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Schooling, skills, and self-rated health: A test of conventional wisdom on the relationship between educational attainment and health

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Schooling, skills, and self-rated health:

A test of conventional wisdom on the relationship between educational attainment and health

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ABSTRACT

Education is a key sociological variable in the explanation of health and health disparities. Conventional wisdom emphasizes a life course-human capital perspective with expectations of causal effects that are quasi-linear, large in magnitude for high levels of educational attainment, and reasonably robust in the face of measured and unmeasured explanatory factors. In this paper, we challenge this wisdom by offering an alternative theoretical account and an empirical investigation organized around the role of measured and unmeasured cognitive and non-cognitive skills as confounders in the association between educational attainment and health. Based on longitudinal data from the National Longitudinal Survey of Youth – 1997 spanning mid adolescence through early adulthood, results indicate that a) effects of educational attainment are very vulnerable to issues of omitted variable bias; b) that measured indicators of cognitive and non-cognitive skills account for a significant proportion of the traditionally observed effect of educational attainment; c) that such skills have effects larger than that of even the highest levels of educational attainment when appropriate controls for unmeasured heterogeneity are incorporated; and d) that models that most stringently control for such time-stable abilities show little evidence of a substantive association between educational attainment and health. Implications for theory and research are discussed.

The relationship between education and health has been a centerpiece of sociological study for over a century. Theories of the socioeconomics of health routinely incorporate educational attainment as a central feature and posit myriad ways in which those with more education have better health (e.g., Adler 1994; Cutler, Huang, and Lleras-Muney 2015; Deaton 2001; Fuchs 2011; Grossman 1972; Hayward, Hummer, and Sasson 2015; Link and Phelan 1995; Mackenbach et al. 2015; Marmot 2005; Palloni 2006). Research across time and across the globe routinely finds that those with higher educational attainment report better health (Ross and Wu 1995), have lower risk of chronic disease (Winkleby, Jatulis, Frank and Fortmann 1992), have lower risk of a variety of cancers (Jemal et al. 2008), and live longer (Rogers, Everett, Zajacova, and Hummer 2010). Equally profound, education was recently singled out as one of a limited number of "social" causes for excess mortality in the United States, where low education was estimated to produce approximately 245,000 deaths in the US in 2000 alone (Galea et al 2011). As such, education is often described as a "fundamental cause of health (e.g., Masters et al. 2015) and important public policy statements have emerged that view "education policy" as an important element of "health policy" (Conti, Heckman, and Urzua 2010; Schoeni et al 2008).

Recent research however questions whether the effects of educational attainment on health are indeed causal. Referencing longstanding concerns about unobserved heterogeneity and omitted variable bias, researchers have used "natural" experiments where changes in law or social policy effectively randomize exposure to more education or studied twins that share genetic and family environment factors. Such work provides a much more equivocal view of the association between educational attainment and health. Studies of changes in compulsory education laws show positive effects for health (Lleras-Muney 2005; Lillard and Malloy 2010; Oreopoulos 2006, Silles 2009; Spasojevic 2003) or null or inconsistent effects (Arendt 2005; Albouy and Lequien 2009; Clark and Royer 2010; Fletcher 2015; Gathmann et al. 2015; Jurges, Kruk, and Reinhold 2013; Mazumder

2008; Powdthavee 2010). Similarly, twin studies show positive effects of educational attainment (Behrman et al. 2015; Lundborg 2008; Madsen et al 2010), non-significant effects (Amin et al. 2015; Behrman et al. 2011) or have mixed results (Fujiwara and Kawachi 2009). While highly informative and possessing good internal validity, such work is largely empirical, does not actually show the confounding effect, often requires acceptance of particular identifying assumptions, and perhaps most important does not offer a compelling theoretical alternative to the dominant life course-human capital explanation of education and health.

Against this backdrop, this study articulates two different ideas about the meaning of education and re-examines its association with health. The conventional view is a life course-human capital model where educational attainment increases access to resources and knowledge that translate into better capability for management of health dynamics in later life. The key feature of this model is the role of educational attainment in cognitive transformation that limits engagement in risk behaviors and in shaping life course sequelae such as family and peer relationships, work and income, and placement in general social contexts that are conducive to better health (e.g., Link and Phelan 1995; Miech et al. 2011; Mirowsky and Ross 2003; Ross and Wu 1995). An alternative view builds upon other key themes in life course sociology and emphasizes the cumulative nature of social life and the importance of age-graded social and psychological development as a necessary basis for producing subsequent experiences and achievements in the unfolding life course (Elder 1994). In the realm of educational attainment, this perspective highlight early life as a "critical period" for the development formation of cognitive and non-cognitive skills that are reasonably stable after childhood and how these coalesce into stocks of abilities that are the engines of educational achievement and attainment over the life course (e.g., Alexander, Entwisle and Horsey, 1997; Cunha et al 2006; DiPrete and Eirich 2006; Entwisle, Alexander and Olson 2005; Farkas et al. 1990; Heckman 2006). Importantly, such skills are almost never measured or modeled in health

research and their absence may distort conclusions about the significance of educational attainment for health given widely accepted principles of omitted variable bias. Research that statistically accounts for such factors, directly or indirectly, would empirically assess the contributions of cognitive and non-cognitive abilities, would evaluate causal claims around education and health in innovative ways, and would advance theoretical understanding in the sociology of health by adjudicating between the different theoretical perspectives.

We pursue these objectives using data from the National Longitudinal Survey of Youth 1997. These data are unique in that the multi-panel structure includes annual measures of educational attainment and health that allows estimation of models that assess the effects of *change in education* on *change in health* that are the basis of random- and fixed-effects estimation. Such models control, in different ways, for time-stable, unobserved characteristics of individuals that will confound identification of causal effects on health. These data also include credible measures of cognitive and non-cognitive abilities that are critically important in evaluating the meaning of the education-health relationship. They also allow us to study a number of time-varying factors that are widely regarded as proximal determinants of health (e.g., body mass, smoking, substance use) and that provide points of comparison in assessing the significance, statistical and substantive, of the skill and educational effects, with the different specifications. Finally, for all analyses, we assess robustness for six race-sex groups.

EDUCATION AS A CAUSE OF HEALTH: A LIFE COURSE-HUMAN CAPITAL PERSPECTIVE

Hegemonic accounts of education and health stress a causal relationship where increases in educational attainment produce better health outcomes (Cutler and Lleras-Muney 2008). Here, education is typically viewed as an engine of human capital acquisition that has transformative

consequences for a diverse set of psychological and social behaviors and experiences (see Becker 2009 for a general discussion). From this perspective, education increases the stock of competencies, general and specific knowledge, and a variety of personal and social attributes that increases one's ability to subsequently function more successfully within both market and non-market environments across the life course.

A life course-human capital perspective proposes several mechanisms in a causal relationship between education and health. To start, educational attainment increases intellectual capability that facilitates rational problem solving, critical thinking skills, and decision-making that assist in medication adherence, reading and understanding of medical information, and evaluation of complex and new health treatments and medical science and technology (Cutler and Lleras-Muney 2008). This has obvious implications for the better navigation of health care systems, identification of more knowledgeable and skilled medical providers, and retention of medical information during health care encounters (Hummer and Lariscy 2011). In other words, if and when one does get sick, one is better able to deal with it.

Education is also seen to help one to avoid or limit exposure to risky situations and imparts knowledge, motivation and discipline to adopt healthy practices (Mirowsky and Ross 1998). Adoption of a healthy lifestyle, including drinking in moderation, avoidance of tobacco or smoking cessation, avoiding recreational drugs, and maintenance of a healthy weight through diet and physical activity, defends against a broad range of diseases and impairments. Education may also foster positive and supportive relationships in later life (Mirowsky and Ross 2003). These assist in coping and dampen the impact of events and experiences in which self-esteem and perceptions of control are threatened (Pearlin and Schooler 1978). Beyond support, those more highly educated are also more likely to have highly educated friends and partners who may in turn place greater value on health and act more healthfully (Cutler and Lleras-Muney 2008). This may result in greater personal

accountability and discouragement of negative health behaviors that would prevent one from getting sick in the first place.

As a final mechanism, education facilitates the acquisition of work that is of personal and practical value in promoting health (Mirowsky and Ross 2008). More education results in greater likelihood of work that provides the means to obtain basic human needs, as well as supports social and psychological needs, such as belongingness, competence and achievement, and esteem. Greater educational attainment further improves labor market experiences, including acquisition of more secure, more stable, and higher status jobs that offer better pay, health insurance and retirement benefits (Reynolds and Ross 1998). Moreover, given the life course structure of work, educational attainment can produce a cumulating path towards better and more advantageous work (Warren, Hauser, and Sheridan 2002). Thus, educational attainment is seen to increase income, assets, and wealth that facilitate the "purchase" of a variety of health enhancing commodities over the life course.

EDUCATION AS ENDOGENOUS: CRITICAL PERIODS, SKILLS, AND LIFE COURSE CONTINGENCY IN PROCESSES OF EDUCATIONAL ATTAINMENT

An alternative model of educational attainment with contrasting implications for health dynamics emphasizes temporality in the life course and the importance of contingent relationships among life course experiences and attainments at different points in time (Elder 1994). A central concept in life course social science is the idea of social trajectories that refer to the institutional pathways that individuals follow, through education, work, and family, that characterize the sum of one's experience (Elder 1998). Importantly, a focus on trajectories highlights the important elements *life course contingency* and *critical periods*. With life course contingency, each step in the path to a particular outcome is dependent on a combination of assets and vulnerabilities related to

experiences, structural constraints, individual traits and chance at earlier points in time (McLeod and Almazan 2003). When one considers action within this framework, enactments that propel people over the age-span often require resources, personal, social, and material, that make such enactments probable. In short, this perspective emphasizes the idea that certain social and psychological phenomena are necessary or probabilistic precursors to subsequent experiences and attainments. This is particularly clear for educational careers.

Educational institutions are hierarchical and select on prior achievements to determine advancement (DiPrete and Eirich 2006). Even in the earliest years, students need to demonstrate some level of mastery with respect to cognitive, psychological, and social skills to warrant (or activate) promotion (Alexander, Entwisle, and Dauber 1993). Teachers evaluate and identify abilities of youth from the earliest days and best evidence suggests that this has important implications for a range of achievements deep into the life course (Entwisle, Alexander, and Olson 1997, 2005). Moreover, curricula become more defined and the requirements for promotion more standardized and universal with advancing stages, typically having a basis in internal or external testing. The institutionalization of education has an added feature of general stages, primary, secondary, post-secondary, graduate, and post-graduate, where there is even more explicit benchmarking of prior achievements and additional, targeted testing to determine entrance into subsequent stages.

