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College majors and social mobility

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Abstract

To further our understanding of social mobility in the United States, this study examines the role of major field of study during college, and the relationships between origin characteristics and education attainment. Data, collected in 2001, consisted of information on the college and labor market experiences of 4435 alumni from 30 colleges, as well as matched ACT data on alumni background and pre-college characteristics from three cohorts of college graduates up to 25 years after college. Results indicate that both placement on and movement along the social ladder are affected by college major, and the extent to which status is awarded based on merit relative to inherited economic resources is partially dependent upon major.

Keywords: Status attainment; Earnings; Higher education; College major

1. Introduction

For as long as human beings have existed, they have lived in stratified societies. Regardless of the time or place, societies have organized hierarchically, distributed valued goods according to positions, and employed rules and mechanisms to determine how individuals fill positions. Rigid societies are societies that allow little or no social mobility, where the chances of children winding up in the same hierarchical position as their parents are great. Conversely, open societies are characterized by the existence of individual social mobility, where children have legitimate opportunities to transcend the socioeconomic position of their parents.

In recent modern history, education has widely been viewed in open societies as the primary mechanism by which individuals can transcend the socioeconomic position of their parents or families. Blau and Duncan's (1967) status attainment research empirically demonstrated that the relationship between a father's and son's socioeconomic positions was mediated by the son's education attainment. However, long before the publication of Blau and Duncan's work, many believed education to be the best way of preventing the inheritance of poverty. Thomas Jefferson's legislative proposals (Lee, 1961), Horace Mann's speeches to the Massachusetts Board of Education (Kaestle, 1983), Horatio Alger's creative work (Gardner, 1971), and the writing of both Washington (1901) and DuBois (1953) reiterate the belief in the transformative or transcendent power of education.

Today, perhaps more than ever, Americans consider education to be the best way of getting ahead or having a better life than one's parents (Labaree, 1997). In the year 2000 there were more than 15 million students participating in the United State's post-secondary system, and

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that number is projected to increase roughly 20% by the year 2012 (Gerald & Hussar, 2002). America is in the midst of a 30-year trend of increasing educational attainment (NCES, 2002, 2004), where the earning premiums accompanying a bachelor's degree have steadily grown (Murphy & Welch, 1989; Pascarella & Terenzini, 2005). However, such trends do not necessarily mean that America is becoming a more open society or that instances of individual upward mobility are on the rise. The American higher education system increasingly reflects the differentiated and stratified American society (Labaree, 1990; Rhoades, 1987).

The expansion of higher education in the U.S. has been accompanied by considerable growth in participation as well as in the types of education alternatives available to students. However, institutions widely differ by cost, selectivity, social prestige, and programs of study, such that increased higher education participation and attainment do not necessarily lessen inequalities at the societal level. Under these circumstances socioeconomically advantaged groups have fewer opportunities to maintain their status by simply attaining *more* education. Instead, advantaged groups draw from their understanding of the higher education system and other social institutions in securing a *better* education. In other words, those with socioeconomic advantage may maintain their status position by securing quantitatively similar but qualitatively better education (Lucas, 2001). If the stratification of post-secondary education serves to maintain inequality and reproduce the social order (Bourdieu & Passeron, 1974; Collins, 1979; Lucas, 2001), then broad assertions that the U.S. is a relatively open society should be questioned.

Considerable amounts of research have demonstrated the lasting impact of higher education in general, and major field of study in particular, on subsequent earnings (e.g., Leslie & Brinkman, 1988; Pascarella & Terenzini, 1991, 2005). Additional studies have identified that college majors have an important role in status attainment (Ayalon & Yogev, 2005; Davies & Guppy, 1997; Knox, Lindsay, & Kolb, 1993; Smart, 1986; Smart & Pascarella, 1986; Wilson, 1978; Wilson & Smith-Lovin, 1983). Continuing along this line of inquiry, we examine the role of higher education attainment in social mobility by focusing on college majors in relation to status, which we define according to the earnings of college alumni. More specifically, in this study we identify, with respect to social mobility, those majors that are more or less meritorious. In other words, we identify majors that promote social mobility and majors that inhibit social mobility, in so far as social mobility is based on a combination of socioeconomic background and education characteristics. In the following sections we review evidence from past research on the effects of education attainment and college majors on earnings and occupational status, followed by our methods, results, discussion, and conclusion.

1.1. Previous research

Research on the earnings effects of higher education has tended to focus on the impacts of different forms of education attainment, differences in institutional academic selectivity, or fields of study, rather than on the mechanism by which higher education may indirectly transmit resources from one generation to the next. Although higher education, in general, has been found to have an important and lasting mediating influence on socioeconomic status, there is considerable evidence suggesting that this influence may not be uniform across all educational experiences.

From an economic perspective, higher education is an excellent investment, but one where the returns vary significantly by amount and type of education. In the U.S., after controlling for differences in individuals' background characteristics, a bachelor's degree leads to a 20–40% advantage in earnings when compared to a high school diploma (Leslie & Brinkman, 1988; Pascarella & Terenzini, 2005; Paulsen, 1998). Even after taking into account the costs of attending college, the earnings advantage of a bachelor's degree corresponds to a private rate of return between 5 and 15% per every dollar invested (Ehrenberg & Smith, 1997; Pascarella & Terenzini, 2005). What is more, the returns of associate's degrees, vocational certificates, and vocational training without an accompanying degree or certificate are, on average, significantly greater than the returns of a high school diploma (e.g., Grubb, 1997; Kerckhoff & Bell, 1998; Perna, 2003), while graduate education also has a lasting impact on earnings (Cohn & Geske, 1990; Ehrenberg & Smith, 1997; Leslie & Brinkman, 1988).

Though not as thoroughly researched as earnings, higher education has a very similar impact on occupational status, which generally has been based on the education and income levels of workers within specific occupations. However, unlike research on earnings, studies of occupational status have placed greater importance on variables pertaining to background and socioeconomic characteristics. Past research provides evidence that parents' socioeconomic characteristics, education attainment, and studying relatively scientific fields all have positive effects on occupational status which may ultimately depend on whether an occupation is profes-

sional or non-professional (Knox et al., 1993; Smart, 1986).

Furthermore, Smart and Pascarella (1986) analyzed 1971–1980 Cooperative Institutional Research Program (CIRP) data to estimate a causal model predicting socioeconomic status, defined according to a combination of one's degree attainment, income, and occupational status. Net of pre-college and college experience characteristics, family socioeconomic status and college major (defined as traditional liberal arts and sciences vs. professional fields) failed to have significant effects on socioeconomic status, although evidence did indicate that the primary impacts of family socioeconomic status and major were indirect, acting through a collection of intervening variables. Smart and Pascarella did not, however, single out specific variables that may individually mediate this relationship.

Across all levels of higher education attainment, significant earnings differences have been linked to differences in students' fields of study. As much as a 25–35% of the earnings effects of higher education have been shown to be directly related to majors (Pascarella & Terenizini, 2005), where those fields accompanying the largest earnings premiums tend to have distinct characteristics. The highest earning fields of study, in general, have a relatively specific and well-defined body of content knowledge, and focus on methods of inquiry requiring high levels of quantitative or scientific skills (e.g., Grubb, 1992; Knox et al., 1993; Rumberger & Thomas, 1993; Thomas, 2000, 2003). Such fields tend also to be more directly linked to specific jobs or occupations (e.g., Grubb, 1997; Rumberger & Thomas, 1993; Thomas, 2000; Wolniak, 2004). Van de Werfhorst (2002) has contributed evidence that different majors are investments in different types of educational resources, and it is the relationship between acquired educational resources and the skills required for a job that ultimately leads to the wage benefits associated with certain majors.

