are robust with regard to different definitions. They might also consider a multi-level construct or distinguishing by the number of parents who attained a particular level of education. Further, qualitative research can examine the experiences of students with various levels of parental education, to better understand the social and cultural capital that is passed down through parents, and how this shapes postsecondary experiences and outcomes.

One potential limitation of this study is that our sample is limited to students with two parents. More research is needed to examine students, including FGCS, from single-parent households, as this could form an additional barrier to successful educational outcomes. Further, future studies should examine postsecondary outcomes for students from non-traditional family structures. While our study included biological, step, adopted, and foster parents, we did not have sufficient numbers of observations in these groups to examine whether differences exist based on who is counted as a parent. For example, do FGCS living with foster parents have different outcomes than FGCS living with biological parents? Due to the ever-evolving nature of families, this line of inquiry will be important in the future.

Given that many FGCS are also from low-income backgrounds or students of color, future research should employ data enabling examination of the combined effects of these multiple characteristics. Our study found that the group of students commonly considered "FGCS" is much more diverse than previously thought and that such diversity has implications for their outcomes. It would not be surprising to also find differences in outcomes among FGCS from different racial/ethnic and family income backgrounds. Other researchers have also called

for an increasing understanding of the effects of multiple intersecting identities (Deil-Amen, 2015; Nguyen & Nguyen, 2018). Although our study was primarily interested in isolating as best as possible the effect of FGCS status net of these other characteristics and data limitations precluded analysis of interaction variables, studying these intersections can further enhance our understanding of FGCS experiences and outcomes.

It is important that researchers continue this line of inquiry to determine why parental education matters and whether FGCS status affects longer-term outcomes. While quantitative methods allow researchers to rule out certain variables, future research can help us further clarify why FGCS matters to college completion. However, this study and other quantitative work will not be able to fully understand why this group is at a disadvantage. Qualitative work might be helpful for better understanding the experiences of college students with varying levels of parental education to better inform practice.

Still, our study provides important evidence about the relationship between parental education level and increased college completion rates. Students with slightly more parental education have slightly more capital in navigating the college completion process. Future research should examine the relationship between parental education on outcomes beyond a baccalaureate, such as graduate school enrollment and persistence, and labor market outcomes. It would also be worthwhile to examine career choices of FGCS and if they select different types of professions. Through these future studies, we can better unpack the ways in which parental education shapes the education and subsequent careers of their children.

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Figure 1: Construction of Parental Education Status Variables from ELS

"*What is the highest level of education you and your spouse/partner have reached?*"

Education Category	Father	Mother
A	High School or Less	High School or Less
B	Attend 2-Year, No Degree	Attend 2-Year, No Degree
C	Associate's Degree	Associate's Degree
D	Attend 4-Year, No Degree	Attend 4-Year, No Degree
E	Bachelor's Degree or More	Bachelor's Degree or More

Exactly one parent is college-educated:

E_{11} = 1 if Father or Mother (but not both) in A, 0 otherwise

E_{12} = 1 if Father or Mother (but not both) in A or B, 0 otherwise

E_{13} = 1 if Father or Mother (but not both) in A or B or C, 0 otherwise

E_{14} = 1 if Father or Mother (but not both) in A or B or C or D, 0 otherwise

Neither parent is college-educated:

E_{21} = 1 if both Father and Mother in A, 0 otherwise

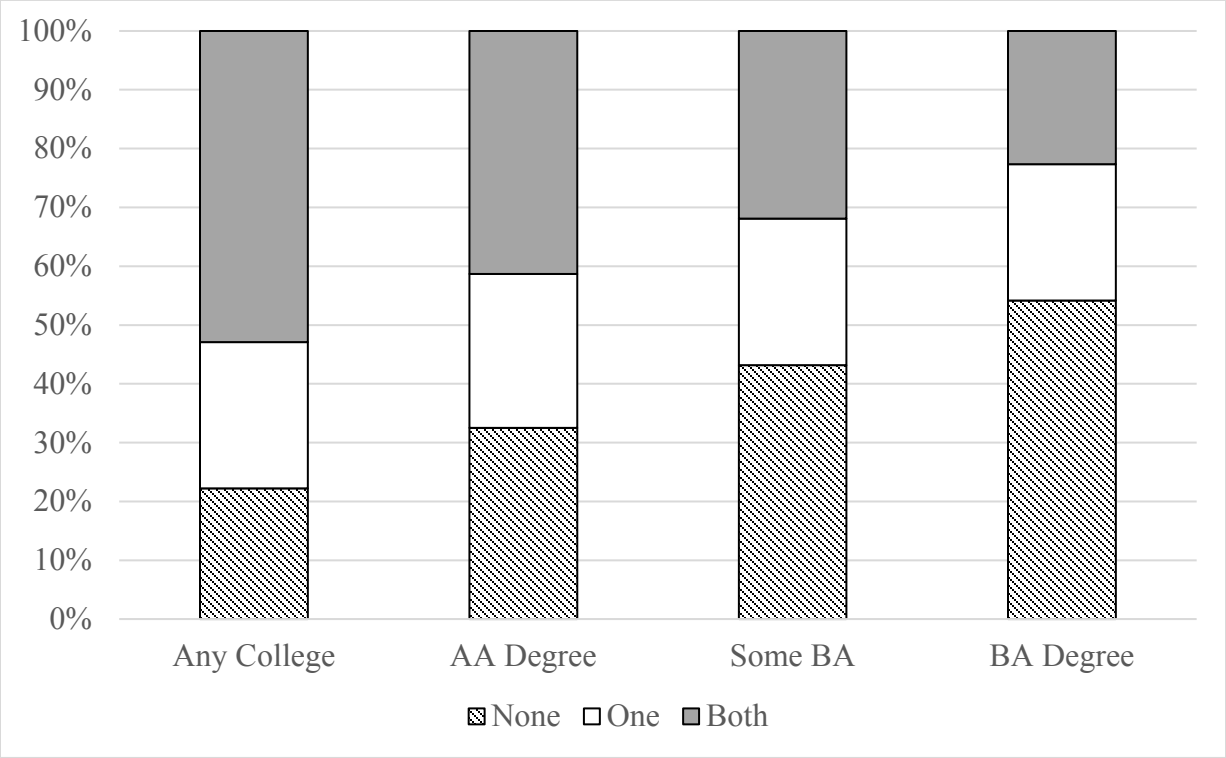
E_{22} = 1 if both Father and Mother in A or B, 0 otherwise

E_{23} = 1 if both Father and Mother in A or B or C, 0 otherwise

E_{24} = 1 if both Father and Mother in A or B or C or D, 0 otherwise

Notes: Data obtained from question 34 on Parent Questionnaire Base Year

Figure 2: Breakdown of Parental Education – 10th Graders



Notes: Each column represents a different measure of college education. Bottom bar = neither parent is college educated. Middle bar = exactly one parent is college educated. Top bar = both parents are college educated.

Table 1

Descriptive Statistics – Full Sample of 10th Graders

Variable	Mean	Standard Deviation	Minimum	Maximum
Gender: Female	0.51	0.50	0	1
Gender: Male [REF]	0.49	0.50	0	1
Race: White [REF]	0.70	0.46	0	1
Race: Black	0.08	0.27	0	1
Race: Asian	0.09	0.29	0	1
Race: All Other	0.07	0.25	0	1
Ethnicity: Hispanic	0.13	0.34	0	1
Ethnicity: Non-Hispanic [REF]	0.86	0.35	0	1
High School GPA	2.90	0.71	0.30	4.00
Score: Math	5.17	0.84	3.08	7.32
Score: Reading	5.49	0.86	3.44	7.09
Live w/Biological Parents	0.82	0.39	0	1
Number of Siblings	2.07	1.50	0	6
Number of Dependents	2.59	1.41	0	8
Income: Below $20K	0.06	0.24	0	1
Income: $20K to $50K	0.28	0.45	0	1
Income: $50K to $100K [REF]	0.37	0.48	0	1
Income: Above $100K	0.18	0.38	0	1
Enrollments: Grade 10 (in 100s)	3.02	2.24	0.03	12.75
School: Urban	0.31	0.46	0	1
School: Suburban	0.50	0.50	0	1
School: Rural [REF]	0.19	0.39	0	1
School: Pct Free Lunch	20.25	20.97	3	88
School: Pct AP	15.44	13.78	0	81
School: Public	0.74	0.44	0	1
School: Non-Public [REF]	0.26	0.44	0	1
School: New England	0.04	0.20	0	1
School: Mid Atlantic	0.13	0.34	0	1
School: E North Central	0.19	0.40	0	1
School: W North Central	0.08	0.26	0	1
School: South Atlantic	0.18	0.38	0	1
School: E South Atlantic	0.08	0.27	0	1
School: W South Atlantic	0.10	0.31	0	1
School: Mountain	0.05	0.22	0	1
School: West [REF]	0.14	0.35	0	1