In understanding movement through and across educational institutions, there is increased attention to the notion of "skills" as the fundamental drivers of educational transitions. Skills can be differentiated into those cognitive and those non-cognitive (Carneiro, Crawford, and Goodman 2007; Farkas 2003; Heckman 2006). Cognitive skills are typically conceptualized as generalized abilities to process information and to problem solve whether it involves comprehension, computation, or strategic and goal oriented applications of rules (e.g., algebra, geometry, or calculus).

In contrast, non-cognitive skills embody issues of effort, organization, and discipline, as well as leadership, sociability, socioemotional regulation, and ability to defer gratification.

When one combines life course contingency and a focus on skills, the importance of critical periods emerges. Here, the likelihood of given life stage attainments is heavily dependent on attainments at earlier stages. In education and social mobility research, recent work emphasizes the importance of *early* skill acquisition and the necessity of such skills for the progression of educational careers and hence indicates childhood and early adolescence as a critical period for skills formation (see reviews in Heckman 2006; Scott 1962). In a number of important papers, Alexander and Entwisle, demonstrate the significance of beginning school transitions for long-term educational stratification. In summarizing much of their work, they write

> …the transition into full-time schooling – entry into first grade - constitutes a "critical" period for children's academic development. First, the early schooling period coincides with important cognitive changes as children shift from preoperational to operational modes of thought. Second, the elementary years, and especially first grade, constitute a special time for acquiring the basic skills of literacy and numeracy, and failing to acquire skills during this time leads to an almost insurmountable handicap (Entwisle and Alexander 1993: 404).

Here, timing is a key issue and the best evidence indicates that there exist critical or sensitive periods in child development early in life where certain skills are more readily acquired. Moreover, if skills are not developed, it becomes difficult for subsequent acquisition. Evidence of this comes from three bodies of research. First, there is extensive work showing significant social differences in both cognitive and non-cognitive traits at the point of school entry and the first years of education (Alexander et al. 1988; Cuhna et al. 2006; Gottfredson and Hirschi 1990; Janus and Duku 2007; Fryer and Levitt 2004; Lee and Burkham 2002). Second, a wealth of evidence suggests substantive

stability in cognitive and non-cognitive skills after adolescence. In the former case, studies repeatedly find test-retest correlations in excess of .6 for IQ scores even when measured decades apart (Deary et al. 2000; Hopkins and Bracht 1975; Kolb and Wishaw 2009; Ramsden et al. 2011; Schuerger and Witt 1989). Evidence of stability in non-cognitive skills is less definitive, although comprehensive reviews suggest reasonable stability for self-control (Gottfredson and Hirschi 1990), personality type (Roberts and Delvecchio 2000), positive and negative affect (Watson and McKee 1996), and attentiveness and hyperactivity (Ingram, Hechtman, and Morgenstem 1999) across the life span. It should be noted that these literatures do not imply that change does not and cannot happen as associations are never perfect (Almlund et al. 2011), but instead that change is much more apparent in the earlier part of the life course than in subsequent periods and evidence of stability outweighs that of change. Finally, a critical period interpretation is supported by the unfortunate lack of effectiveness of interventions and changes of environment in adolescence and adulthood. Rutter and colleagues (2001), for example, studied transnational adoptees and found that children who experienced deprivation into early childhood had much poorer psychosocial development in later childhood and their preteen years regardless of the enriched environments to which they relocated (see also, Beckett et al. 2006 on cognitive abilities; Gottfredson and Hirschi 1990 on self-control; Newport 2002 on language; Spitz 1986 on intelligence). In the realm of intervention, Heckman (2000; 2006) reviews a wide range of programs delivered at different stages of the life course and concludes that later interventions show much less evidence of effectiveness. Taken together, the weight of the evidence suggests that early life is a critical period for the development of cognitive and non-cognitive skills and that skills acquisition after this period is both difficult and not the norm.

The combination of critical periods for skill acquisition and life course contingency suggests considerable endogeneity in school achievements and educational attainment. From this

perspective, educational achievements, including test scores and overall attainment, are largely a function of cognitive and non-cognitive abilities that are established early in life. Empirical evidence on this is strong. McCoy and Reynolds (1999), for example, found that early school performance, test scores and marks were the strongest predictors of grade retention with further, independent, associations with poorer school performance and subsequent attainment (see also Reynolds 1992). Similarly, Farkas and colleagues' (1990) study of seventh- and eighth-grade students found that both cognitive and non-cognitive skills, the latter that they call 'cultural resources,' had extremely large effects on course work mastery and grades, effects that were larger than the effects of sex, race, and family income combined. Also consistent, Carneiro, Crawford and Goodman's (2007) analysis of data from the UK National Child Development Survey showed large effects of cognitive and non-cognitive traits at age 11 on educational attainment at age 42. Perhaps most impressive, Entwisle, Alexander, and Olson's (2005) study of students in Baltimore found that marks in reading and math and a composite indicator of temperament in grade one were significant predictors overall educational attainment in early adulthood. In general, numerous studies indicate the overwhelming importance of cognitive (see Beckett et al. 2006; Doherty 1997; Fryer and Levitt 2004; Janus and Duku 2007; Lee and Burkam 2002) and non-cognitive skills (see Evans et al. 1997; Gottfredson and Hirschi 1990; Harris and Robinson 2007; Tach and Farkas 2006) for educational achievements. A graphic showing the temporal aspects of the associations we describe is shown in Figure 1. The key element of model is reinforcing processes of cognitive and non-cognitive skills from infancy to early adulthood, non-recursive associations between skills and schooling in early and late childhood, and recursive effects of skills on schooling in the teenage and early adult years.

[Figure 1 about here]

When a critical period-life course contingency perspective is applied to education-health dynamics, there are number of implications. First, *cognitive and non-cognitive skills should have a strong association with health by virtue of their links to psychological affect, risk-behaviors, and socio-economic status that are the theoretical underpinnings of health dynamics over the life course.* Stronger cognitive ability allows for the better and faster processing of health-related information and for better ability to problem solve. Similarly, the conceptualization of non-cognitive abilities (e.g., self control) maps closely onto various orientations towards risk and risk aversion that have clear relevance for health (Caspi et al. 1997). Second, *educational attainment as conventionally measured (i.e., total years, highest grade completed, credential) may proxy time-stable (at least at the point of measurement) unmeasured cognitive and non-cognitive abilities*. In theory, those with more years of education or higher degree attainment have accumulated and demonstrated possession of the stock of skills necessary for promotion into that particular rank and their presence in that rank is a signal of their cumulative stock of cognitive and non-cognitive abilities. Third, *the time-stable stock of cognitive and non-cognitive abilities are unmeasured confounders of the education-health relationship in research that examines health at any point past mid-adolescence.* Here, one does not need to accept that key skill formation occurs in early life and prior to school entry (cf. Heckman 2006), but could simply assume that key skill formation solidifies at any time before the initial point of educational stratification, typically high school completion. Finally and summarizing, *educational attainment may be of questionable relevance for health with appropriate controls, either direct or indirect, for typically unmeasured time-stable attributes such as cognitive and non-cognitive skills that are exogenous to educational attainment and important determinants of health.* A soft version of this thesis would deem a significant portion of the educational attainment effect to be spurious with controls for cognitive and non-cognitive abilities. A harder version of the thesis would view the effects of education to be non-causal and substantively and statistically insignificant with appropriate controls for such abilities.

Given these expectations, fruitful research would use statistical models that control for such time-stable attributes of individuals and directly or indirectly models the association between cognitive and non-cognitive traits, educational attainment and health. After briefly reviewing the literature on skills and health, we pursue a multi-pronged strategy to untangle the relationship between cognitive and non-cognitive skills, educational attainment, and health using unique longitudinal data from American adolescents followed into adulthood.

SKILLS AND HEALTH: A REVIEW OF THE EVIDENCE

Evidence on the role of cognitive and non-cognitive skills in health dynamics is simultaneously unequivocal, complicated, and difficult to interpret. For cognitive skills, Gottfredson (2004) elaborated the idea that intelligence is the true 'fundamental cause' of health by stressing that "health self-management is inherently complex and thus puts a premium on the ability to learn, reason, and solve problems" (p. 189). Link and colleagues (2008) reviewed several studies and concluded that most show a cross-sectional or longitudinal relationship between cognitive ability and health. But further consideration of educational attainment complicates things. In some studies, socioeconomic status including educational attainment significantly attenuates the effects of cognitive ability, suggesting that educational attainment may explain the effects of cognitive ability. Other studies show that the effects of socioeconomic status are attenuated by cognitive ability. Link and colleagues' (2008) own research was more definitive: the effects of cognitive ability were substantially reduced with controls for educational attainment and income, but the effects of educational attainment and income were substantively unchanged conditional on cognitive ability. In contrast, Conti and colleagues (2010) analyzed longitudinal data from the 1970 British Cohort Study and concluded that selection due to cognitive and non-cognitive skills measured in early childhood account for over half of the observed educational differences in poor health, depression,

and obesity at age 30. From such research, cognitive ability is clearly implicated in health dynamics but its conditional relationship with educational attainment is much less definitive.

Evidence of the role of non-cognitive skills in health dynamics is either quite rare or routine, depending upon conceptualization. Gottfredson and Hirschi (1990), for example, describe "low self-control" as characterized by impulsivity, a preference for simple tasks, risk seeking, physicality, self-centeredness, and being temperamental. From this perspective, the vast literature that relates a range of risk behaviors, including dangerous driving, substance use, involvement in crime and violence, smoking, poor diet and lack of exercise, non-compliance with medical advice, poor preventative care practices, etc. to poor health could all be seen as evidence of the importance of non-cognitive traits for health over the life course (see also Moffitt et al 2011). At the same time, personality measures of the type that Conti and colleagues (2010) use are quite rare in socio-health research but still suggest important effects. Summarizing across a number of studies, the evidence that links cognitive and non-cognitive skills to health dynamics is provocative, but underdeveloped, but interpretation is complicated and conclusions ultimately equivocal.

THE CURRENT RESEARCH

Having articulated two theses on educational attainment and health and having provided a brief accounting of relevant evidence, we now turn to the focus of our empirical research: analysis of the relationship between cognitive and non-cognitive abilities, educational attainment, and health using statistical models that have different capacities for accounting for unobserved or unmeasured heterogeneity.