Riley (1982) introduced the notion that congruence, which he defined as the applicability of a college education to a job, could be used to evaluate economic theories and hypotheses related to education, productivity, and earnings, and provides a useful basis for interpreting the effects of congruence on earnings. For example, human capital theory assumes that education makes individuals more productive and that employers reward workers according to their levels of productivity (Becker, 1993; Schultz, 1963). While some have argued that formal schooling is primarily a screening devise that signals employers of the potential productivity and training costs of employees (e.g., Psacharopoulos, 1979; Spence, 1973; Stiglitz, 1975), others have viewed the rewards associated with an education as the means of maintaining existing class structures (Collins, 1979; Rubinson & Browne, 1994). The effect of congruence on earnings may reflect employers' tendencies to compensate workers with congruent education in the form of greater pay, based on expectations of productivity and training costs. Alternatively, a lack of effect of congruence on income may indicate reward structures based on methods of screening according to employee characteristics other than human capital.

Interestingly, Wilson (1978) defined "targeted education" to be the "relative probabilities for 'feeding into' high-level occupations" (p. 688), which were later found useful for explaining differences in the occupational prestige and wages of college graduates from the early1960s (Wilson & Smith-Lovin, 1983). This research highlights that, with respect to higher education, prestige and wage attainment should be considered distinct forms of occupational reward. While prestige is tied to occupational titles, wages may vary independent of occupational titles (Wilson & Smith-Lovin, 1983).

Interpreting research on the earnings differences across majors is further complicated by evidence that high status fields have been historically dominated by men (e.g., Dey, Wimsatt, Rhee, & Waterson, 1998; Turner & Bowen, 1999). Men tend to be over-represented in majors that are closely linked to the highest earning occupations while women tend to be over-represented in fields of study linked to lower paying occupations (e.g., Eide, 1994; Hearn & Olzak, 1981; Jacobs, 1996; Polachek, 1981; Wilson & Boldizar, 1990). Despite a gradual convergence in the gender distribution across majors over the last three decades, the weight of evidence clearly indicates that differences in academic field of study account for much, but not all, of the gender gap in earnings (Angle & Wissman, 1981; Eide, 1994; Freeman, Snyder, & Connolly, 2005; Grubb, 1997; Jacobs, 1996; Kerckhoff & Bell, 1998; Perna, 2003).

Overall, as reflected in more than three decades of status attainment and social mobility research, education attainment mediates the effects that individuals' background characteristics have on their abilities to obtain high-paying and prestigious jobs. In addition, research has demonstrated that individuals' status substantially differ according to their college majors, with the greatest advantages going to those fields that are relatively more quantitative and scientifically oriented, fields that are more functionally linked to jobs, and fields that have traditionally been over-represented by men. Altogether, this evidence suggests that the mediating role of education attainment may differ by college major.

While none of the studies reviewed above isolated the mediating, or indirect, effects of education attainment, there is evidence that the role of education attainment in the transmission of socioeconomic status may differ by college major. Two studies have explicitly examined the relationships between major fields of study, status attainment, and mobility. Davies and Guppy (1997) identified field of study along with institutions' academic selectivity as the primary axes of stratification in higher education, and focused on the influence of students' ascriptive characteristics in selecting a field of study to explain lingering stratification at the societal level. Davies and Guppy estimated the effects of ascriptive, socioeconomic, and academic ability characteristics on the selectivity of institutions attended, as well as on the degree to which a field of study may be financially lucrative (constructed from average earnings statistics for occupational fields that were assumed related to given majors). Based on their findings, Davies and Guppy contributed important evidence that more lucrative majors are disproportionately male, and that college's selectivity and students' fields of study interact in ways that perpetuate stratification. More recently, Ayalon and Yogev (2005) found that in Israel, educational inequality was maintained even as higher education opportunities expanded, primarily due to a concurrent increase in the stratification within the higher education system. Ayalon and Yogev's evidence supports Lucas' (2001) model of Effectively Maintained Inequality and provides additional evidence that women are over-represented in traditionally female and non-selective fields of study. However, neither Davies and Guppy nor Ayalon and Yogev incorporated a direct measure of status into their study, relying instead on assumptions about how the characteristics of majors and institutions may signal status.

1.2. Purpose and research questions

The purpose of this study is to improve our understanding of education attainment and social status by concentrating on the impact of college major. We examine how socioeconomic status is transmitted from parents to their college-going children by focusing on education attainment and distinct fields of study while in college in relation to socioeconomic status, as indicated by labor market earnings. We test the effects of several background characteristics (such as gender, parents' education and income, as well as educational and regional variables) on the earnings of three cohorts of college graduates 5, 15, and 25 years after college to disentangle observed differences in the earnings of college alumni. Specifically, we sought answers to the following two questions.

1.2.1. Research Question 1

Are the effects of background characteristics and educational attainment on earnings conditional on college major? In other words, do the effects of background and pre-college characteristics, as well as higher education and education attainment variables differ by college majors? This research question examines the degree to which college majors affect status attainment, or placement on the social ladder.

1.2.2. Research Question 2

To what degree do the mediating effects of education attainment on earnings differ by college major? In other words, how do college majors alter the effect of education on the relationship between background characteristics and earnings? This research question examines the degree to which college majors affect social mobility, or movement on the social ladder.

Taken together, these research questions enable us to consider college majors as more or less meritorious, and whether or not education attainment has a different sociological meaning for students studying different fields. We will consider college majors to be more meritorious if the earnings effect of an education is large within a major relative to the effects of background characteristics within the same major. Conversely, we will consider college majors to be less meritorious if the earnings effect of an education is small within a major relative to the effects of background characteristics within the same major.

2. Methods

2.1. Data

Our data consisted of information provided by alumni from thirty private and public colleges in the Appalachian Region, collected in 2001, with the purpose of studying the effects of attending a small group of liberal arts colleges, compared to attending one of several public regional institutions, on the personal and occupational lives of their graduates. As officially designated by the Appalachian Regional Commission, the Appalachian Region is a large geographical region in the eastern continental United States. It is generally contiguous with the Appalachian mountain range and officially extends from southern New York State south to northern Mississippi and Alabama. The thirty private and public colleges in the study were primarily located in what is known as the "Central Appalachian Region." This specific region

includes parts of the states of Kentucky, Virginia, West Virginia, North Carolina, and Tennessee.

An Alumni Survey was used to collect information on current work experiences and retrospective college experiences of three cohorts of alumni (the classes of 1974–1976, 1984–1986, and 1994–1996) from twenty liberal arts colleges located in and around Central Appalachia, five public regional institutions, and five liberal arts colleges that instituted a work program for their student body, all located in the same general region. The survey instrument sent to prospective alumni participants captured a wide range of information, including: background information (e.g., birth year, race, gender, parents' education attainment, marital status, work status), education and college experiences (e.g., education attainment, college major, college grades), employment experiences (e.g., job satisfaction, annual salary/income), and geographic location (e.g., living and working in the Appalachian Region). The alumni survey yielded an overall response rate of 27% across all institutions and cohorts. These data were then matched to information from the ACT Assessment that the participants took prior to college, adding data on ACT scores, high school academic accomplishments, demographic characteristics, and educational aspirations. Together these sources produced an overall sample of 7083 alumni.