Table 2

Comparison of College Graduation Rates by First-Generation College Student Definition

Student Graduated From:	Definition of College-Educated Parent:	Number of College-Educated Parents: Two	One	None	None vs. One	One vs. Two	None vs. Two
Four-Year College	Any College	54.3%	30.9%	20.2%	-10.7%***	-23.4%***	-34.1%***
	AA Degree	58.7%	36.5%	21.9%	-14.6%***	-22.2%***	-36.8%***
	Some BA	62.7%	42.1%	24.2%	-17.9%***	-20.6%***	-38.5%***
	BA Degree	67.9%	49.7%	25.9%	-23.8%***	-18.2%***	-42.0%***
Two-Year College	Any College	5.6%	8.4%	8.5%	0.1%	2.8%	2.9%
	AA Degree	4.7%	8.3%	8.7%	0.4%	3.6%	4.0%
	Some BA	3.7%	7.6%	9.0%	1.4%	3.9%	5.3%
	BA Degree	2.7%	7.2%	8.6%	1.4%	4.5%	5.9%
Any College	Any College	59.9%	39.4%	28.7%	-10.7%***	-20.5%***	-31.2%***
	AA Degree	63.4%	44.8%	30.6%	-14.2%***	-18.6%***	-32.8%***
	Some BA	66.4%	49.7%	33.2%	-16.5%***	-16.7%***	-33.2%***
	BA Degree	70.6%	56.9%	34.5%	-22.4%***	-13.7%***	-36.1%***

Notes: Sample includes all 10th graders who live with two parents and have complete data on the variables used in subsequent statistical models (n ~ 7,800). Data are weighted using survey weights for participation in 10th grade. Parents include biological, step, adopted, and foster parents. Education level of a college-educated parent: Any College = Parent(s) attended any postsecondary institution; AA Degree = Parent(s) earned an associate's degree or attended a 4-year institution; Some BA = Parent(s) enrolled in a 4-year institution (does not include enrolling in or completing an associate's degree); BA Degree = Parent(s) earned a bachelor's degree. *** $p<.001$.

Table 3
Multinomial Logit Models for College Graduation -- All 10th Graders

Variable	(1) No Graduation	(2) Two-Year Grad	(3) Four-Year Grad
Both Parents: HS	0.082***	0.009	-0.091***
	(0.016)	(0.011)	(0.015)
One Parent: HS	0.055***	0.009	-0.064***
	(0.015)	(0.010)	(0.014)
Female	-0.039**	0.019*	0.020+
	(0.012)	(0.008)	(0.011)
Black	-0.070**	0.004	0.066**
	(0.022)	(0.014)	(0.021)
Asian	-0.036	-0.018	0.055*
	(0.031)	(0.019)	(0.026)
All Other Races	-0.022	0.016	0.006
	(0.021)	(0.015)	(0.021)
Hispanic	0.021	0.000	-0.021
	(0.024)	(0.015)	(0.022)
High School GPA	-0.261***	-0.015*	0.276***
	(0.010)	(0.007)	(0.010)
Score: Math	-0.047***	0.005	0.042***
	(0.012)	(0.008)	(0.010)
Score: Reading	-0.012	-0.008	0.020*
	(0.010)	(0.007)	(0.010)
Live w/Biological Parents	-0.065***	0.002	0.063***
	(0.015)	(0.010)	(0.014)
Number of Siblings	0.003	0.002	-0.006
	(0.005)	(0.003)	(0.005)
Number of Dependents	0.009+	-0.005	-0.005
	(0.005)	(0.003)	(0.005)
Income Below $20K	0.043	-0.013	-0.030
	(0.027)	(0.018)	(0.026)

(Table continues)

Variable	(1) No Graduation	(2) Two-Year Grad	(3) Four-Year Grad
Income $20K to $50K	0.056***	-0.008	-0.048***
	(0.014)	(0.009)	(0.013)
Income Above $100K	-0.015	-0.036*	0.051**
	(0.021)	(0.015)	(0.017)
Enrollments: Grade 10	-0.008*	-0.000	0.008**
	(0.004)	(0.003)	(0.003)
School: Urban	-0.023	-0.027+	0.051**
	(0.021)	(0.015)	(0.018)
School: Suburban	0.004	0.001	-0.005
	(0.017)	(0.011)	(0.015)
School: Pct Free Lunch	0.001+	-0.000+	-0.000
	(0.000)	(0.000)	(0.000)
School: Pct AP	-0.000	-0.000	0.001+
	(0.001)	(0.000)	(0.000)
School: Public	0.062**	-0.001	-0.061***
	(0.020)	(0.014)	(0.017)
School: New England	-0.069+	-0.041	0.111***
	(0.037)	(0.029)	(0.026)
School: Mid Atlantic	-0.119***	0.014	0.105***
	(0.025)	(0.017)	(0.023)
School: E North Central	-0.045+	-0.005	0.050*
	(0.023)	(0.017)	(0.020)
School: W North Central	-0.030	0.019	0.011
	(0.027)	(0.018)	(0.024)
School: South Atlantic	-0.057*	0.009	0.048*
	(0.024)	(0.018)	(0.021)
School: E South Central	-0.027	-0.007	0.033
	(0.028)	(0.020)	(0.026)