DATA AND MEASURES

The data that we use in this research come from the National Longitudinal Survey of Youth – 1997 (hereafter NLSY97). The NLSY97 consists of an initial sample of 8,984 youths who were between the ages of 12 and 16 in 1997. When possible the respondents were re-interviewed annually and data were collected on a range of topics on the transition to adulthood. As of 2016, there are 16 waves of data that cover an age range of 12 to 32. In addition to non-Hispanic whites, the NLSY97 oversampled blacks and Hispanics such that there are relatively large samples of six race-sex groups. Compared to other national surveys, panel retention is excellent with 80 percent of the sample retained at wave 16.

For a study of skills, educational attainment, and health, we capitalize on the record structure of the NLSY97 data and its position in the history of population health in America. For the former, the multi-panel record structure provides annual, repeated measures of both education and health coupled with reasonable measures of cognitive and non-cognitive traits in adolescence, and hence allow for statistical approaches that are better at controlling for unobserved heterogeneity than traditionally used OLS approaches. In the latter case, the obesity epidemic in the United States has had profound effects on the age structure of health liabilities. As Harris (2010) notes, numerous data, including studies such as the National Longitudinal Study of Adolescent Health show that obesity is a harbinger of both short-term and longer-term chronic health problems and that a range of serious health problems (e.g., type II diabetes, hypertension) are increasingly visible through the early adult years. Given this, heterogeneity in health liabilities, including those self-perceived, is increasingly measurable in the early adult years among contemporary cohorts (Bauldry et al 2012).

Health: In these analyses, we measure health as self-rated health (hereafter SRH). This is a widely used measure that is one of the most validated survey instruments with strong and robust associations shown for a wide range of morbidities and for follow-up mortality (Ferraro and Farmer

1999; Idler and Benyamini 1997) and validated for samples of youth and young adults (Bauldry et al. 2012; Fosse and Haas 2009; Vingilis et al 2002). *Self-rated health* (hereafter SRH) asks respondents to describe their health on a scale from 'excellent' coded 1 through 'very good,' 'good,' 'fair,' to 'poor' coded 5. Although we recognize range limitations, we treat SRH as a continuous variable to ensure maximum sample representation over the 16 waves of data. Change in health status across panels varies between 43% and 56% of respondents.

Educational attainment: Although there are a number of conceptualizations, we treat *educational attainment* as a set of dummy variables indexing 'high school/GED,' 'some college,' a 'two-year degree,' or a 'four-year college degree or greater' with the reference category being 'less than a high school degree.' This allows us to capture a range of meaningful contrasts in education as they relate to health and allows us to assess linearity or consider nonlinearities if apparent. Panel specific change in educational attainment varies from 15% to 28.3% of respondents. Panel specific change in educational attainment that coincides with panel specific changes in health varies from 19.1% to 36.5% of respondents.

Cognitive skills: We operationalize skills using the Armed Services Vocational Aptitude Battery (ASVAB). In the NLSY97, the ASVAB is a summary percentile score variable based on four key subsets of the larger ASVAB battery. The subsets covered include mathematical knowledge, arithmetic reasoning, word knowledge, and paragraph comprehension and were calculated for each three-month age grouping and assigned to percentiles based on theta scores. Carroll's (1992: 267) comprehensive review of measures of cognitive abilities describes the ASVAB as "one of the most widely administered group tests of cognitive abilities…that feature dimensions of intelligence such as verbal, reasoning, spatial, quantitative, and memory abilities that have been recognized, for at least

50 years, as being partly independent traits, along with a more global trait of general intelligence." Specific comparisons of ASVAB scores with those from the Wechsler Adult Intelligence Scale (WAIS), the Wechsler Intelligence Scale for Children (WISC-III), and the traditional Stanford Binet IQ test indicate correlations in excess of .95 (Herrnstein and Murray 1994: 580-585). To facilitate comparison of the magnitude of effects, we transform the continuous distribution into equal quintiles.

Non-cognitive skills: We use four measures of non-cognitive skills that capture different types of aptitudes and orientations. A first measure comes from the 1997 wave of data and indexes quintiles of *commitment* to schooling, when respondents were 12 to 16 years of age, based on number of unexcused absences from school in the previous year. A second measure is also measured in 1997 and captures *self control*. Drawing upon the work of Gottfredson and Hirschi (1990), our measure is a variety index of the total number of distinct delinquent acts that respondents report committing during the previous 12 month period. A third measure comes from the 2002 wave of data when respondents were 17 to 21 and indexes *task-orientation*. This is the degree (on a scale of one to five) that respondents were "organized" (as opposed to "disorganized"), "conscientious" (as opposed to "not conscientious"), "dependable" (as opposed to undependable), and "thorough" (as opposed to "careless"). A final measure, also from the 2002 wave, indexes *sociability* as the degree that respondents were "agreeable" (as opposed to "quarrelsome"), "difficult " (as opposed to "cooperative"), "stubborn" (as opposed to "flexible") and "trustful" (as opposed to "distrustful"). For both of the latter measures, we conducted a one-component principle components analysis, derived a regression-based cumulative score, and then differentiated the sample into 20th percentiles, again for ease of comparison. As a set, these measures capture both behavioral and psychological aspects of non-cognitive skills that may have differing validity (Almlund et al. 2011). They also

include measures that are clearly temporally exogenous to our initial stratification point for educational attainment, although the psychological indicators were measured subsequent to the teen years.[2] Given recent work (e.g., Almlund et al. 2011), it is useful to think of the measures as bearing some, albeit imperfect, affinity with the "Big Five" personality constructs and here we would argue that sociability seems quite consistent with "agreeableness," and task-orientedness and commitment seem consistent with "conscientiousness." Self-control, at the same time, does not seem to fit well, as has been noted in earlier theoretical statements on its structure and dimensionality (Gottfredson and Hirschi 1990).

Risk behaviors/states: In certain models, we incorporate a number of measures of behavioral risks and states that all have resonance in sociological research on health. A first risk measure is marital status, which has a long history in health research (Waite and Gallagher 2002), and differentiates those *married*, those *separated or divorced*, and those never married (reference category). A second set of measures captures variation in vocational activities and identifies those *enrolled in school.* A third set of measures is based on body mass index (BMI) score calculated from self-reported height and weight and differentiates respondents that are *underweight* (< 18.5), *overweight* (25-29.9), *obese* (30-34.9), and *severely obese* (35 or greater). The reference category includes respondents whose BMI falls in the *optimal range* (18.5-24.9). In these data, a BMI of 30 or greater is the standard indicator of obesity in adults and corresponds almost identically to the 95th percentile for respondents at ages 12 through 14 and is above the 90th percentile for ages 15 through 17 in the NLSY97 data.

[2] Given that the measurement window stretches beyond high school, we re-analyzed all models restricting the sample to cohorts for which measurement of cognitive and non-cognitive abilities were measured at or before age 17. Our conclusions do not change and thus we opt for the larger, more representative sample.

We also include various types of substance use. With respect to smoking, we differentiate respondents who do not smoke from *light* (31 to 180 cigarettes per month), *moderate* (181-600 cigarettes per month), or *heavy* (more than 600 cigarettes per month) smokers. We adopt a similar strategy for alcohol consumption with abstainers distinguished from *light* (1-30 drinks per month), *moderate* (61-120 drinks per month), and *heavy* (more than 120 drinks per month) drinkers. Finally, we include two indicators of drug use that index ever using *marijuana* or *other drug use* in each wave of data during the previous 12 months.

Controls and Stratification: Our models also include measures associated with both health and educational selection. To capture socioeconomic influences, we include a measure indexing whether respondents reported living in *hard times* and variables measuring *parental educational attainment* with similar categories used for respondents for both mother and father regardless of residence. To capture early health disadvantage, we include two dummy variables indexing whether respondents had a history of *chronic disease* or *limb disability*. All these measures were drawn from the 1997 data collection. Our models also include a key control for *aging* captured through the panel structure of the data. We measure aging both in terms of a linear specification and a dummy variable specification but only report the former as the results are consistent. This measure accounts for both well-recognized declines in health with advancing age, as well as the strong determinism of educational attainment with aging.[3] To stratify by race and sex, we distinguish *white males*, *white females*, *Black males*, *Black females*, *Hispanic males*, and *Hispanic females*. Descriptive statistics for the full sample and the six sub-samples are shown in Table 1.

[3] Nine percent of respondents were still in school at the final wave of data. The majority of these would be classified as some college (70.5%) or four-year degree or greater (26.5%) and hence problems of right-censoring that should not bias our results (i.e., already of high educational attainment).

[Table 1 about here]

ANALYTIC METHODS

Our analytic strategy involves the estimation of three types of models. First, we estimate between-effect models that mimic traditional OLS and GLMs that characterize the vast majority of work on educational attainment and health (see Cutler and Lleras-Muney 2008 for discussion of the use of conventional regression models). The between- estimator regresses the mean response for health on the mean responses of all the predictor variables with information on the regression coefficients from within-respondent variability eliminated. Second, we estimate maximum likelihood, random effects (ML-RE) models where the model includes a random intercept, typically denoted ζ_j, that is independent across subjects and a residual, ε_{ij}, that is independent across subjects and time periods. Both are normally distributed with zero means and are independent of one another. A random-effects approach provides a more stringent control for unmeasured heterogeneity, in that it parameterizes across person variation, while still accommodating time-stable and time-varying variables, particularly our indicators of cognitive and non-cognitive skills that are only measured at one point in time. To account for the possibility of serial correlation, we estimate the ML-RE models with an autoregressive component with a lag of 1 (AR1). Finally, a third specification is a maximum likelihood, fixed effects (ML-FE) model. With this specification, there is a parameter, α_i, which is a unique intercept for each respondent, and we model deviations off the person-specific intercept. In contrast to the conventional OLS (and to a lesser extent ML-RE approaches), statistical wisdom views a fixed effects approach as providing much more stringent control for unobserved heterogeneity bias, at least under most circumstances (see general discussions in Allison 2009; Halaby 2004). The disadvantage of course is that they require time-varying covariates and hence

cannot include measures of adolescent based skills and traits that are fixed attributes. Still, such models capture the broad, but undefined, "stock" of time-invariant attributes of which cognitive and non-cognitive traits established in the early life course would be a key component. These models should not be viewed as ensuring causal identification but instead as preferred for controlling for the large battery of time-stable traits which can bias coefficients of effects of educational attainment on health. By conventional statistical wisdom, the effects of cognitive and non-cognitive skills will be captured in the unit-specific intercept. As with the random-effects specification, we estimate the ML-FE models with an autoregressive component with a lag of 1 (AR1).