To make the data more representative of the overall population of alumni and to adjust for potential non-response bias, we weighted the data by gender and institution, within each graduation cohort. Using figures provided by ACT, Inc. on student characteristics at the participating institutions during each of the three graduation cohorts, we developed a sample-weighting algorithm. For example, if an institution had 200 women graduate from 1994–1996, and we only had 100 women from that institution and that cohort in our sample, data representing those particular female graduates were given a weight of 2.00. While such a weighting procedure could not adjust for non-response bias, it did make the sample analyzed more representative of the estimated population of alumni by gender, institution, and graduation cohort.

The analytic sample was defined according to two criteria. First, our sample included only alumni who reported earnings information and employment status. Second, because the focus of this study is college major, we only included those individuals who had studied a major that fit into one of eight categories. We purposely excluded those respondents who studied fields such as "cross-disciplinary studies," "community and personal services," and "other" due to ambiguities related to what these majors represent both economically and socially. Based on these criteria our sample consisted of 5244 alumni. We additionally conducted mean or median substitutions for all continuous variables with missing data, and eliminated those records accompanying missing data for categorical variables. These steps produced a final analytic sample of 4435 alumni. Table 1 describes the variables in our models in terms of these 4435 alumni.

2.2. Model and analysis

Using multiple regression techniques, our analysis consisted of three stages. In the first stage, we applied a variation on the standard log-linear Mincerian (Mincer, 1974) earnings function to identify the general effects of demographic, socioeconomic, and pre-college characteristics, as well as higher education experiences and education attainment. The log-linear form corrects for positively skewed earnings distributions and allows unstandardized regression coefficients to approximate percent differences, or proportional changes, in earnings due to incremental changes in predictor variables (Björklund & Kjellström, 2002; Rosenfeld & Kalleberg, 1990).

$$\ln \boldsymbol{Y} = a_0 + a_1\boldsymbol{X} + a_2\boldsymbol{S} + a_3\boldsymbol{A} + a_4\boldsymbol{W} + e \quad (1)$$

In Eq. (1) $\boldsymbol{Y}$ represents annual earnings reported for the most recent year (collected in 2001) in categories of varying intervals (1 = \$0, not employed; 2 = \$14 999 or less; 3 = \$15 000–19 999; 4 = \$20 000–24 999; 5 = \$25 000–29 999; 6 = \$30 000–39 000; 7 = \$40 000–49 999; 8 = \$50 000–74 999; 9 = \$75 000–99 999; 10 = \$100 000–124 999, 11 = \$125 000 or more). We assigned midpoint dollar values for each response interval to make earnings more appropriate for analysis. While there is no standard approach for assigning a value for an open-ended category, we followed the Pareto approximation technique specified by Parker and Fenwick (1983) to estimate a midpoint value. The final range for $\boldsymbol{Y}$ was \$7500–189 726.

Additionally, we excluded respondents in the first category to limit our analysis to alumni who reported being employed and earning an income within the previous year. While this selection prevents our study from being general to all alumni from our sample of institutions, it allows us to better understand the effects of majors on earnings and the mechanisms acting on this relationship. In the absence of information on the reasons that alumni may have been unemployed, we eliminated unemployed alumni from our analytic sample. After eliminating cases with missing data in all other variables in our model, less

Table 1
Descriptive statistics ($N = 4435$)

	Mean	S.D.	Minimum	Maximum	Label
Demographic, family and pre-college academic characteristics					
Male	.45	.50	.00	1.00	MALE
White	.97	.16	.00	1.00	WHITE
Married	.76	.43	.00	1.00	MARRIED
Dependent children	.66	.47	.00	1.00	CHILDREN
Graduated from undergraduate institution					
1974–1976	.35	.48	.00	1.00	COHORT1970s
1984–1986	.31	.46	.00	1.00	COHORT1980s
1994–1996	.34	.47	.00	1.00	COHORT1990s
Mothers' education attainment (years)	13.08	2.22	10.00	20.00	MOMED
Fathers' education attainment (years)	13.37	2.82	10.00	20.00	DADED
Family income (standardized)	10.06	.98	7.22	12.91	FAMINC
Lived in Appalachia during high school	.64	.48	.00	1.00	LIVEAPP
ACT composite score	21.72	4.33	4.00	33.00	ACADABILITY
Education aspirations (years)	17.10	1.86	12.00	20.00	EDASPIRE
College characteristics					
College mean ACT composite score	21.35	1.07	18.91	23.62	SELECTIVITY
Private liberal arts college	.60	.49	.00	1.00	LIBARTS
Public regional institution	.28	.45	.00	1.00	PUBREG
Work college	.12	.33	.00	1.00	WORKCOLL
College major[a]					
Math/Computer Science/Engineering	.05	.22	.00	1.00	MCE
Business	.16	.37	.00	1.00	BUSINESS
Health Sciences	.12	.33	.00	1.00	HEALTH
Sciences (Biological and Physical)	.10	.30	.00	1.00	SCIENCE
Social Sciences	.13	.34	.00	1.00	SOCSCI
Technical and Applied fields	.08	.27	.00	1.00	TECH
Education	.23	.42	.00	1.00	EDUC
Arts and Humanities	.14	.34	.00	1.00	ARTHUM
Higher education attainment (years)	4.93	1.43	1.00	8.00	YRSHIED
Employment characteristics					
Work full-time	.89	.31	.00	1.00	FULLTIME
Work at a for-profit organization	.37	.48	.00	1.00	FORPROFIT
Work in the Appalachian Region	.50	.50	.00	1.00	WORKAPP
Relatedness of most recent degree and job	3.29	1.07	1.00	4.00	JOBMATCH
Earnings characteristics					
Annual income ($\$_{\text{year 2001}}$)	$48748.94	$35656.76	$7500.00	$189726.00	
Natural log of annual income	10.59	.64	8.92	12.15	

[a] Gender concentration of majors (% female), in descending order: HEALTH = .87, EDUC = .73, TECH = .56, ARTHUM = .48, SOCSCI = .43, BUSINESS = .39, SCIENCE = .38, MCE = .38.

than 0.5% of alumni reported zero earnings. Importantly, we did not restrict our sample to full-time employees, as we conceived of part-time vs. full-time work to provide a useful proxy for balancing family circumstances and employment demands (e.g., Rosenfeld & Kalleberg, 1990).

$\boldsymbol{X}$ is a vector of demographic, family, and pre-college academic characteristics. The demographic and family variables are consistent with the origin characteristics commonly found in status attainment models (Blau & Duncan, 1967), including gender, race, parental education attainment, pre-college family income, and whether or not alumnus lived in the Appalachian Region at the time he or she graduated from high school. To control for the confounding influence of pre-college academic ability, we included each participant's composite score on the ACT assessment taken at the time they were applying to college up to 30 years prior to completing the Alumni Survey. The ACT assessment is designed to measure general educational development and academic achievement in English, reading, mathematics, and science.

Grounded in the social psychological model of status attainment (Haller & Portes, 1973; Otto & Haller, 1979; Sewell, Haller, & Portes, 1969), vector ***X*** also includes a variable of educational aspirations prior to college. Finally, given the role life cycle development plays in affecting education attainment (Alexander & Reilly, 1981; Hanson, 1983; Lowe & Witt, 1984; Marini, 1978, 1984), we incorporated variables representing marital status, whether one has dependent children, and college graduation cohort (mid-1970s, 1980s, or 1990s).