(Table continues)

Variable	(1) No Graduation	(2) Two-Year Grad	(3) Four-Year Grad
School: W South Central	-0.009	0.003	0.006
	(0.024)	(0.018)	(0.023)
School: Mountain	0.037	0.014	-0.052+
	(0.031)	(0.019)	(0.027)
Pseudo R2 = 0.25			
Chi-Square = 1755.16***			

Notes: Sample size ~ 7,800. Coefficients are reported as average marginal effects. Standard errors are shown in parentheses and are clustered at the school level. Data are weighted using survey weights for participation in 10th grade. Reference category for race is white. Reference category for income is $50K to $100K. Models also include variables for missing income, ethnicity, siblings, dependents, family income, school FLP, school AP, and race.
+ $p<.10$, * $p<.05$, ** $p<.01$, *** $p<.001$

Table 4

Effects of First-Generation College Status on College Graduation – 10th Graders

# College-Educated Parents[1]	Definition of College-Educated Parent[2]	Outcome: No College	Outcome: Two-Year Grad	Outcome: Four-Year Grad
Zero	Any College	+0.082*** (0.016)	+0.009 (0.011)	-0.091*** (0.015)
	AA Degree	+0.070*** (0.015)	+0.026* (0.011)	-0.097*** (0.014)
	Some BA	+0.057*** (0.016)	+0.041*** (0.012)	-0.098*** (0.014)
	BA Degree	+0.073*** (0.019)	+0.042** (0.016)	-0.114*** (0.016)
One	Any College	+0.055*** (0.015)	+0.009 (0.010)	-0.064*** 0.014)
	AA Degree	+0.031* (0.016)	+0.024* (0.010)	-0.054*** (0.014)
	Some BA	+0.028 (0.018)	+0.035** (0.013)	-0.063*** (0.015)
	BA Degree	+0.016 (0.021)	+0.042* (0.016)	-0.058*** (0.016)
Zero or One	Any College	+0.065*** (0.013)	+0.009 (0.009)	-0.074*** (0.012)
	AA Degree	+0.049*** (0.013)	+0.025** (0.009)	-0.073*** (0.012)
	Some BA	+0.043** (0.015)	+0.038*** (0.011)	-0.081*** (0.013)
	BA Degree	+0.048** (0.018)	+0.041** (0.015)	-0.089*** (0.015)

Notes: Marginal effects for the alternative first-generation college student variables. Standard errors are in parentheses and are clustered at the school level. Data are weighted using survey weights for participation in 10th grade. Each model also controls for gender, race, GPA, standardized test score, number of siblings and dependents, family status and income, grade 10 enrollments, and school attributes. [1] Parents include biological, step, adopted, and foster parents (n ~ 7,300); [2] Education level of a college-educated parent: Any College = Parent(s) attended any postsecondary institution; AA Degree = Parent(s) earned an associate's degree or attended a 4-year institution; Some BA = Parent(s) enrolled in a 4-year institution (does not include enrolling in or completing an associate's degree); BA Degree = Parent(s) earned a bachelor's degree. + p <.10, * p<.05, ** p<.01, *** p<.001.