To our knowledge, these models have not been used in the study of educational attainment and health, yet provide a more powerful tool for assessing the importance of time stable attributes that are formed early in life, prior to the key cut-points of educational attainment, and that might confound the education-health relationship. Still, our approach has affinities with a long and insightful tradition of dynamic modeling of health (e.g., Adams et al. 2004; Contoyannis, Jones, and Rice 2004; Halliday 2008; Preston and Taubman 1994). As noted, we present effects based on categorical coding to allow for substantive comparison across indicators that have varying levels of measurement. It should be clear that these are not standardized coefficients in the traditional sense and instead represent group-based differences in health conditional on the various covariates in each model.

RESULTS

Our research begins by estimating between- and within-person variance for health and educational attainment. This is a fundamental precursor for the research in that it shows both change in SRH and educational attainment over time, as well as heterogeneity in such change, that is the foundational requirement for the panel models that we ultimately use. For SRH, there are

statistically significant linear declines over time ($b = .027$, $p < .001$), as well as significant cross-respondent heterogeneity in slopes ($\sqrt{\psi} = .0542$, $p < .001$). The intraclass correlation coefficient indicates that 55% of the variance is longitudinal variation, within respondents over time. Similar dynamics are clear with respect to educational attainment. Here, educational attainment on average increases substantially ($b = .141$, $p < .001$) and with significant heterogeneity ($\sqrt{\psi} = .0993$, $p < .001$). In contrast to SRH, across-person variance is somewhat larger than within person-variance as the intraclass correlation coefficients shows that 35.6% of the variance is over time. In general, the data conform well to the necessary statistical criteria for the estimation of the models that we subsequently use.

Skills and Schooling

Our substantive analyses begin by briefly describing results modeling different levels of educational attainment (in 2013) based on race-sex, family socioeconomic status, early health, and cognitive and non-cognitive skills (in 1997/2002). For the sake of brevity, we simply note four things (see Table 2). Evidence of socioeconomic and health selection is strong. Relative to not graduating from high school, For respondents who reported living in "hard times", the odds of successively greater educational attainment beyond not completing high school are .65 ($e^{-.437} = .646$), .65 ($e^{-.425} = .654$), .37 ($e^{-.994} = .370$), and .25 ($e^{-1.382} = .251$), for high school completion, some college, a two-year degree, or a four-year degree, respectively. The effects of parental education are even stronger. For example, respondents with a parent with a four-year degree or more are 3 times more likely ($e^{1.232} = 3.428$) to graduate high school, almost 18 times more likely ($e^{2.880} = 17.814$) to have some college, 21.8 times more likely ($e^{3.085} = 21.867$), to have a two year degree, and 97 times more likely ($e^{4.579} = 97.417$), to have a four-year degree or more attainment when compared to those whose parents did not finish high school. Evidence of health selection is more mixed. Respondents

who reported chronic conditions in early life were 38% less likely ($e^{-.479} = .619$) to achieve a two-year degree, but no other associations were apparent. Similarly, there are no significant effects for respondents with limb limitations.

Second, both cognitive and non-cognitive skills have significant associations with educational attainment independent of the effects of early health and early socioeconomic status. For example, quintile increases in cognitive ability track increases in educational attainment (i.e., coefficients get successively larger as one moves up quintile rank and up educational attainment. For school commitment, effects are less linear across quintiles but still show that higher commitment is associated with successively greater educational attainment. Effects for self-control, in contrast, are quite linear and show low self control to be a distinct liability for greater educational attainment. For example, low self control decreases the odds of high school completion by 36 percent ($e^{-.449} = .638$), yet decreases the odds of a four-year degree or more by 86 percent ($e^{-1.948} = .143$). Finally, sociability and task-orientedness also show myriad associations and higher levels of each are associated with successively greater educational attainment.

[Table 2 about here]

Third, the inclusion of cognitive and non-cognitive skills significantly reduces associations with family socioeconomic status. In comparing across models, the effect of living in "hard times" is reduced to non-significance while the effects of parental attainment are reduced by 14 percent, 17 percent, 17 percent, and 19 percent, for high school completion, some college, two-year and four-year or more degree attainment, respectively. Lastly, the effects of cognitive and non-cognitive skills are large in magnitude. If one uses parents with a four-year or more college degree as a benchmark, the effects of being in the top quintile of cognitive ability have effects that 80% larger for high school completion, 181% larger for some college, 177% larger for two-year degree attainment, and

189% larger for four-year or more degree attainment. If one wanted to find comparable groups, having parents with a four-year degree is equivalent for educational attainment to respondents around the 30th percentile of cognitive ability for high school completion, some college, and a four-year or more degree, and is equivalent to respondents around the median for two-year degree attainment. Although less dramatic, respondents with the highest levels of school commitment have similar attainments to respondents whose parents have "some college" and respondents with the highest levels of sociability and task-orientedness have similar attainments to respondents with parents who have a high school degree. Finally, self-control has a more non-linear association with the most pronounced associations seen for four-year degree and here the effects are larger than all levels of parental education with the exception of parents having a four-year degree or more. In summary, these analyses show that cognitive and non-cognitive skills are fundamental determinants of educational attainment and by extension measured educational attainment will typically capture unmeasured stocks of cognitive and non-cognitive skills without appropriate model specification.

Skills, Schooling, and Health – Between-effects Analyses

Our initial analyses of health involve between-effects regressions. These models mimic in panel data standard OLS regression models typically used in sociological research on health. It is these latter models that have produced the "conventional wisdom" of quasi-linear effects for educational differences that are large in magnitude and reasonable robust to background controls and proximal determinants. Results are shown in Table 3.

Model 1 includes covariates indexing sociodemographic, family background, and early health status. Consistent with a wide body of research, SRH is poorer among females, particularly Black and Hispanic females, for those having lived in "hard times" or whose parents had low educational attainment, and for those who have chronic conditions or limb limitations. When educational

attainment and enrolment are added (see model 2), the differences across educational categories are very large. With a "between" standard deviation of .677 for SRH, the effect for being a high school graduate is -.154, the effect for having some college is -.253, the effects for attaining a two-year degree is -.411, and the effect for a four-year degree or more is -.774. In short, the gradient is large and entirely in line with expectations. School environments are also conducive to better health in that being enrolled has a moderate ($b = -.219$, $p < .001$) effect on SRH.

[Table 3 about here]

Model 3 includes cognitive and non-cognitive ability measures and the effects of education are diminished. But they are not diminished a lot and large associations continue to be seen for the attainment of two-year ($b = -.306$) and four-year degrees or more (-.613). The effects of high levels of cognitive and non-cognitive skills are less impressive in that they manifest coefficients where even the effects for the highest quantiles are similar in magnitude to that of high school graduation (e.g. -.072 for cognitive skills versus -.113) or some college (e.g., .145 for self control versus -.195). When risk behaviors and state measures are included in model 4, they have the expected effects on health and significantly reduce the effects of educational attainment. Still, the effects of educational attainment continue to be large in size and comparatively larger to those seen for cognitive and non-cognitive skills. Equally important, effect sizes are large even in comparison to those of the proximal determinants. Only being obese ($b = .436$, $p < .001$) or severely obese ($b = .710$, $p < .001$) has effects that are substantially larger and factors like intimate ties, being overweight, smoking, drinking, and drug use typically have effects smaller in magnitude to that of high educational attainment (e.g., -.352 for a four-year degree or more versus .209 for moderate smoking). From a purely empirical standpoint, the "conventional wisdom" on educational attainment and health is clearly demonstrated with the NLSY97 data and a between-effects estimation strategy.

Skills, Schooling, and Health – Random-effects Analyses

We next turn to a random-effects approach (see Table 4). Beginning with model 1, sociodemographic, family socioeconomic status, and health status variables have the expected effects and manifest coefficients that are very similar to that observed with a "between" approach. The same cannot be said for educational attainment (see model 2). Here, the effects of education are dramatically smaller, although still statistically significant, and show a gradient that is only moderate in magnitude. For example, the coefficient for having a four-year degree or more is -.225 with a RE specification, as opposed to -.774 with a BE specification. In general, the coefficients for the different levels of educational attainment are much smaller with values of -.031, -.050, and -.129 for high school completion, some college, and a two-year degree attainment, respectively. In contrast, the effects for cognitive and non-cognitive skills are more robust (see model 3). Combined with the further decrease in effect sizes for educational attainment, the effects of cognitive and non-cognitive skills are now either similar to or greater than the highest levels of educational attainment. For example, if one uses as a benchmark the coefficient for a four-year degree or more, -.164, the effect for being in the upper 20^{th} percentile for cognitive ability is 29% larger ($b = -.212$, $p < .001$), the effect for being in the upper quintile for school commitment is 12% larger ($b = .183$, $p < .001$), the effect for low self control is 41% larger ($b = .231$, $p < .001$), the effect for high sociality is 20% larger ($b = -.197$, $p < .001$), and the effect for task-orientedness is 7% greater ($b = -.175$, $p < .001$).

[Table 4 about here]

The final model includes the risk behavior and state measures that are proximal determinants of health (see model 4). Effects are as expected with obesity ($b = .253$, $p < .001$) and severe obesity ($b = .460$, $p < .001$) and heavy smoking ($b = .230$, $p < .001$) showing moderate to large associations

and marital status, light or moderate smoking, and drug use showing small, but statistically significant, effects. Relevant coefficients indicate that magnitudes of the education effects are further reduced. Effects for high school graduation and some college are still small (b = -.025 and -.032, p < .001). Effects for a two-year degree are larger but still fall into the range of a small effect (b = -.079, p < .001) and effects for a four-year degree or more are somewhat larger and fall into the lower range of moderate in magnitude (b = -.141, p < .001). Effects of cognitive and non-cognitive skills are also reduced. In the end, all the effects for the most extreme quantiles of cognitive(b = -.187, p < .001) and non-cognitive skills (bs = .149, .158, -.174, and -.150 for commitment, self control, sociability, and task orientedness, respectively) fall in the lower range of the moderate.

Skills, Schooling, and Health – Fixed-effects Analyses

Our third set of analyses attempts to control even more stringently for problems of unobserved heterogeneity and omitted variable bias through the use of FE effects models. Model 1 includes only educational attainment and school enrolment. With all time-stable attributes controlled, all associations between educational attainment and health seen in previous models disappear. Effects are actually, contrary to expectations positive for high school graduation, some college, and a two-year degree. These effects, however, are very small in magnitude and indicate only marginal differences in health. Effects for a four-year degree or more are not statistically significant. Model 2 includes the risk behavior and state measures that are proximal determinants of health. Here, a number of these factors continue to have significant associations with SRH. For example, respondents underweight (b = .088, p < .001), overweight (b = .052, p < .001), obese (b = .176, p < .001), and severely obese (b = .330, p < .001) report poorer SRH. Respondents who smoke and smoke more also report poorer health (e.g. b = .185, p < .001 for heavy smokers). And while drinking shows only very small effects on SRH, those of marijuana (b = .051, p < .001) and

other drug use (b = .079, p < .001) are somewhat larger. Not surprisingly, the effects of educational attainment in this models are reduced is size, but still show no substantive association with SRH.