S is a vector of schooling variables intended to capture qualitative differences in the undergraduate college experience. Based generally on college impact models (e.g., Pascarella & Terenzini, 2005) and specifically on models of undergraduate socialization (e.g., Vreeland & Bidwell, 1966; Weidman, 1989), formal and informal institutional contexts contribute to the ongoing socialization of students. Students' socialization, in turn, influences their development of values, aspirations, and career choices. As such, we control for differences in institutional and programmatic characteristics.

Specifically, ***S*** is comprised of the academic selectivity of the institution attended based on each institution's mean ACT composite score (e.g., Bowen & Bok, 1998; Pascarella et al., 2006; Rumberger & Thomas, 1993). By including academic selectivity of institutions in our model we intended to control for differences in prestige and selectivity, which Davies and Guppy (1997) have identified as key variables related to stratification in the U.S. post-secondary system.

S also consists of dichotomous variables indicating the type of institution attended, as well as undergraduate major field of study. Based on the fields of study alumni specified from a list of 23 major and occupational categories developed by ACT, Inc., we created eight dichotomous variables corresponding to distinct major fields. Numerous studies have addressed college majors in relation to actual or expected labor market earnings (e.g., Ayalon & Yogev, 2005; Davies & Guppy, 1997; Grubb, 1992, 1997; Knox et al., 1993; Thomas, 2000, 2003; Van de Werfhorst, 2002). Accordingly, we conceptually organized majors into two groups. The first group – majors we expect to be relatively high earnings fields – includes the following: Mathematics, Computer Science, and Engineering ($n = 217$); Business and Business Related Fields ($n = 709$); Health Sciences and Allied Health Fields ($n = 513$) and Biological and Physical Sciences ($n = 458$). The second group – majors we expect to be relatively low earnings fields – includes the following: Social Sciences ($n = 574$); Technical and Applied Fields ($n = 346$); Education ($n = 1017$); and Arts and Humanities ($n = 601$). Importantly, past research has also demonstrated that those majors we have included in the first group tend to be more directly linked to jobs, accompany a defined body of content knowledge, and foster development of quantitatively and technically oriented skills. Research has also shown that high earnings majors tend to be more male-dominated.

Table 2
Major and occupational categories by major field of study

Major	Alumni survey categories of major and occupational fields
Math, Computer Science, or Engineering	Computer and Information Sciences
	Engineering (pre-engineering)
	Mathematics
Business	Business and Management
	Marketing and Distribution
Health Sciences	Health Sciences and Allied Health Fields
Sciences	Sciences (Biological and Physical)
Social Sciences	Social Sciences
Technical or Applied	Agriculture
	Architecture and Environmental Design
	Business and Office
	Engineering-Related Technologies
	Home Economics/Family and Consumer Services
	Trade and Industrial
Education	Education
Arts & Humanities	Foreign Languages
	Letters
	Religion, Philosophy, and Theology
	Visual and Performing Arts

Note: Alumni who majored in fields "Communications & Communications Technology", "Community & Personal Services", "Cross-Disciplinary Studies", or "Other" could not be combined into a single category and were counted as missing. See Appendix A for List of College Majors and Occupations from which alumni identified their college majors.

Table 2 shows how the 23 major and occupational categories comprise these eight major fields. Furthermore, Appendix A provides the List of College Majors and Occupations that accompanied the Alumni Survey questionnaires, containing sub-groups of fields intended as examples from which alumni could gain a clear sense of the category best describing their previous majors and current occupations. Also related to alumni education, ***A*** is a single variable representing higher education attainment in years, ranging from 1 (e.g., Voc./Tech. certificate) to 8 (e.g., Ph.D., Ed.D., MD).

Finally, to control for the influences of labor markets and work experiences on earnings, $\boldsymbol{W}$ is vector of employment characteristics representing full-time employment, whether one worked at a for-profit organization, and whether one's job was in the Appalachian Region. Additionally, $\boldsymbol{W}$ includes a measure of alumni perceptions regarding the relatedness, or congruence, of their most recent degree to their current job (coded 1 = not at all related to 4 = highly related). Congruence has been used to examine social–psychological and economic implications of majors in relation to jobs, and is an important covariate to studying the earnings of college graduates (e.g., Grubb, 1997; Holland, 1997; Knox et al., 1993; Riley, 1982; Van de Werfhorst, 2002). Our measure of congruence isolates the relationship between an undergraduate major and a current jobs *only* if one's most recent degree was at the baccalaureate level. It therefore provided only a general control for alumni educational backgrounds in relation to their current jobs. Finally, variable e represents random error.

In this first stage of analysis, blocks of variables were entered into Eq. (1) sequentially to isolate the variance in earnings explained by sets of predictor variables. The fully specified model was estimated by statistically controlling for differences in employment experiences. By statistically holding constant other potentially confounding variables, full model estimates isolate the variance in earnings that could be explained by the variance of any given predictor variable, independent of the covariance between earnings and employment characteristics.

In the second stage of analysis we sought to identify if earnings effects differed by major. We re-estimated Eq. (1) for sub-samples of alumni based on their college majors, excluding the employment characteristics found in the fully specified model in order to estimate indirect effects in the third stage of analysis (with higher education attainment ($\boldsymbol{A}$) defined as the mediating variable). Eq. (2) corresponds to this model, where m represents one of eight college majors. $\boldsymbol{S}'$ is a vector of schooling variables as defined above, but excluding college major. Vectors $\boldsymbol{X}$ and $\boldsymbol{A}$ are as previously defined, and u represents random error.

$$\ln \boldsymbol{Y}_m = b_0 + b_1 \boldsymbol{X}_m + b_2 \boldsymbol{S}'_m + b_3 \boldsymbol{A}_m + u_m \tag{2}$$

Eq. (2) characterizes a direct effects model, where the effects of each predictor variable on earnings are assumed not mediated by any intervening variables (McClendon, 1994). Importantly, the fully standardized coefficient estimates in this stage of analysis allow for the comparison of effects within each sample population (based on major), while unstandardized (or, metric) coefficient estimates allow for the comparison of effects for any given predictor across sample populations (Pedhazur, 1982). In addition, to identify predictor variables that may have significantly different effects on earnings for alumni with different majors, sets of cross-products were added to Eq. (1), with each set representing a specific major (e.g., [Arts and Humanities major (vs. all others) × family income], [Arts and Humanities major (vs. all others) × education aspiration], etc.). Using t-tests of individual cross-product estimates, we were able to identify those variables within any given major that were significantly different from the average effects among the other majors.

Finally, in the third stage of analysis we estimated the mediating effects of higher education attainment for each sample of alumni based on college major. We first regressed the education attainment variable ($\boldsymbol{A}$) on vectors $\boldsymbol{X}$ and $\boldsymbol{S}'$. Eq. (3) represents this step, with v indicating random error.

$$\boldsymbol{A}_m = c_0 + c_1 \boldsymbol{X}_m + c_2 \boldsymbol{S}'_m + v_m \tag{3}$$

After substitutions, Eq. (2) could be re-written as:

$$\ln \boldsymbol{Y}_m = (b_0 + b_3 \cdot c_0) + (b_1 + b_3 \cdot c_1)\boldsymbol{X}_m + (b_2 + b_3 \cdot c_2)\boldsymbol{S}'_m + (u + b_3 \cdot v)_m \tag{4}$$

Eq. (4) depicts a total effects model, where the estimated effects of predictor variables are the mathematical sum of each variable's direct and indirect effects, equivalent to the effects of each predictor variable in a model excluding the mediator (in this case, $\boldsymbol{A}$). Conceptually, a total effect represents the change in a dependent variable resulting from an incremental change in a predictor variable, "irrespective of the mechanisms by which the change may occur" (Alwin & Hauser, 1975, p. 39).