Table 5
Multinomial Logit Models for College Graduation -- All College Enrollees

Variable	(1) No Graduation	(2) Two-Year Grad	(3) Four-Year Grad
Both Parents: HS	0.050*	0.018	-0.067***
	(0.020)	(0.012)	(0.019)
One Parent: HS	0.055**	0.012	-0.067***
	(0.018)	(0.012)	(0.017)
Female	-0.036*	0.021*	0.016
	(0.014)	(0.010)	(0.014)
Black	-0.028	0.003	0.025
	(0.027)	(0.017)	(0.025)
Asian	-0.004	-0.028	0.032
	(0.033)	(0.022)	(0.030)
All Other Races	-0.037	0.028	0.010
	(0.028)	(0.018)	(0.027)
Hispanic	0.046	-0.017	-0.029
	(0.030)	(0.017)	(0.027)
GPA High School	-0.236***	-0.030***	0.266***
	(0.013)	(0.008)	(0.013)
Score: Math	-0.031*	-0.001	0.033*
	(0.015)	(0.008)	(0.013)
Score: Reading	0.001	-0.012	0.012
	(0.012)	(0.008)	(0.012)
Live w/Biological Parents	-0.071***	0.005	0.066***
	(0.017)	(0.011)	(0.017)
Number of Siblings	-0.003	0.003	-0.000
	(0.006)	(0.004)	(0.006)
Number of Dependents	0.017*	-0.005	-0.011+
	(0.007)	(0.004)	(0.006)
Income Below $20K	0.003	0.005	-0.008
	(0.034)	(0.022)	(0.032)

(Table continues)

Variable	(1) No Graduation	(2) Two-Year Grad	(3) Four-Year Grad
Income $20K to $50K	0.045**	-0.002	-0.043*
	(0.017)	(0.011)	(0.017)
Income Above $100K	-0.016	-0.042*	0.058**
	(0.023)	(0.018)	(0.020)
Enrollments: Grade 10	-0.008+	-0.002	0.010**
	(0.005)	(0.003)	(0.004)
School: Urban	-0.026	-0.029+	0.055**
	(0.025)	(0.017)	(0.021)
School: Suburban	0.005	-0.001	-0.004
	(0.020)	(0.013)	(0.017)
School: Pct Free Lunch	0.001	-0.000+	-0.000
	(0.000)	(0.000)	(0.000)
School: Pct AP	-0.000	-0.001	0.001+
	(0.001)	(0.000)	(0.001)
School: Public	0.054*	0.004	-0.058**
	(0.022)	(0.016)	(0.020)
School: New England	-0.061	-0.030	0.091**
	(0.045)	(0.032)	(0.031)
School: Mid Atlantic	-0.104***	0.013	0.091***
	(0.029)	(0.021)	(0.027)
School: E North Central	-0.028	-0.012	0.040+
	(0.027)	(0.021)	(0.023)
School: W North Central	-0.008	0.020	-0.012
	(0.031)	(0.022)	(0.026)
School: South Atlantic	-0.044+	0.004	0.040+
	(0.027)	(0.020)	(0.023)
School: E South Central	-0.010	-0.008	0.019
	(0.032)	(0.024)	(0.030)

(Table continues)

Variable	(1) No Graduation	(2) Two-Year Grad	(3) Four-Year Grad
School: W South Central	-0.004	0.007	-0.004
	(0.029)	(0.020)	(0.027)
School: Mountain	0.037	0.017	-0.054+
	(0.037)	(0.022)	(0.032)
Enrolled in College FT	-0.183***	0.003	0.179***
	(0.022)	(0.012)	(0.024)
1st Attend Public College	-0.089*	-0.043**	0.132***
	(0.040)	(0.016)	(0.040)
1st Attend Private NP College	-0.070	-0.095***	0.165***
	(0.044)	(0.022)	(0.042)
Planned STEM Major	-0.033+	0.015	0.018
	(0.019)	(0.013)	(0.018)
Planned Business Major	-0.055**	-0.003	0.058**
	(0.020)	(0.013)	(0.018)
Pay for College w/Grants	-0.033*	-0.006	0.039**
	(0.015)	(0.010)	(0.014)
Pay for College w/Loans	-0.021	-0.028**	0.049***
	(0.015)	(0.010)	(0.013)
Pseudo R2 = 0.20			
Chi-Square = 1370.43***			

Notes: Sample size ~ 6,300. Coefficients are reported as average marginal effects. Standard errors are shown in parentheses and are clustered at the school level. Data are weighted using survey weights for participation in 10th grade. Reference category for race is white. Reference category for income is $50K to $100K. Models also include variables for missing income, ethnicity, siblings, dependents, family income, school FLP, school AP, and race.
+ p <.10, * p<.05, ** p<.01, *** p<.001.