[Table 5 about here]

Robustness across race-sex groups

Our final analyses repeat the RE and FE analyses for each of the six race-sex groups in our sample. These results are shown in Table 6. To summarize a large amount of information succinctly, we simple note the following. There is clearly some variability in the RE estimates, but there is considerable consistency.[4] For high levels of cognitive ability, all coefficients are negative, as expected. For poor school commitment, effects are positive in all cases, as expected, and statistically significant for five of six groups. For low self-control, coefficients are positive in all cases, as expected, and statistically significant in four of six cases. For high task-orientedness, the coefficients are all negative, as expected, and statistically significant in four of six cases. Finally, the coefficients for high sociability are negative, as expected, in five of six cases and statistically significant in four of these. At the same time, the effects for educational attainment are quite mixed. If one brackets completion of a four-year degree, significant negative associations are only seen for only two of eighteen coefficients, for white females for attainment of a two-year degree and for Hispanic males for some college attainment. Turning to the highest level of attainment in our model, there is somewhat more consistency as effects are statistically significant in four of six cases. At the same time, a comparison of magnitude of effects with those of cognitive and non-cognitive skills suggests that the latter, in numerous instances, have effects of similar size or greater. Summary of the

[4] Variation in statistical significance is influenced by differences in the distribution of races across quintiles and resulting power

educational coefficients with a FE specification is much simpler. Out of 24 coefficients estimated, none are statistically significant and in the expected direction.

DISCUSSION AND CONCLUSION

This research presents five pieces of evidence that collectively challenge conventional wisdom of a life course-human capital account and derivative causal interpretation of the positive association between educational attainment and health. First, traditional between-effect regression approaches show a strong, quasi-linear relationship between educational attainment and SRH where high levels of educational attainment have effect sizes that rival or best some of the strongest proximal determinants of health. Second, measured cognitive and non-cognitive skills that are temporally exogenous and potential sources of spuriousness account for a sizable proportion of the effects of educational attainment on SRH. Third, the application of controls for unmeasured heterogeneity further reduce the magnitude and statistical significance of the educational attainment effects, but have much less of an impact upon the effects of cognitive and non-cognitive skills. Fourth, the effects of high levels of cognitive and non-cognitive skills are consistently larger than those of educational attainment, including the effects of a four-year college degree or greater, when we include appropriate controls for unmeasured time-stable traits formed in the early life course. Finally, a fixed-effects approach produces effects of educational attainment, including that of a four-year college degree or greater, that are reduced to a level where they are small or very small in magnitude, that are typically not statistically significant, and where one could legitimately question their overall importance for health dynamics. These findings are robust across six race-sex groups. Taken together, the findings highlight the importance of cognitive and non-cognitive skills that are formed in early part of the life course, and in doing so raise questions about the typical life course-human capital and causal effect interpretation of the education-health relationship.

[Table 6 about here]

Our research extends a growing body of work, most of it outside of sociology, which questions the causal interpretation of education on health. While natural experiments and studies of twins are clearly valuable, they have well recognized limitations in that statistical power is often low, scope conditions are often vague (e.g., to what populations do natural experiments that occur in a given place at a given time and typically apply only to select cohorts apply), and modes of instrumentation are often laden with heavy and sometimes questionable assumptions (e.g., that results from twin studies generalize to the wider population or even that twins who are discordant on some factor generalize to the larger population of twins) (see discussions in Boardman and Fletcher 2015; Fletcher 2015; Madsen and Osler 2009). In contrast, our analyses of the NLSY97 data show small or null effects of educational attainment that are robust for both a nationally representative sample of Americans and among six race-sex subsamples. From the standpoint of conventional statistics, well-powered between-, random- and fixed-effects analyses and the breadth and heterogeneity of the samples have advantages and make the evidence against a life course-human capital and causal interpretation compelling.

From a theoretical standpoint, we emphasize the role of cognitive and non-cognitive abilities in that these can clearly be understood as the engines of educational attainment and serve to connect other factors such as early family circumstances, community context and even early health profiles to educational attainment (Haas 2006; Palloni 2006). In doing so, we emphasize the dynamics of early skill formation, prior to school entry (Entwisle and Alexander 1989) as well as the effects of early schooling (Berhman 2015; Muenning 2015; Smith-Greenaway) and their role in educational attainment deep into the life course. Together these frame the social context of the "critical period" for skill formation and suggest an alternative life course model to that which dominates sociological

research (e.g., Hayward et al. 2015; Kirkpatrick Johnson, Staff, Schulenberg, and Patrick 2016; Ross and Wu 1995). Our model emphasizes the idea of life course contingency and how experiences at particular points of the life course have unique salience and consequences. While the determinants of skill acquisition are not a concern of the current paper, there is good evidence to suggest the importance of genetic endowments, family structure, family processes, social class, neighborhood context, to name but a few (see discussion in Cunha, Heckman, and Scennach 2010). At the same time, we cannot and do not rule out the possibility of compensatory processes. Ben-Schlomo and Kuh's (2002) thoughtful overview of life course perspectives on chronic disease epidemiology was careful to describe two "critical period" perspectives within the life course framework depending upon the possibility and probability of compensation through later life events. Importantly, they stress that compensation is much more likely when "function" rather than "structure" is undermined. As cognitive and non-cognitive skills fall clearly within the realm of "function," this is an important avenue of future research given that there is no a priori reason to rule out the possibility that attainments in later life could modify relationships and there is tantalizing evidence in the life course variability in the education-health association (House et al. 2002; Ross and Wu 1996). Moreover, while evidence of compensation for cognitive limitations is not strong, the same cannot be said for non-cognitive skills. Here, the extent body of research is much smaller and possible plasticity much greater (see for example, Almlund et al. 2011).

Our work offers a novel view on the complexity of general or routine health management. In her discussion of intelligence and health, Gottfredson (2004: 74) argues that "health self management is inherently complex" (see also Hummer and Larisey 2011). From our perspective, it is unclear that routine health management is complicated and we suggest that degree of complexity increases with extent of illness and extent of treatment. This however complicates conceptualization in that one is already compromised with respect to health when one specifies the conditions that are

seen to produce better or worse health (e.g., comprehension and compliance with physician recommendations). For the majority of the population that spends most of its time free of complex diseases, the basics of diet, physical activity, and the avoidance of risk behaviors and situations does not seem to require high levels of cognitive ability and would be mitigated by even moderate levels of self-control. If the latter is true, then basic cognitive and non-cognitive skills acquired in childhood may be more than sufficient for routine maintenance of health.

On the issue of causality, it is important to recognize that population science and public policy is not entirely dependent upon causality and the findings from conventional analyses are valuable in their own right. Those with lower educational attainment have a greater likelihood of health problems and early mortality. As such, educational attainment, a variable easily and typically measured in a wide range of health data, provides an important lens into social disparities in health regardless of its causal status. Still, if our findings generalize, manipulations to education, either at an individual level or at system level, will not yield significant improvements in population health unless they specifically enhance stocks of skills (cf. Galea et al 2011; Lleras-Muney 2005; Schoeni et al. 2008). Given this, policies that emphasize early life interventions to augment skills are likely to have particularly strong payoffs (see discussion in Meunning 2015), a conclusion consistent with widespread evidence of the significance of primary education and consequent literacy for population health (e.g., Baker et al. 2011; Behrman 2015; Smith-Greenway 2015). Recent research points to the salience of early childhood education (ECE) for skill development and educational attainment. In the last decade, a number of evaluation studies have examined the relationship between early childhood education and educational achievement among participants in large and small scale public education programs with a preschool component (e.g., Head Start, the Chicago Child-Parent Centers, High/Scope Perry Preschool Program, the Carolina Abecedarian Project). In particular, high quality preschool program participation is linked to lower rates of special education placement

and lower rates of grade retention (e.g., Campbell and Ramey 2010; Reynolds et al. 2007). Given this, interventions that focus on early life and target cognitive and non-cognitive skill acquisition might have important implications for health dynamics over the life course, particularly in contexts where familial human capital is low (Reynolds et al. 2011).

We recognize that our work is not a global test of the role of education for health dynamics. As noted, there is evidence that the association between educational attainment and health varies across the life course, both in magnitude and in perceived causal mechanisms (House et al. 2002). By necessity, our research focuses on a particularly slice of the life course and, while useful for the questions that we pursue, might not generalize to the entire life course. With the age range we study, we are not capturing the entirety of variance in SRH given that a number of diseases and conditions onset or manifest only at later ages. At the same time, we focus on only one measure of health, that self-assessed, and, while this is widely validated, different diseases and conditions have unique life course dynamics and structural determinants (Ben-Schlomo and Kuh 2002). In the end, we hope that our test of the education-health relationship and identification of the under acknowledged importance of cognitive and non-cognitive skills is provocative enough to spark future research on skills at different phases of the life course and for different conditions.

In the end, our research will not, and should not, be the final word on the life course-human capital explanation of education and health or on whether the typically observed association between educational attainment and health is indeed causal. Yet, our research challenges conventional views of how we should think about the association between educational attainment and heath, why it exists, and what it means. In particular, we provide of an explanation of why associational models show such strong effects of educational attainment, while natural experiments and twin-studies are much more equivocal given our emphasis on skills and the fact that the latter approaches never stratify on such things. At minimum, we need to consider the possibility that dominant etiological

frameworks that link education to health may require rethinking, we need to consider what dimensions of health may or may not have causal relations with educational attainment, and design research that identifies and measures other, potentially new factors that may link social position to health over the life course. For us, a better understanding of the social and psychological dynamics that yield massive health disparities and diminished life expectancies might do well to focus on the nexus of early family context, early years of schooling, and how these constitute a critical period for the development of self-reproducing cognitive and non-cognitive abilities that are powerful engines of educational attainment and are implicated in heterogeneity in health over the life course.

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Table 1. Descriptive Statistics, NLSY97.