For each variable, b_i represents the estimated direct effect on log-earnings. In addition, $b_i \cdot c_j$ represents the estimated indirect effect on log-earnings that are mediated by higher education attainment, obtained by multiplying standardized coefficient estimates of predictor variables on education attainment (c_i), by the standardized coefficient estimates of education attainment on earnings (b_3) (Alwin & Hauser, 1975; McClendon, 1994). Conceptually, indirect effects are the change in a dependent variable resulting from an incremental change in independent variables acting solely through an intervening, or mediating, variable (McClendon, 1994). In each case where indirect effects were estimated, Preacher and Leonardelli's (2006) Sobel Test Application was used to identify statistical significance.

Altogether, our analysis allowed us first to assess the degree to which variables in our model explain the vari-

ance in alumni earnings (see Eq. (1)). Second, we were able to identify if those variables that affect earnings are general (the same for all alumni), or conditional on college major (see Eq. (2)). And third, we were able to identify if and to what extent the mediating effects of education attainment differ according to college majors (see Eq. (4)).

2.3. Limitations

The longitudinal nature of these data allowed for the statistical control for differences across a range of demographic, socioeconomic, and educational characteristics important to social mobility. However, this study had noteworthy limitations.

First, our sample of institutions and their alumni from three graduation cohorts represent only a small proportion of the American post-secondary system. While this ultimately threatens the external validity of our study, the sample offers a unique context for analyzing education in relation to social mobility. Historically linked to economic distress, considerable educational and economic variation exists within the Appalachian Region (McLaughlin, Lichter, & Matthews, 1999; Pollard, 2003). Based on the 2000 Census, increases in the education attainment of the region have exceeded the general United States population, but on average the region still lags behind the rest of the country (Pollard, 2003). Thus, our sample of thirty institutions in and around Central Appalachian, while limited in terms of generalizability, offers a unique opportunity to study education in relation to social mobility in a context of an increasingly educated but structurally constrained region.

Second, because this is a study of college alumni, our measure of education attainment is positively skewed in comparison to more representative populations. Our alumni sample contains education attainment levels ranging from vocational/technical certificate or diploma, to doctorate and professional degrees. The large majority of the sample had attained a 4-year degree or more, while the sample was relatively evenly distributed between alumni who had completed 4 years of higher education and those who had completed more than 4 years. Our study was therefore challenged by the fact that we did not have a comparison group of individuals who had not completed any higher education, and proportionately few who had completed only 1 or 2 years of college. This particular challenge further limited the generalizability of our findings.

Third, as with almost every study based on survey data, non-response bias potentially limits the results of this study. To reduce this threat, we developed population weights by comparing the available pre-college data to the population of alumni by gender, institution, and cohort. This enabled us to use expected population values to improve the representativeness of responses and correct for sample bias on these three characteristics. Nevertheless, error introduced by alumni who were unable or unwilling to participate in this study could not be fully eliminated.

Finally, this study is based on testing a theoretical model of social mobility. As such, our findings either support or fail to support the model, but need to be estimated on other, more nationally representative data. All aspects of this study should be viewed in light of these limitations.

3. Results

The results we report are weighted sample estimates, adjusted to the actual sample size to obtain correct standard errors. Because of the large sample size ($N = 4435$) statistical significance is identified at $p < .01$ for estimates of the overall sample (i.e., results from the first stage of analysis). Due to the reduced sample sizes when disaggregated by college major, a more liberal $p < .05$ was applied when testing for statistical significance in the second and third stages of the analysis.

Table 3 presents estimated effects based on the model depicted in Eq. (1). The unstandardized (metric) coefficient estimates represent the average, statistically adjusted change in dependent variables (approximately the percent change in earnings) that is expected from a unit increase in the predictor variable in the original metric of each variable. Parentheses contain standardized coefficient (beta) estimates representing the standard deviation (S.D.) change in a dependent variable associated with a one S.D. change of the independent variable, holding constant all other variables in the model.

Generally consistent with previous research, Table 3 illustrates three main findings. First, among background variables and regardless of model specification, men reported significantly greater earnings than women, the effects of graduation cohort (a proxy for number of years working) were both positive and non-linear, and family income had a persistent and positive effect. Alternatively, race, marital status, children, parents' education, and living in Appalachia prior to college had weak and generally insignificant effects. Finally, while the effects of pre-college academic ability and educational aspirations were positive, the size of the effects is small and statistical significance depended on the model specification.

Second, among education variables, several majors were associated with significantly greater earnings fol-

Table 3
Estimated metric (beta) coefficients predicting year 2001 log-earnings ($N = 4435$)

Independent variables	I	II	III	IV
MALE	.365** (.283)	.341** (.264)	.321** (.249)	.235** (.182)
WHITE	.023 (.006)	.045 (.011)	.042 (.028)	−.008 (−.002)
MARRIED	.052 (.035)	.043 (.029)	.043 (.028)	.042 (.028)
CHILDREN	−.011 (−.008)	−.012 (−.009)	.002 (.002)	.024 (.018)
COHORT1980s[a]	−.169** (−.122)	−.206** (−.149)	−.180** (−.130)	−.169** (−.122)
COHORT1990s[a]	−.441** (−.326)	−.478** (−.353)	−.414** (−.306)	−.399** (−.295)
MOMED	−.008 (−.027)	−.006 (−.021)	−.010 (−.033)	−.011* (−.038)
DADED	−.004 (−.019)	−.001 (−.007)	−.002 (−.011)	−.001 (−.004)
FAMINC	.091** (.019)	.074** (.112)	.074** (.113)	.070** (.107)
LIVEAPP	.021 (.016)	−.022 (−.017)	−.033 (−.025)	.053* (.040)
ACADABILITY	.007** (.048)	.006* (.040)	.002 (.012)	.001 (.010)
EDASPIRE	.024** (.068)	.020** (.057)	.010 (.029)	.013* (.037)
SELECTIVITY		−.003 (−.004)	−.012 (−.021)	−.012 (−.020)
LIBARTS[b]		.040 (.031)	.034 (.026)	.051 (.039)
PUBREG[b]		.083* (.058)	.077 (.054)	.066 (.046)
College major (EDUC = 0)				
MCE		.392** (.132)	.453** (.152)	.289** (.097)
BUSINESS		.301** (.172)	.391** (.223)	.223** (.127)
HEALTH		.223** (.111)	.345** (.172)	.293** (.146)
SCIENCE		.201** (.096)	.180** (.086)	.161** (.076)
SOCSCI		.031 (.016)	.064 (.033)	.050 (.026)
TECH		−.003 (−.001)	.104* (.044)	−.003 (−.001)
ARTHUM		−.112** (−.060)	−.083* (−.044)	−.102** (−.055)
Education attainment				
YRSHIED			.107** (.239)	.088** (.196)
Employment characteristics				
FULLTIME				.612** (.295)
FORPROFIT				.291** (.219)
WORKAPP				−.154** (−.120)
JOBMATCH				.076** (.127)
R^2	.204	.261	.307	.443
ΔR^2		.057**	.046**	.136**

[a] Dummy variable compared against COHORT1970s.
[b] Dummy variable compared against WORKCOLL.
* $p < .01$.
** $p < .001$.

lowing college, while institution-specific variables (i.e., selectivity and type) had mostly insignificant effects. More specifically, as expected, in comparison to Education majors and controlling for education attainment (see column III), the greatest positive earnings differences existed for alumni who majored in Math/Computer Science/Engineering ($b = .453$, or approximately 45%), Business ($b = .391$), Health Sciences ($b = .345$), and to lesser extents, Science ($b = .180$) and Technical/Applied programs ($b = .104$). Arts and Humanities majors, on the other hand, reported approximately 8.3% ($b = -.083$) lower earnings than Education majors. After taking into account differences in employment characteristics, the significance of these majors tended to remain the same while their magnitudes decreased. In addition, each additional year of higher education increased earnings an average of 8.8% ($b = .088$) to 10.7% ($b = .107$) depending on model specification, and explained nearly 5% of the variance in earnings ($\Delta R^2 = .046$), net of background and other education variables.