Table 6

Effects of First-Generation College Status on College Graduation – All College Enroll

# College-Educated Parents[1]	Definition of College-Educated Parent[2]	Outcome:		
		No College	Two-Year Grad	Four-Year Grad
Zero	Any College	+0.050* (0.020)	+0.018 (0.012)	-0.067*** (0.019)
	AA Degree	+0.047** (0.018)	+0.033** (0.012)	-0.080*** (0.017)
	Some BA	+0.039* (0.018)	+0.049*** (0.014)	-0.087*** (0.017)
	BA Degree	+0.062** (0.021)	+0.047** (0.018)	-0.110*** (0.019)
One	Any College	+0.055** (0.018)	+0.012 (0.012)	-0.067*** (0.017)
	AA Degree	+0.034+ (0.018)	+0.020+ (0.011)	-0.054** (0.017)
	Some BA	+0.035+ (0.020)	+0.033* (0.014)	-0.067*** (0.018)
	BA Degree	+0.019 (0.023)	+0.045* (0.019)	-0.064*** (0.019)
Zero or One	Any College	+0.053*** (0.015)	+0.014 (0.010)	-0.067*** (0.015)
	AA Degree	+0.039** (0.015)	+0.026* (0.010)	-0.065*** (0.015)
	Some BA	+0.036* (0.017)	+0.041** (0.013)	-0.077*** (0.016)
	BA Degree	+0.042* (0.020)	+0.046** (0.017)	-0.088*** (0.017)

Notes: Sample only includes students who enrolled in college (~6,300). Marginal effects for the alternative first-generation college student variables. Standard errors are in parentheses and are clustered at the school level. Data are weighted using survey weights for participation in 10th grade. Each model also controls for gender, race, GPA, standardized test score, number of siblings and dependents, family status and income, grade 10 enrollments, school attributes, and college attributes. [1] Parents include biological, step, adopted, and foster parents; [2] Education level of a college-educated parent: Any College = Parent(s) attended any postsecondary institution; AA Degree = Parent(s) earned an associate's degree or attended a 4-year institution; Some BA = Parent(s) enrolled in a 4-year institution (does not include enrolling in or completing an associate's degree); BA Degree = Parent(s) earned a bachelor's degree. + p <.10, * p<.05, ** p<.01, *** p<.001.

Table 7

Effects of First-Generation College Status on College Graduation – 4-Year Enroll

# College-Educated Parents[1]	Definition of College-Educated Parent[2]	Outcome: No College	Two-Year Grad	Four-Year Grad
Zero	Any College	+0.055* (0.025)	+0.010 (0.014)	-0.066** (0.025)
	AA Degree	+0.031 (0.023)	+0.027* (0.012)	-0.058* (0.024)
	Some BA	+0.030 (0.021)	+0.039*** (0.012)	-0.069** (0.022)
	BA Degree	+0.049* (0.023)	+0.052*** (0.015)	-0.101*** (0.024)
One	Any College	+0.056** (0.020)	+0.012 (0.011)	-0.068** (0.021)
	AA Degree	+0.023 (0.021)	+0.025* (0.012)	-0.048* (0.021)
	Some BA	+0.040+ (0.022)	+0.025+ (0.013)	-0.065** (0.022)
	BA Degree	+0.041+ (0.023)	+0.040* (0.016)	-0.081*** (0.022)
Zero or One	Any College	+0.056** (0.018)	+0.011 (0.010)	-0.067*** (0.019)
	AA Degree	+0.026 (0.018)	+0.026** (0.010)	-0.052** (0.019)
	Some BA	+0.035+ (0.018)	+0.032** (0.011)	-0.067*** (0.019)
	BA Degree	+0.045* (0.020)	+0.046** (0.014)	-0.091*** (0.020)

Notes: Sample includes students who initially enrolled in a 4-year institution (~3,900). Marginal effects for the alternative first-generation college student variables. Standard errors are in parentheses and are clustered at the school level. Data are weighted using survey weights for participation in 10th grade. Each model also controls for gender, race, GPA, standardized test score, number of siblings and dependents, family status and income, grade 10 enrollments, school attributes, and college attributes. [1] Parents include biological, step, adopted, and foster parents; [2] Education level of a college-educated parent: Any College = Parent(s) attended any postsecondary institution; AA Degree = Parent(s) earned an associate's degree or attended a 4-year institution; Some BA = Parent(s) enrolled in a 4-year institution (does not include enrolling in or completing an associate's degree); BA Degree = Parent(s) earned a bachelor's degree. + p <.10, * p<.05, ** p<.01, *** p<.001.