	Mean/Percent	SD	Minimum	Maximum
Self-rated health (Time-varying)	2.139	.945	1	5
Sociodemographics				
Race-Sex group (1997)	2.781	1.657	1	6
White males	28.29%	.---	.---	.---
White females	27.05%	.---	.---	.---
Black males	12.03%	.---	.---	.---
Black females	13.17%	.---	.---	.---
Hispanic males	9.87%	.---	.---	.---
Hispanic females	9.60%	.---	.---	.---
Birth cohort (1997)	1981.903	1.389	1982	1984
Socioeconomic & Health Selection (1997)				
Lived in 'hard times'	.052	.222	0	1
Limb deformity	.015	.121	0	1
Has chronic condition	.109	.312	0	1
Parental education	2.674	1.027	1	4
Less than high school	14.13%	.---	.---	.---
High school graduate	31.92%	.---	.---	.---
Some college	26.37%	.---	.---	.---
Four year degree or more	27.59%	.---	.---	.---
Respondent's educational attainment (Time-varying)	2.660	1.255	1	5
Less than high school	20.92%	.---	.---	.---
High school graduate	24.31%	.---	.---	.---
Some college	37.06%	.---	.---	.---
Two-year degree	3.28%	.---	.---	.---
Four-year degree or more	14.43%	.---	.---	.---
Respondent's enrollment (Time-varying)	.326	.469	0	1
Cognitive and Non-cognitive Skills				
Cognitive ability - Categories (1997)	3.591	1.662	1	5
Educational commitment - Categories (1997)	2.774	1.469	1	5
Self-control - Categories (1997)	.777	.879	0	3
Task-orientedness - Categories (2002)	4.456	1.774	1	5
Sociability - Categories (2002)	4.460	1.774	1	5
Proximal Risk factors (Time-varying)				
Marital Status	.267	.514	0	2
Never married	76.77%	.---	.---	.---
Married	19.76%	.---	.---	.---
Seperated/Divorced/Widowed	3.47%	.---	.---	.---
BMI	2.794	1.003	1	5
Underweight	1.63%	.---	.---	.---
Normal range	48.49%	.---	.---	.---
Overweight	28.07%	.---	.---	.---
Obese	12.47%	.---	.---	.---
Severly obese	9.33%	.---	.---	.---
Smoking	.696	1.097	0	3
Non-smoker	66.41%	.---	.---	.---
Light smoker	11.20%	.---	.---	.---
Moderate smoker	8.79%	.---	.---	.---
Heavy smoker	13.59%	.---	.---	.---
Drinking	1.325	1.205	0	3
Abstainer	38.14%	.---	.---	.---
Light drinker	14.67%	.---	.---	.---
Moderate drinker	23.73%	.---	.---	.---
Heavy drinker	23.46%	.---	.---	.---
Marijuana Use	.215	.407	0	1
Other drug use	.050	.218	0	1
Respondents	7,177			
Observations	80,282			

Table 2. Multinomial logit coefficients: Educational attainment in 2013 regressed on demographic, socioeconomic and health background factors, and cognitive and non-cognitive skills, NLSY97.

	Educational attainment in 2013							
	High School Completion		Some College		Two-year degree		Four-year degree or more	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Race-Sex (Reference = White males)								
White female	-0.113	-0.197	0.189	0.113	0.198	0.089	0.619***	0.468**
	(0.176)	(0.185)	(0.174)	(0.191)	(0.206)	(0.223)	(0.177)	(0.201)
Black male	-0.232	0.019	-0.114	0.669***	-0.906***	-0.133	-0.869***	0.450**
	(0.171)	(0.181)	(0.173)	(0.192)	(0.249)	(0.268)	(0.197)	(0.225)
Black female	-0.082	0.170	0.694***	1.476***	0.215	0.946***	0.486**	1.655***
	(0.197)	(0.211)	(0.192)	(0.216)	(0.241)	(0.266)	(0.204)	(0.236)
Hispanic male	-0.380**	-0.239	-0.093	0.327	-0.547**	-0.107	-0.702***	-0.024
	(0.185)	(0.192)	(0.187)	(0.203)	(0.259)	(0.275)	(0.213)	(0.240)
Hispanic female	-0.028	0.050	0.571***	0.968***	0.400	0.812***	0.509**	1.211***
	(0.208)	(0.217)	(0.207)	(0.225)	(0.262)	(0.281)	(0.221)	(0.250)
Cohort (Reference = 1980)								
1981	-0.057	-0.099	0.012	-0.052	-0.004	-0.078	0.130	-0.032
	(0.178)	(0.182)	(0.175)	(0.187)	(0.228)	(0.238)	(0.188)	(0.206)
1982	-0.144	-0.697**	-0.318*	-1.251***	-0.104	-2.052***	-0.028	-1.809***
	(0.175)	(0.291)	(0.175)	(0.316)	(0.225)	(0.552)	(0.186)	(0.377)
1983	0.038	-0.563*	-0.013	-0.999***	0.081	-1.964***	0.001	-1.939***
	(0.179)	(0.301)	(0.178)	(0.324)	(0.228)	(0.559)	(0.190)	(0.387)
1984	-0.120	-0.744**	-0.111	-1.115***	-0.096	-2.212***	-0.015	-2.045***
	(0.177)	(0.306)	(0.175)	(0.328)	(0.228)	(0.563)	(0.188)	(0.389)
Background variables (1997)								
Lived in 'hard times'	-0.437**	-0.283	-0.425**	-0.119	-0.994***	-0.654**	-1.382***	-0.916***
	(0.183)	(0.191)	(0.183)	(0.199)	(0.315)	(0.327)	(0.249)	(0.281)
Has limb deformity	0.831	1.090*	0.316	0.613	0.753	1.064	0.063	0.364
	(0.542)	(0.563)	(0.558)	(0.598)	(0.622)	(0.663)	(0.578)	(0.634)
Has chronic condition	-0.103	-0.146	-0.282*	-0.383**	-0.479**	-0.546**	-0.305*	-0.331*
	(0.165)	(0.172)	(0.166)	(0.180)	(0.231)	(0.242)	(0.178)	(0.200)
Parent - High school graduate	0.582***	0.467***	0.989***	0.734***	1.225***	0.943***	1.145***	0.710***
	(0.134)	(0.138)	(0.139)	(0.150)	(0.218)	(0.228)	(0.177)	(0.198)
Parent - Some college	0.839***	0.745***	1.816***	1.512***	1.951***	1.672***	2.455***	1.972***
	(0.167)	(0.173)	(0.168)	(0.180)	(0.240)	(0.252)	(0.197)	(0.220)
Parent - Four year degree or more	1.232***	1.057***	2.880***	2.382***	3.085***	2.566***	4.579***	3.725***
	(0.276)	(0.282)	(0.269)	(0.281)	(0.323)	(0.336)	(0.285)	(0.306)
Cognitive ability - ASVAB percentile (1997)								
20th	.---	0.786***	.---	1.634***	.---	1.704***	.---	2.786***
		(0.162)		(0.173)		(0.243)		(0.270)
40th	.---	1.223***	.---	2.573***	.---	2.266***	.---	3.945***
		(0.214)		(0.219)		(0.283)		(0.298)
60th	.---	1.954***	.---	3.806***	.---	3.765***	.---	5.722***
		(0.363)		(0.363)		(0.403)		(0.414)
80th	.---	1.913***	.---	4.305***	.---	4.532***	.---	7.057***
		(0.609)		(0.600)		(0.625)		(0.630)
Missing	.---	0.230	.---	1.013***	.---	0.784***	.---	2.509***
		(0.144)		(0.157)		(0.246)		(0.256)
School commitment percentile (1997)								
20th	.---	-0.496**	.---	-0.627***	.---	-0.407	.---	-0.829***
		(0.205)		(0.210)		(0.249)		(0.223)
40th	.---	-0.260	.---	-0.363	.---	-0.442	.---	-0.692***
		(0.187)		(0.191)		(0.232)		(0.204)
60th	.---	-0.393**	.---	-0.573***	.---	-0.522**	.---	-1.100***
		(0.183)		(0.188)		(0.230)		(0.205)
80th	.---	-0.877***	.---	-1.126***	.---	-1.219***	.---	-1.948***
		(0.171)		(0.177)		(0.231)		(0.203)
Self-control (1997)								
High	.---	-0.422***	.---	-0.407***	.---	-0.536***	.---	-0.876***
		(0.134)		(0.138)		(0.171)		(0.150)
Moderate	.---	-0.526***	.---	-0.501***	.---	-0.715***	.---	-1.473***
		(0.174)		(0.179)		(0.229)		(0.207)
Low	.---	-0.449**	.---	-0.702***	.---	-1.756***	.---	-2.303***
		(0.215)		(0.229)		(0.392)		(0.307)
Sociability percentile (2002)								
20th	.---	0.473**	.---	0.375	.---	0.436	.---	0.375
		(0.215)		(0.229)		(0.308)		(0.262)
40th	.---	0.378	.---	0.596**	.---	0.625	.---	0.521
		(0.259)		(0.267)		(0.348)		(0.301)
60th	.---	0.659***	.---	0.958***	.---	1.150***	.---	1.064***
		(0.236)		(0.244)		(0.310)		(0.272)
80th	.---	0.611**	.---	0.793***	.---	1.102***	.---	0.815***
		(0.247)		(0.257)		(0.323)		(0.286)
Missing	.---	-0.657	.---	-0.560	.---	0.072	.---	-1.770
		(0.999)		(1.080)		(2.029)		(1.262)
Task oriented percentile (2002)								
20th	.---	-0.100	.---	0.203	.---	-0.243	.---	0.385
		(0.203)		(0.215)		(0.285)		(0.257)
40th	.---	0.383	.---	0.691**	.---	0.547	.---	1.090***
		(0.262)		(0.273)		(0.334)		(0.311)
60th	.---	0.298	.---	0.544	.---	0.255	.---	0.971***
		(0.268)		(0.279)		(0.342)		(0.313)
80th	.---	0.360	.---	0.656**	.---	0.495	.---	1.381***
		(0.255)		(0.264)		(0.320)		(0.296)
Missing	.---	0.685	.---	0.599	.---	-1.127	.---	1.568
		(0.990)		(1.067)		(2.026)		(1.236)
Constant	0.901***	1.184***	0.245	-0.407	-1.236***	-0.566	-0.753***	-2.022***
	(0.199)	(0.410)	(0.203)	(0.442)	(0.283)	(0.693)	(0.232)	(0.551)
Observations	5,829	5,829	5,829	5,829	5,829	5,829	5,829	5,829

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3. Between-effects regression coefficients: Self-rated health regressed on Educational attainment, demographic, socioeconomic and health background factors, cognitive and non-cognitive skills, and proximal causes of health, NLSY97.