Third, employment characteristics had large and significant effects on earnings, including 61% ($b = .612$) greater earnings for full-time (vs. part-time) workers, a 29% ($b = .291$) premium for working at a for-profit organization, and 15% less ($b = -.154$) earnings for working in the Appalachian Region. In addition, irrespective of college majors, the relatedness of most recent degrees to current jobs had a positive and significant

effect on earnings. Simultaneously, over one-quarter of the explanatory power of the full model was attributable to employment characteristics.

Altogether, these results are consistent with an abundance of previous research. The variables with relatively the greatest impact on earnings include gender, graduation in the 1970s vs. the 1990s, education attainment, and full-time, for-profit employment. Among education variables, more narrowly specified and well-defined majors proved to be the most financially rewarding. These results also provided the basis for our second stage of analysis, where we estimated earnings effects among sub-samples of alumni grouped by their major field of study. Accordingly, Table 4 presents the direct effects of origin and education variables on earnings for each major.

Net of background and education variables, but not controlling for employment characteristics, we found that males reported significantly greater earnings than females within any given field of study, while large differences also were found between fields of study. For instance, Math/Computer Science/Engineering, as well as Technical or applied fields accompanied greater than a 48% earning advantage for men, while Education accompanied earnings differences of less than half this magnitude (approximately 20%, or $b = .200$).

In terms of graduation cohort, the greatest differences were found in comparing graduates from the 1970s to graduates from the 1990s. For this comparison, net of education attainment and all control variables, alumni who studied a Science or Social Science field reported the greatest growth in earnings while those who studied Health Sciences and Education reported the smallest growth in earnings. Additionally, with respect to the earnings effects of fathers' education and with the exception of the above average effects among Social Science majors, the only statistically significant effects parents' education had were negative, as evidenced by the effect of mothers' education among Health Sciences alumni, and for fathers' education among Math/Computer Science/Engineering alumni. Furthermore, the earnings effects of living in Appalachia as well as pre-college education aspirations failed to be statistically significant across all sample populations.

Interestingly, pre-college family income and higher education attainment, which had significant and positive general effects (as shown in Table 3), persisted across the majority of our major-specific populations. The direct effects of family income on earnings were positive and significant for all majors except Health Sciences and Technical/Applied fields, while the impact of

Table 4
Metric (beta) coefficients predicting year 2001 log-earnings by college major

Independent variables[a]	Math, Comp. Sci., or Engr.	Business	Health Sciences	Sciences	Social Sciences	Technical or Applied	Education	Arts & Humanities
MALE	.505$^{**,\#}$ (.379)	.368** (.273)	.407** (.240)	.248** (.165)	.297** (.219)	.489$^{**,\#}$ (.362)	.208$^{**,\#}$ (.192)	.306** (.246)
COHORT1980s[b]	−.260* (−.189)	−.214** (−.160)	−.082 (−.067)	−.154* (−.100)	−.149* (−.096)	−.230** (−.156)	−.144** (−.126)	−.211** (−.164)
COHORT1990s[b]	−.398** (−.291)	−.473** (−.348)	−.201$^{**,\#}$ (−.175)	−.550$^{**,\#}$ (−.348)	−.575$^{**,\#}$ (−.423)	−.370** (−.251)	−.325$^{**,\#}$ (−.307)	−.431** (−.306)
MOMED	.008 (.029)	−.002 (−.006)	−.036$^{**,\#}$ (−.131)	−.019 (−.059)	−.020 (−.076)	.012 (.038)	−.012 (−.051)	−.001 (−.005)
DADED	−.037$^{*,\#}$ (−.168)	−.015 (−.057)	−.001 (−.005)	−.020$^{\#}$ (−.089)	.020$^{\#}$ (.091)	−.008 (−.034)	.003 (.018)	.014 (−.065)
FAMINC	.134** (.178)	.103** (.152)	.033$^{\#}$ (.059)	.139** (.183)	.109** (.150)	.044 (.065)	.029$^{*,\#}$ (.060)	.082** (.130)
LIVEAPP	−.122 (−.088)	−.033 (−.024)	−.053 (−.035)	.098$^{\#}$ (.066)	.019 (.014)	−.065 (−.048)	−.012 (−.012)	−.089 (−.071)
EDASPIRE	.036 (.089)	.006 (.017)	−.006 (−.022)	.026 (.065)	−.012 (−.032)	.032 (.088)	−.016$^{\#}$ (−.052)	.027$^{\#}$ (.085)
YRSHIED	.045 (.089)	.147** (.231)	.093** (.257)	.150$^{**,\#}$ (.357)	.068$^{**,\#}$ (.151)	.066$^{*,\#}$ (.123)	.134$^{**,\#}$ (.297)	.094** (.208)
R^2	.378	.299	.218	.404	.338	.252	.280	.218
n	217	709	513	458	574	346	1017	601

[a] In addition to variables shown, models additionally included: WHITE, MARRIED, CHILDREN, ACADABILITY, SELECTIVITY, LIBARTS (vs. WORKCOLL), PUBREG (vs. WORKCOLL).
[b] Dummy variable compared against COHORT1970s.
* $p < .05$.
** $p < .01$.
\# Coefficient significantly ($p < .05$) different from the combined average of all other majors.

family income was significantly less than average among Education and Health Science majors.

Aside from gender and graduate cohort, among the origin and education variables, education attainment had the greatest impact with the exception of those who majored in Math/Computer Science/Engineering fields. Significant effects of education attainment ranged from about 6% earning increase per additional year of education for Technical/Applied majors, to over 13% per year for Business, Education, and Science majors.

Overall, in terms of *Research Question 1*, our results indicate that the explanatory power of the earnings model differs across distinct populations of alumni. The percent of earnings variance explained by the direct effects model (R^2) ranged from 21.8% among Arts and Humanities and Health Sciences majors, to 40.4% among Science majors. In addition, it appears that origin and education variables have different effects on earnings for alumni who majored in different fields while in college in terms of both the direction and magnitude of the effects. For a closer look at the form of these effects, in our third stage of analysis we focused on the mediating role of education attainment.

To address *Research Question 2*, we estimated the mediating effects of education attainment, where Table 5 presents the standardized effects (beta coefficients) for origin and education variables. Table 5 clearly illustrates that education attainment does not uniformly mediate the effects that background characteristics have on earnings. For example, education attainment significantly mediated the earnings effects of several pre-college characteristics among Health Sciences and Social Sciences majors, while among Math/Computer Science/Engineering majors (one of the highest earnings majors in our sample) years of completed higher education had only a trivial role in mediating the effects of gender, parents' education, family income, living in Appalachia prior to college, or graduation cohort. Among Arts and Humanities majors (the field associated with the lowest earnings in our sample), alumni education attainment significantly and positively mediated the earnings effects of gender and living in Appalachia prior to college, while negatively mediating the effects of graduating in the 1990s cohort. For Arts and Humanities majors, these mediating effects served to reinforce the direct effects we found for gender and graduation cohort, while offsetting the earnings effects of having lived in Appalachia.