Table 8

Effects of First-Generation College Status on College Graduation – 2-Year Enroll

# College-Educated Parents[1]	Definition of College-Educated Parent[2]	Outcome:		
		No College	Two-Year Grad	Four-Year Grad
Zero	Any College	+0.025 (0.032)	+0.024 (0.029)	-0.050+ (0.030)
	AA Degree	+0.024 (0.032)	+0.040 (0.031)	-0.064* (0.028)
	Some BA	+0.020 (0.037)	+0.054 (0.036)	-0.073* (0.032)
	BA Degree	+0.087+ (0.047)	+0.000 (0.046)	-0.087* (0.038)
One	Any College	+0.042 (0.033)	+0.001 (0.029)	-0.043 (0.029)
	AA Degree	+0.036 (0.035)	+0.007 (0.031)	-0.043 (0.031)
	Some BA	+0.026 (0.040)	+0.033 (0.039)	-0.060+ (0.034)
	BA Degree	+0.000 (0.051)	+0.029 (0.049)	-0.029 (0.041)
Zero or One	Any College	+0.035 (0.027)	+0.011 (0.025)	-0.046+ (0.024)
	AA Degree	+0.029 (0.030)	+0.025 (0.028)	-0.054* (0.025)
	Some BA	+0.022 (0.035)	+0.046 (0.035)	-0.068* (0.030)
	BA Degree	+0.058 (0.046)	+0.009 (0.045)	-0.067+ (0.037)

Notes: Sample includes students who initially enrolled in 2-year institutions (~1,600). Marginal effects for the alternative first-generation college student variables. Standard errors are in parentheses and are clustered at the school level. Data are weighted using survey weights for participation in 10th grade. Each model also controls for gender, race, GPA, standardized test score, number of siblings and dependents, family status and income, grade 10 enrollments, school attributes and college attributes. [1] Parents include biological, step, adopted, and foster parents; [2] Education level of a college-educated parent: Any College = Parent(s) attended any postsecondary institution; AA Degree = Parent(s) earned an associate's degree or attended a 4-year institution; Some BA = Parent(s) enrolled in a 4-year institution (does not include enrolling in or completing an associate's degree); BA Degree = Parent(s) earned a bachelor's degree. + p <.10, * p<.05, ** p<.01, *** p<.001.

Appendix

Variable Descriptions

Variable Name	ELS:02 Variable	Description
Grad 4-Year	F3ICRED	1 if highest degree earned across all reported higher education credentials was a 4-year degree by 2012
Grad 2-Year	F3ICRED	1 if highest degree earned across all reported higher education credentials was a 2-year degree by 2012
Grad Any	F3ICRED	1 if Grad 4-Year = 1 or Grad 2-Year = 1
Enroll	F2B07	1 if student enrolled in a postsecondary institution as of 2nd follow-up survey, 0 otherwise
Enroll2Yr	F2PS1SEC	1 if student first enrolled in a 2-year or less than 2-year postsecondary institution, 0 otherwise
Enroll4Yr	F2PS1SEC	1 if student first enrolled in a 4-year postsecondary institution, 0 otherwise
Neither Parent: Any College	BYP34A, BYP34B	1 if educational attainment for both parents was at most a high school diploma or GED, 0 otherwise
Neither Parent: AA Degree	BYP34A, BYP34B	1 if neither parent earned an associate's degree nor enrolled at a 4-year institution, 0 otherwise
Neither Parent: Some BA	BYP34A, BYP34B	1 if educational attainment for both parents was at most an associate's degree, 0 otherwise
Neither Parent: BA Degree	BYP34A, BYP34B	1 if neither parent earned a bachelor's degree, 0 otherwise
One Parent: Any College	BYP34A, BYP34B	1 if educational attainment for only one parent was at most a high school diploma or GED, 0 otherwise
One Parent: AA Degree	BYP34A, BYP34B	1 if only one parent did not earn an associate's degree nor enroll at a 4-year institution, 0 otherwise
One Parent: Some BA	BYP34A, BYP34B	1 if educational attainment for only one parent was at most an associate's degree, 0 otherwise
One Parent: BA Degree	BYP34A, BYP34B	1 if only one parent did not earn a bachelor's degree, 0 otherwise
Female	BYS14	1 if sex = female, 0 otherwise