	Self-rated health			
	BE	**BE**	**BE**	**BE**
	(1)	(2)	(3)	(4)
Aging	0.037***	0.050***	0.048***	0.033***
	(0.005)	(0.006)	(0.006)	(0.006)
Race-Sex (Reference = White males)				
White female	0.122***	0.173***	0.189***	0.181***
	(0.021)	(0.020)	(0.020)	(0.020)
Black male	-0.019	-0.065**	-0.067***	-0.044*
	(0.026)	(0.026)	(0.026)	(0.025)
Black female	0.260***	0.289***	0.289***	0.239***
	(0.027)	(0.026)	(0.026)	(0.026)
Hispanic male	0.062**	0.032	0.027	0.052*
	(0.029)	(0.028)	(0.028)	(0.027)
Hispanic female	0.221***	0.251***	0.244***	0.279***
	(0.030)	(0.029)	(0.029)	(0.028)
Cohort (Reference = 1980)				
1981	-0.037	-0.036	-0.026	-0.011
	(0.025)	(0.024)	(0.024)	(0.022)
1982	-0.073***	-0.085***	-0.168***	-0.112***
	(0.026)	(0.025)	(0.041)	(0.039)
1983	-0.046*	-0.074***	-0.148***	-0.096**
	(0.026)	(0.027)	(0.043)	(0.041)
1984	-0.084***	-0.118***	-0.180***	-0.115***
	(0.027)	(0.029)	(0.045)	(0.043)
Background variables (1997)				
Lived in 'hard times'	0.135***	0.070**	0.051	0.039
	(0.035)	(0.034)	(0.033)	(0.031)
Has limb deformity	0.231***	0.207***	0.182***	0.142**
	(0.065)	(0.063)	(0.062)	(0.058)
Has chronic condition	0.210***	0.200***	0.186***	0.172***
	(0.025)	(0.024)	(0.024)	(0.022)
Parental Education - High school graduate	-0.112***	-0.057**	-0.056**	-0.066***
	(0.025)	(0.025)	(0.025)	(0.023)
Parental Education - Some college	-0.169***	-0.050*	-0.059**	-0.072***
	(0.026)	(0.026)	(0.026)	(0.025)
Parental Education - Four year degree or more	-0.298***	-0.059**	-0.060**	-0.058**
	(0.027)	(0.028)	(0.028)	(0.027)
Respondent's Educational Attainment				
High school graduate	.---	-0.154***	-0.113***	-0.067**
		(0.032)	(0.033)	(0.031)
Some college	.---	-0.253***	-0.195***	-0.132***
		(0.034)	(0.035)	(0.034)
Two-year degree	.---	-0.411***	-0.306***	-0.182***
		(0.068)	(0.068)	(0.065)
Four-year degree or more	.---	-0.774***	-0.613***	-0.352***
		(0.049)	(0.052)	(0.050)
Enrolled				
Yes		-0.219***	-0.145***	-0.059
		(0.044)	(0.043)	(0.041)
Cognitive ability - ASVAB percentile (1997)				
20th	.---	.---	0.049*	0.025
			(0.027)	(0.025)
40th	.---	.---	-0.015	-0.025
			(0.028)	(0.027)
60th	.---	.---	-0.032	-0.061**
			(0.030)	(0.028)
80th	.---	.---	-0.072**	-0.090***
			(0.032)	(0.030)
			0.002	-0.013
			(0.026)	(0.025)
School commitment percentile (1997)				
20th	.---	.---	0.018	0.008
			(0.024)	(0.022)
40th	.---	.---	0.038*	0.035*
			(0.021)	(0.020)
60th	.---	.---	0.067***	0.048**
			(0.022)	(0.021)
80th	.---	.---	0.145***	0.109***
			(0.023)	(0.022)

Self-control (1997)				
Moderate	.---	.---	0.046***	0.013
			(0.017)	(0.016)
Low	.---	.---	0.117***	0.056**
			(0.024)	(0.023)
Very low	.---	.---	0.189***	0.105***
			(0.034)	(0.033)
Sociability percentile (2002)				
20th	.---	.---	-0.072**	-0.048
			(0.033)	(0.031)
40th	.---	.---	-0.084**	-0.065*
			(0.036)	(0.034)
60th	.---	.---	-0.118***	-0.091***
			(0.032)	(0.030)
80th	.---	.---	-0.189***	-0.152***
			(0.033)	(0.031)
Missing			0.056	0.032
			(0.156)	(0.146)
Task oriented percentile (2002)				
20th	.---	.---	-0.002	-0.006
			(0.032)	(0.030)
40th	.---	.---	-0.108***	-0.109***
			(0.036)	(0.034)
60th	.---	.---	-0.081**	-0.070**
			(0.036)	(0.034)
80th	.---	.---	-0.149***	-0.118***
			(0.033)	(0.031)
			-0.347**	-0.254*
			(0.153)	(0.144)
Marital Status				
Married	.---	.---	.---	-0.131***
				(0.030)
Separated/Divorced	.---	.---	.---	0.222***
				(0.063)
Body Mass (Reference = Normal range)				
Underweight	.---	.---	.---	0.281***
				(0.083)
Overweight	.---	.---	.---	0.102***
				(0.026)
Obese	.---	.---	.---	0.436***
				(0.035)
Severely Obese	.---	.---	.---	0.710***
				(0.033)
Smoking				
Light	.---	.---	.---	0.117***
				(0.042)
Moderate	.---	.---	.---	0.209***
				(0.043)
Heavy	.---	.---	.---	0.363***
				(0.031)
Drinking				
Light	.---	.---	.---	0.087*
				(0.047)
Moderate	.---	.---	.---	-0.066*
				(0.036)
Heavy	.---	.---	.---	-0.109***
				(0.035)
Drug Use				
Marijuana	.---	.---	.---	0.149***
				(0.032)
Other drugs	.---	.---	.---	0.135**
				(0.065)
Constant	1.906***	1.979***	2.108***	1.896***
	(0.064)	(0.057)	(0.076)	(0.073)
Respondents	7,177	7,177	7,177	7,177
Observations	80,282	80,282	80,282	80,282
R-squared	0.071	0.135	0.164	0.268

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Random effects coefficients: Self-rated health regressed on Educational attainment, demographic, socioeconomic and health background factors, cognitive and non-cognitive skills, and proximal risk factors, NLSY97.

	Self-rated health			
	RE	**RE**	**RE**	**RE**
	(1)	(2)	(3)	(4)
Aging	0.027***	0.031***	0.030***	0.024***
	(0.001)	(0.001)	(0.001)	(0.001)
Race-Sex (Reference = White males)				
White female	0.127***	0.142***	0.173***	0.183***
	(0.021)	(0.020)	(0.020)	(0.019)
Black male	-0.019	-0.032	-0.071***	-0.041*
	(0.026)	(0.025)	(0.026)	(0.024)
Black female	0.261***	0.267***	0.254***	0.258***
	(0.026)	(0.025)	(0.026)	(0.024)
Hispanic male	0.069**	0.060**	0.034	0.051**
	(0.029)	(0.028)	(0.028)	(0.026)
Hispanic female	0.228***	0.235***	0.222***	0.265***
	(0.030)	(0.029)	(0.029)	(0.027)
Cohort (Reference = 1980)				
1981	-0.030	-0.029	-0.014	-0.008
	(0.024)	(0.023)	(0.023)	(0.021)
1982	-0.055**	-0.058**	-0.110***	-0.085**
	(0.024)	(0.024)	(0.043)	(0.040)
1983	-0.027	-0.035	-0.076*	-0.056
	(0.024)	(0.024)	(0.044)	(0.041)
1984	-0.055**	-0.064***	-0.089**	-0.064
	(0.025)	(0.024)	(0.044)	(0.042)
Background variables (1997)				
Lived in 'hard times'	0.136***	0.117***	0.072**	0.060**
	(0.034)	(0.033)	(0.032)	(0.030)
Has limb deformity	0.239***	0.232***	0.194***	0.167***
	(0.064)	(0.062)	(0.061)	(0.057)
Has chronic condition	0.214***	0.211***	0.194***	0.184***
	(0.024)	(0.024)	(0.023)	(0.022)
Parental Education - High school gradua	-0.113***	-0.099***	-0.074***	-0.074***
	(0.025)	(0.024)	(0.024)	(0.022)
Parental Education - Some college	-0.169***	-0.137***	-0.103***	-0.098***
	(0.026)	(0.025)	(0.025)	(0.024)
Parental Education - Four year degree or .	-0.299***	-0.231***	-0.147***	-0.120***
	(0.027)	(0.026)	(0.027)	(0.025)
Respondent's Educational Attainment				
High school graduate	.---	-0.031**	-0.021*	-0.025**
		(0.012)	(0.012)	(0.012)
Some college	.---	-0.050***	-0.021*	-0.032***
		(0.011)	(0.011)	(0.011)
Two-year degree	.---	-0.129***	-0.084***	-0.079***
		(0.024)	(0.025)	(0.024)
Four-year degree or more	.---	-0.225***	-0.164***	-0.141***
		(0.017)	(0.017)	(0.017)
Enrolled				
Yes	.---	-0.069***	-0.054***	-0.035***
		(0.009)	(0.009)	(0.009)
Cognitive ability - ASVAB percentile (1997)				
20th	.---	.---	0.008	0.003
			(0.026)	(0.025)
40th	.---	.---	-0.080***	-0.072***
			(0.027)	(0.025)
60th	.---	.---	-0.131***	-0.124***
			(0.028)	(0.026)
80th	.---	.---	-0.212***	-0.187***
			(0.029)	(0.027)
Missing	.---	.---	-0.047*	-0.045*
			(0.026)	(0.024)
School commitment percentile (1997)				
20th	.---	.---	0.022	0.014
			(0.023)	(0.022)
40th	.---	.---	0.053**	0.045**
			(0.021)	(0.019)
60th	.---	.---	0.091***	0.072***
			(0.022)	(0.020)
80th	.---	.---	0.183***	0.149***
			(0.023)	(0.021)
Self-control (1997)				