Interestingly, the negative direct effects we found mothers' education to have among Health Sciences majors in the previous stage (see Table 4) were somewhat offset by the significantly positive indirect effects mediated by education attainment. In other words, mothers' education had a positive influence on alumni education attainment, which in turn led to significantly greater earnings. Holding education attainment constant, mothers' education had the opposite effect on earnings. Among Social Science majors, mothers' education also had a significant positive mediating effect, compensating for an insignificant direct effect. The only significant influences that education attainment had in mediating the effects of fathers' education were among Business and Health Sciences majors.

The persistent positive direct effects we found family income to have on earnings for most majors were not reflected in effects mediated by education attainment. The only case where education attainment did mediate family income was among Science majors, and the mediating effect served to reinforce the positive direct effect previously found. Thus, among Science majors, one's earnings were significantly enhanced by one's level of family income prior to college, as well as one's education attainment, which additionally enhanced earnings. Among Arts and Humanities majors, a different pattern emerged for the effects of family income. In this case we found the direct effect of family income among Arts and Humanities majors to be significant and positive, while the mediating influence of education attainment was moderate in size, not statistically significant, and negative.

Finally, the most persistent earnings effect mediated by education attainment proved to be graduation cohort. It appears that the mediating effects of education attainment served primarily to reinforce the earnings effects of graduation cohort, and were most pronounced for the earnings differences between 1970s and 1990s graduates. It is likely that the most recent cohort of alumni had not attained as much education as their 1970s counterparts, which in combination with fewer years of work experience served to significantly suppress their earnings. Aside from graduation cohort, the most persistent mediating effects of education attainment were related to alumni education aspirations prior to college. The education aspirations of alumni who studied Business, Science, Social Science, and Technical/Applied fields affected their earnings indirectly, by way of their education attainment. Given the positive effect of education attainment on earnings, it is not particularly surprising that education aspirations positively influenced alumni attaining more advanced education. This finding illustrates the importance of ambitions on subsequent earnings, insofar as education aspirations prior to college approximate ambition.

Table 5
Beta coefficients of the mediating effects of higher education attainment on year 2001 log-earnings

Independent variables[a]	Math, Comp. Sci., or Engr.	Business	Health Sciences	Sciences	Social Sciences	Technical or Applied	Education	Arts & Humanities
MALE	−.015	.001	.059***	.028	.004	.003	.010	.033*
COHORT1980s[b]	−.012	.006	−.025**	−.016	−.022**	−.005	−.022**	−.010
COHORT1990s[b]	−.021	−.013	−.042***	−.045**	−.053***	−.007	−.086***	−.048***
MOMED	.017	.007	.026**	.010	.029***	−.010	.010	−.010
DADED	.008	.019*	.023*	−.019	−.013	.013	−.003	.012
FAMINC	−.000	.006	−.004	.033*	.001	.000	−.002	−.014
LIVEAPP	.005	.004	−.011	.006	.003	.006	.012	.030**
EDASPIRE	.006	.025***	.015	.082***	.026***	.022**	.007	.008
n	217	709	513	458	574	346	1017	601

[a] In addition to variables shown, models additionally included: WHITE, MARRIED, CHILDREN, ACADABILITY, SELECTIVITY, LIBARTS (vs. WORKCOLL), PUBREG (vs. WORKCOLL).
[b] Dummy variable compared against COHORT1970s.
* $p < .10$.
** $p < .05$.
*** $p < .01$.

4. Discussion

In this study we examined how socioeconomic status is transmitted from parents to their college-going children. We estimated a model of earnings, our status indicator, and we examined whether or not the effects of background characteristics and education attainment are conditional on major field of study. Finally, we examined the degree to which education attainment has a mediating effect on earnings and if the effect differs by major. Our goal was to determine if and to what extent college majors affect placement on and movement along the social ladder. We also sought to identify more meritorious college majors and less meritorious college majors. We accomplished this task by examining the relative strength of individual education attainment to the relative strength of background characteristics in determining status, which we discuss below.

The results of our study support an abundance of previous research by clearly indicating that college majors affect individuals' earnings, which we interpret as a signal of placement on the social ladder. However, our results also provide new information about the potential effects of college majors on social mobility. The mediating effects of education on the relationship between individuals' socioeconomic backgrounds and individuals' earnings vary in complex ways that are linked to college majors. In other words, college majors affect the degree to which education enables individuals to be socially mobile. As well as affecting an individual's *placement on* the social ladder, a person's college major also affects that person's *movement along* the social ladder.

Our results suggest that, when viewed along a continuum, college majors are more or less meritorious based on the net effects of socioeconomic background characteristics (particularly family income) in comparison to the net effects of education attainment. For example, net of the effects of all other variables in our model, those majors for which pre-college family income had the greatest direct effect on earnings were Math/Computer Science/Engineering, and Science. Additionally, majors for which education attainment had the greatest direct effect were Business, Science, and Education. At the extremes of the continuum, an Education major stands out as particularly meritorious based on the finding that socioeconomic background characteristics have uniquely small effects, while education attainment has a uniquely large effect on status. On the other hand, for Math/Computer Science/Engineering majors, pre-college family income largely determined status, while net of this and other characteristics, education attainment failed to have more than a negligible effect. For Science majors, we found education attainment to have a strong impact on status, but we also found economic resources prior to college to have an even stronger total impact when considering the indirect effects that were mediated by education attainment. Majoring in a Science field, therefore, falls somewhere in the middle along a continuum of more or less meritorious majors. Thus, it appears that the influence that a person's starting position has on where they end up on the social ladder may differ by major, where Education is more meritorious, and where Math, Computer Science, or Engineering are less meritorious.

Table 6
Effect size of pre-college family income (FAMINC) on 2001 log-earnings and the gender concentration of majors

College major	Effect size of FAMINC[a]	% Females within major
Math, Computer Science, or Engineering ($n = 217$)	.207	38.0%
Sciences ($n = 458$)	.191	38.4%
Social Sciences ($n = 574$)	.162	42.9%
Business ($n = 709$)	.156	39.3%
Arts and Humanities ($n = 601$)	.132	48.3%
Technical or Applied ($n = 346$)	.066[b]	56.3%
Education ($n = 1017$)	.060	72.6%
Health Sciences ($n = 513$)	.058[b]	87.1%
Bivariate correlation = −.883		

[a] Based on the estimated metric effects of FAMINC shown in Table 4, divided by the pooled S.D. of log-earnings for each major sub-sample. An effect size represents the S.D. change in a dependent variable that is based on an incremental change in an independent variable.
[b] Metric effect was not statistically significant at $p < .05$ (see Table 4).