Variable Name	ELS:02 Variable	Description
Male	BYS14	1 if sex = male, 0 otherwise [Reference]
Missing: Gender	BYS14	1 if sex = missing, 0 otherwise
White	BYS17A	1 if race = only white, 0 otherwise [Reference]
Black	BYS17B	1 if race = only black, 0 otherwise
Asian	BYS17C	1 if race = only Asian, 0 otherwise
Hispanic	BYS15	1 if ethnicity = Hispanic or Latino/a, 0 otherwise
All Other Races	BYS17D, BYS17E	1 if race = all other categories (includes multiple races), 0 otherwise
Missing: Race	BYS17A-E	1 if race = missing, 0 otherwise
Missing: Ethnicity	BYS15	1 if ethnicity = missing, 0 otherwise
GPA Grade 9	F1RGP9	Freshman year grade point average (missing cases dropped)
Score: Math	BYPISAME	Score on mathematics test administered by the Program for International Student Assessment (PISA) in 2003 (missing cases dropped)
Score: Reading	BYPISARE	Score on reading test administered by the Program for International Student Assessment (PISA) in 2003 (missing cases dropped)
Number of Siblings	BYP08	Number of siblings as of grade 10. Includes adoptive, half- and step-brothers and sisters
Missing: Number of Siblings	BYP08	1 if number of siblings is not reported, 0 otherwise
Number of Dependents	BYP06	Number of people who are dependent on the parent or spouse/partner (not counting parents).
Missing: Number of Dependents	BYP06	1 if number of dependents is not reported, 0 otherwise
Income Below $20K	BYP85	1 if total family income in 2001 from all sources is $20,000 or less, 0 otherwise
Income $20K to $50K	BYP85	1 if total family income in 2001 from all sources is between $20,001 and $50,000, 0 otherwise

Variable Name	ELS:02 Variable	Description
Income $50K to $100K	BYP85	1 if total family income in 2001 from all sources is between $50,001 and $100,000, 0 otherwise [Reference]
Income Above $100K	BYP85	1 if total family income in 2001 from all sources is at least $100,001, 0 otherwise
Missing: Income	BYP85	1 if total family income in 2001 from all sources is not reported, 0 otherwise
Enrollments: Grade 10	BYG10ER	Number of students in the respondent's 10th grade level (in 100s)
School: Urban	BYURBAN	1 if school is located in an urban area, 0 otherwise
School: Suburban	BYURBAN	1 if school is located in a suburban area, 0 otherwise
School: Rural	BYURBAN	1 if school is located in a rural area, 0 otherwise [Reference]
School: Pct Free Lunch	BY10FLP	Percentage of students in the high school who received free lunch services (midpoints for categories used as values)
Missing: Pct Free Lunch	BY10FLP	1 if school is missing data on percent of students receiving free lunch, 0 otherwise
School: Pct AP	F1A22F	Percentage of high school student body in Advanced Placement (AP) classes
Missing: Pct AP	F1A22F	1 if school is missing data on percent of students taking an AP exam, 0 otherwise
School: Public	BYSCTRL	1 if school is public, 0 otherwise
School: New England	BYCENDIV	1 if Census division is New England (CT, ME, MA, NH, RI, VT), 0 otherwise
School: Mid Atlantic	BYCENDIV	1 if Census division is Middle Atlantic (NJ, NY, PA), 0 otherwise
School: E North Central	BYCENDIV	1 if Census division is East North Central (IL, IN, MI, OH, WI), 0 otherwise
School: W North Central	BYCENDIV	1 if Census division is West North Central (IA, KS, MN, MO, NE, ND, SD), 0 otherwise

Variable Name	ELS:02 Variable	Description
School: South Atlantic	BYCENDIV	1 if Census division is South Atlantic (DE, DC, FL, GA, MD, NC, SC, VI, WV), 0 otherwise
School: E South Central	BYCENDIV	1 if Census division is East South Central (AL, KY, MS, TN), 0 otherwise
School: W South Central	BYCENDIV	1 if Census division is West South Central (AR, LA, OK, TX), 0 otherwise
School: Mountain	BYCENDIV	1 if Census division is Mountain (AZ, CO, ID, MT, NV, NM, UT, WY), 0 otherwise
School: Pacific	BYCENDIV	1 if Census division is Pacific (AK, CA, HA, OR, WA), 0 otherwise [Reference]
Enroll in College FT	F2PS1FTP	1 if enrolled full time at first postsecondary institution
1st Attend Public College	F2PS1CTR	1 if first institution attended was public
1st Attend Private NP College	F2PS1CTR	1 if first institution attended was private not-for-profit
Planned STEM Major	F2B15	1 f planned major was in a STEM field (responses 4, 5, 6, 7)
Planned Business Major	F2B15	1 if planned major was business (response 1)
Pay for College w/Grants	F2B25A	1 if student used grants to help pay for college
Pay for College w/Loans	F2B25B	1 if student used loans to help pay for college