Moderate	.---	.---	0.064***	0.035**
			(0.017)	(0.015)
Low	.---	.---	0.146***	0.095***
			(0.024)	(0.022)
Very low	.---	.---	0.231***	0.158***
			(0.034)	(0.032)
Sociability percentile (2002)				
20th	.---	.---	-0.072**	-0.061**
			(0.032)	(0.030)
40th	.---	.---	-0.093***	-0.083**
			(0.036)	(0.033)
60th	.---	.---	-0.130***	-0.110***
			(0.031)	(0.029)
80th	.---	.---	-0.197***	-0.174***
			(0.033)	(0.031)
Missing	.---	.---	0.060	0.043
			(0.158)	(0.149)
Task oriented percentile (2002)				
20th	.---	.---	-0.006	-0.009
			(0.031)	(0.029)
40th	.---	.---	-0.118***	-0.117***
			(0.035)	(0.033)
60th	.---	.---	-0.095***	-0.089***
			(0.035)	(0.033)
80th	.---	.---	-0.175***	-0.150***
			(0.032)	(0.030)
Missing	.---	.---	-0.342**	-0.284*
			(0.155)	(0.146)
Marital Status				
Married	.---	.---	.---	-0.022**
				(0.010)
Separated/Divorced	.---	.---	.---	-0.011
				(0.020)
Body Mass (Reference = Normal range)				
Underweight	.---	.---	.---	0.076***
				(0.025)
Overweight	.---	.---	.---	0.078***
				(0.008)
Obese	.---	.---	.---	0.253***
				(0.012)
Severely Obese	.---	.---	.---	0.460***
				(0.016)
Smoking				
Light	.---	.---	.---	0.061***
				(0.010)
Moderate	.---	.---	.---	0.169***
				(0.012)
Heavy	.---	.---	.---	0.230***
				(0.012)
Drinking				
Light	.---	.---	.---	0.009
				(0.008)
Moderate	.---	.---	.---	0.007
				(0.008)
Heavy	.---	.---	.---	0.009
				(0.009)
Drug Use				
Marijuana	.---	.---	.---	0.052***
				(0.009)
Other drugs	.---	.---	.---	0.089***
				(0.014)
Constant	1.956***	1.975***	2.144***	1.986***
	(0.031)	(0.031)	(0.061)	(0.058)
Respondents	7,177	7,177	7,177	7,177
Observations	80,282	80,282	80,282	80,282
R-squared				

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. ML Fixed effects coefficients: Self-rated health regressed on Educational attainment, demographic, socioeconomic and health background factors, cognitive and non-cognitive skills, and proximal causes of health, NLSY97.

	Self-rated health	
	FE	**FE**
	(1)	(2)
Aging	0.031***	0.028***
	(0.001)	(0.001)
Respondent's Educational Attainment		
High school graduate	0.078***	0.071***
	(0.017)	(0.017)
Some college	0.111***	0.095***
	(0.018)	(0.018)
Two-year degree	0.081***	0.070**
	(0.031)	(0.031)
Four-year degree or more	0.041	0.035
	(0.024)	(0.024)
Enrolled		
Yes	-0.002	0.003
	(0.010)	(0.010)
Marital Status		
Married	.---	-0.008
		(0.012)
Separated, Divorced, Widowed	.---	-0.040*
		(0.023)
Body Mass (Reference = Normal range)		
Underweight	.---	0.088***
		(0.029)
Overweight	.---	0.052***
		(0.010)
Obese	.---	0.176***
		(0.015)
Severely Obese	.---	0.330***
		(0.020)
Smoking		
Light	.---	0.049***
		(0.011)
Moderate	.---	0.139***
		(0.014)
Heavy	.---	0.185***
		(0.015)
Drinking		
Light	.---	0.018**
		(0.009)
Moderate	.---	0.022**
		(0.009)
Heavy	.---	0.033***
		(0.010)
Drug use		
Marijuana	.---	0.051***
		(0.010)
Other drug	.---	0.079***
		(0.015)
Constant	1.810***	1.705***
	(0.012)	(0.013)
Respondents	7,081	7,081
Observations	73,105	73,105

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6. Random and Fixed-effects coefficients: Self-rated health regressed on Educational attainment, demographic, socioeconomic and health background factors, and cognitive and non-cognitive skills, NLSY97 by race and sex.

	White males		White females		Black males		Black females		Hispanic males		Hispanic females	
	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE	RE	FE
	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Respondent's Educational Attainment												
High school graduate	-0.030	0.024	-0.006	0.038	-0.047	-0.012	0.004	0.054	-0.013	-0.007	0.043	0.061
	(0.021)	(0.023)	(0.023)	(0.026)	(0.030)	(0.034)	(0.033)	(0.036)	(0.035)	(0.040)	(0.038)	(0.043)
Some college	-0.010	0.071***	-0.025	0.011	-0.010	0.034	0.007	0.075**	-0.124***	-0.048	-0.003	0.056
	(0.018)	(0.020)	(0.018)	(0.020)	(0.031)	(0.037)	(0.029)	(0.033)	(0.035)	(0.041)	(0.033)	(0.039)
Two-year degree	-0.041	0.052	-0.105**	-0.013	-0.129	-0.045	-0.046	0.083	-0.135	-0.056	-0.116	-0.016
	(0.041)	(0.045)	(0.041)	(0.046)	(0.081)	(0.090)	(0.065)	(0.071)	(0.086)	(0.095)	(0.076)	(0.084)
Four-year degree or more	-0.113***	0.007	-0.169***	-0.046	-0.088	-0.009	-0.152***	-0.011	-0.242***	-0.151**	-0.108*	-0.005
	(0.028)	(0.032)	(0.027)	(0.031)	(0.057)	(0.066)	(0.048)	(0.054)	(0.064)	(0.074)	(0.056)	(0.064)
Cognitive ability - ASVAB percentile (1997)												
20th	-0.107**	.---	-0.083	.---	-0.016	.---	0.107*	.---	-0.053	.---	0.017	.---
	(0.054)		(0.064)		(0.055)		(0.061)		(0.067)		(0.073)	
40th	-0.196***	.---	-0.273***	.---	-0.051	.---	0.050	.---	0.075	.---	-0.103	.---
	(0.051)		(0.061)		(0.065)		(0.068)		(0.076)		(0.072)	
60th	-0.233***	.---	-0.280***	.---	-0.059	.---	-0.035	.---	-0.070	.---	-0.261***	.---
	(0.050)		(0.060)		(0.081)		(0.077)		(0.088)		(0.083)	
80th	-0.280***	.---	-0.374***	.---	-0.186	.---	-0.119	.---	-0.148	.---	-0.201**	.---
	(0.050)		(0.060)		(0.115)		(0.100)		(0.093)		(0.095)	
Missing	-0.173***	.---	-0.163***	.---	-0.016	.---	0.052	.---	0.007	.---	-0.105	.---
	(0.052)		(0.062)		(0.054)		(0.065)		(0.066)		(0.069)	
School commitment percentile (1997)												
20th	0.061	.---	0.039	.---	0.012	.---	-0.058	.---	-0.043	.---	0.036	.---
	(0.037)		(0.039)		(0.062)		(0.070)		(0.071)		(0.079)	
40th	0.057*	.---	0.095***	.---	0.141**	.---	-0.019	.---	0.029	.---	0.007	.---
	(0.034)		(0.036)		(0.057)		(0.059)		(0.065)		(0.064)	
60th	0.102***	.---	0.159***	.---	0.080	.---	0.067	.---	0.080	.---	0.055	.---
	(0.036)		(0.039)		(0.057)		(0.063)		(0.064)		(0.069)	
80th	0.239***	.---	0.207***	.---	0.231***	.---	0.065	.---	0.183***	.---	0.128*	.---
	(0.040)		(0.039)		(0.060)		(0.064)		(0.065)		(0.069)	
Self-control (1997)												
Moderate	0.067**	.---	0.095***	.---	0.017	.---	0.096**	.---	0.068	.---	0.015	.---
	(0.028)		(0.028)		(0.044)		(0.046)		(0.050)		(0.050)	
Low	0.191***	.---	0.215***	.---	0.053	.---	-0.017	.---	0.060	.---	0.179**	.---
	(0.037)		(0.044)		(0.061)		(0.075)		(0.067)		(0.078)	
Very low	0.240***	.---	0.265***	.---	0.149*	.---	0.136	.---	0.258***	.---	0.075	.---
	(0.047)		(0.074)		(0.079)		(0.161)		(0.085)		(0.141)	
Task-oriented percentile (2002)												
20th	0.052	.---	-0.110*	.---	-0.195**	.---	0.049	.---	-0.062	.---	0.112	.---
	(0.050)		(0.062)		(0.077)		(0.092)		(0.093)		(0.090)	
40th	-0.119**	.---	-0.159**	.---	-0.259***	.---	0.071	.---	-0.139	.---	0.045	.---
	(0.057)		(0.067)		(0.089)		(0.097)		(0.107)		(0.102)	
60th	-0.115**	.---	-0.122*	.---	-0.151	.---	0.073	.---	-0.223*	.---	0.024	.---
	(0.057)		(0.064)		(0.093)		(0.101)		(0.117)		(0.103)	
80th	-0.170***	.---	-0.198***	.---	-0.273***	.---	-0.070	.---	-0.257**	.---	-0.031	.---
	(0.054)		(0.060)		(0.084)		(0.092)		(0.103)		(0.094)	
	-0.260	.---	-0.552*	.---	-0.471	.---	0.433	.---	-0.642*	.---	-0.501	
	(0.278)		(0.315)		(0.346)		(0.450)		(0.348)		(0.427)	
Sociability percentile (2002)												
20th	-0.148***	.---	-0.101*	.---	0.230***	.---	-0.121	.---	-0.088	.---	0.030	.---
	(0.053)		(0.056)		(0.088)		(0.094)		(0.100)		(0.088)	
40th	-0.130**	.---	-0.112*	.---	0.069	.---	-0.225**	.---	-0.075	.---	0.024	.---
	(0.059)		(0.063)		(0.101)		(0.098)		(0.114)		(0.099)	
60th	-0.189***	.---	-0.139**	.---	0.089	.---	-0.122	.---	-0.056	.---	-0.153*	.---
	(0.051)		(0.055)		(0.087)		(0.089)		(0.099)		(0.087)	
80th	-0.205***	.---	-0.218***	.---	0.062	.---	-0.200**	.---	-0.132	.---	-0.318***	.---
	(0.056)		(0.058)		(0.086)		(0.090)		(0.106)		(0.095)	
	-0.085	.---	0.119	.---	0.290	.---	-0.521	.---	0.346	.---	0.579	.---
	(0.279)		(0.320)		(0.352)		(0.468)		(0.354)		(0.433)	
Respondents	2,064	988	1,925	905	942	422	926	433	735	282	693	308
Observations	28,091	13,639	26,583	12,604	13,181	5,779	13,644	6,250	10,070	3,905	9,927	4,317

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note. For random-effects specifications, all models include control variables for aging, cohort, family socioeconomic status, and early health status.

Figure 1. Conceptual Model of Skills and Schooling in Early Life