By conceptualizing majors along a continuum, our results also suggest an interesting relationship between gender and the degree to which a major is meritorious. Relative to other majors, being female accompanied a greater earnings disadvantage among Math/Computer Science/Engineering majors (which we found family income to have a particularly strong effect), while being female accompanied the smallest earnings disadvantage among Education majors (the major for which family income had the weakest effect). Other than these two cases, the similarities between earnings differences by gender and the effects of socioeconomic background characteristics are less clear. What we found to be strikingly clear, however, was the relationship between the gender concentration of a major and the size of the effect of family income prior to college. The size of the effect of family income within a given major (net of an array of statistical controls) nearly perfectly coincided with the gender concentration of that major. After rank-ordering the estimated effect sizes of family income on earnings, we found an almost identical ordering as the proportion of males within a given field of study, as shown in Table 6. The effect size of family income was nearly 90% correlated with the gender concentration of major ($r = -.883$, where gender concentration is defined as percent female).

It appears that gender concentration of a major may be a proxy for the extent to which merit, relative to inherited economic resources, is rewarded. In terms of social mobility, traditionally female fields offer a relatively more meritorious structure for distributing status, but the actual occurrence of social mobility ultimately depend on the influence of education variables in comparison to the overall influence of inherited characteristics. Our results may also reflect differences in men's and women's aspirations as they relate to more technical fields of study. Focusing on mathematics achievement, Wilson and Boldizar (1990) have demonstrated that gender segregation in college majors are shaped by students' aspirations formed while in high school and that women may have perceived few visible rewards in fields requiring high levels of mathematics achievement.

Not to be overlooked in this discussion of college majors are the important structural differences across fields of study when viewed against occupations and income attainment. Past research has shown that the characteristics of relatively high paying fields of study include a well-defined body of content knowledge and skills, a focus on quantitative or scientific skills, and a direct and established link to jobs or occupations (e.g., Grubb, 1992, 1997; Knox et al., 1993; Thomas, 2000, 2003). On more theoretical grounds, both Van de Werfhorst (2002) and Riley (1982) drew largely from a human capital perspective to explain that the earnings benefits associated with certain majors stem from enhanced efficiencies on the job (either from greater productivity or reduced training costs) resulting from congruence between education resources and valued job skills.

Alternatively, Wilson (1978) contributed the concept of "targeted education" as the likelihood that a particular curricula feeds into a high-level occupation. Based on a Marxist perspective of stratification emphasizing earnings as a direct reflection of occupational power, Wilson demonstrated the utility of the concept of targeted education, in combination with occupational power, in predicting earnings. Extending this concept, Wilson and Smith-Lovin (1983) provided evidence that the manner and the degree to which an educational program is targeted may explain sex differences in occupational attainment. While our data did not permit us to incorporate a measure of occupational status, our results may actually reflect the "structural interlinkages" (Wilson and Smith-Lovin,

1983, p. 161) between college programs of study and occupations, and the status associated with occupations.

5. Conclusion

Compared to other societies, the United States is an open society. However, relative to the idea of a completely meritorious society or even Blau and Duncan's (1967) original claims about the power of education in mediating the relationship between a person's background and their earnings, we believe our results suggest there is more work to be done. The persistence of background characteristics, particularly family income, in affecting individuals' earnings, even after education and many other factors were controlled, suggests that individuals' original positions on the social ladder play a significant and lasting role in affecting their final positions on the social ladder. What's more, the choices that individuals make as they navigate educational institutions – particularly the choice of college major, which is strongly influenced by gender – can inhibit the degree to which their education attainment allows them to be socially mobile.

Lucas (2001) has proposed that, as any given level of education attainment reaches a certain level of universality, "the socioeconomically advantaged seek out whatever qualitative differences there are *at that level* and use their advantages to secure quantitatively similar but qualitatively better education" (p. 1652). It may be that as access to and participation in higher education has expanded, college majors have increasingly become mechanisms for qualitatively maintaining previously quantitative differences, and thus, maintaining inequality.

In reviewing and synthesizing 30 years worth of stratification research, Corcoran (1995) emphasized family economic resources in comparison to other variables, as the most consistent predictor of earnings. While this relationship appears to be clear, Corcoran also noted that the mechanisms that influence this relationship are far less obvious and more complex. Ultimately, Corcoran concluded that, "The strongest priority for future research on the intergenerational transmission of poverty should now be to show how and why parental poverty itself diminishes children's adult economic attainment" (p. 262). By focusing on how socioeconomic origins interact with college majors in affecting earnings, we have at the very least, raised important questions regarding the role of education attainment in social mobility, and illustrated the complex mechanisms relating individuals' backgrounds, their education, and their socioeconomic positions.

Acknowledgements

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Appendix A

Appalachian College Association Alumni Survey List of College Majors and Occupations

01	Agriculture (e.g., Ag Business, Economics, & Mechanics; Animal Sciences; Food Sciences/Tech; Natural Resources)
02	Architecture and Environmental Design (e.g., Building Construction; City, Community, and Regional Planning; Interior Design; Landscape Architecture)
03	Business & Management (e.g., Accounting, Banking & Finance, Human Resources, Management Information Systems, Real Estate, Small Business Management/Ownership)
04	Business & Office (e.g., Bookkeeping, Business Data Processing/Computer Operation, Office Supervision and Management, Word Processing)
05	Marketing & Distribution (e.g., Retailing and Sales, Travel Services and Tourism)
06	Communication & Communications Technologies (e.g., Advertising, Journalism, Public Relations, Radio/Television)
07	Community & Personal Services (e.g., Corrections, Fire Protection/Fire Control & Safety Technology, Food Service, Hospitality Industry, Library Science, Parks and Recreation, Public Affairs, Social Work)
08	Computer and Information Sciences (e.g., Computer programming, Computer Science, Information Sciences and Systems, Math/Computer Science)
09	Cross-Disciplinary Studies (e.g., Area and Ethnic Studies, Liberal/General Studies, Multi-Interdisciplinary Studies)
10	Education (e.g., Adult and Continuing Education; Education Administration; Elementary, Junior/Senior High; Industrial Arts Ed; Mathematics Ed; Special Ed; Student Counseling; Teacher Aide; Post-secondary Education & Research)
11	Engineering (Pre-Engineering) (e.g., Bioengineering/Biomedical Engineering, Chemical Engineering, Computer Engineering, Construction Engineering/Construction Management)
12	Engineering-Related Technologies (e.g., Aeronautical Technology, Civil Technology, Computer Technology, Environmental Control Technology, Occupational Safety & Health Technology)
13	Foreign Languages (e.g., Classical, French, Russian, Spanish)
14	Health Sciences & Allied Health Fields (e.g., Dental Assisting, Dentistry, Emergency Medical, Health Care Administration, Nursing, Pharmacy, Physical Therapy/Assisting, Veterinary Medicine)
15	Home Economics/Family & Consumer Services (e.g., Child Development, Care, and Guidance; Culinary Arts; Family/Consumer Resource Management; Fashion Design; Food Production, Management, and Services; Textiles and Clothing)

16	Letters (e.g., Classics, Comparative Literature, English, Linguistics, Literature)
17	Mathematics (e.g., Actuarial Sciences, Applied Mathematics, Statistics)
18	Religion, Philosophy, & Theology (e.g., Bible Studies, Ministry, Philosophy, Religious Education, Theology)
19	Sciences (Biological & Physical) (e.g., Biochemistry and Biophysics, Botany, Ecology, Physics, Zoology)
20	Social Sciences (e.g., Economics, History, Law, Political Science/Government, Sociology, Urban Studies)
21	Trade & Industrial (e.g., Airplane Piloting and Navigation, Automotive, Construction Trades and Carpentry, Drafting, Welding and Welding Technology)
22	Visual & Performing Arts (e.g., Applied Design/Crafts, Dance, Dramatic Arts, Graphic Arts Technology, Graphic Design, Music, Photography)
23	Other

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