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Cognitive ability has powerful, widespread and robust effects on social stratification: Evidence from the 1979 and 1997 US National Longitudinal Surveys of Youth

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ABSTRACT

Few issues in the social sciences are as controversial as the role of cognitive ability for educational and subsequent socioeconomic attainments. There are a variety of arguments raised to dismiss, discount or discredit the role of cognitive ability: socioeconomic background is the dominant influence; if cognitive ability appears important, that is only because important predictors have been omitted; the relative importance of socioeconomic background and cognitive ability cannot be ascertained; and cognitive ability is simply a function of socioeconomic background and, for post-education socioeconomic attainments, education. This study analyses the effects of cognitive ability and socioeconomic background on a chronological sequence of social stratification outcomes - school grades, SAT and ACT scores, educational and occupational attainment, income and wealth - in data from the 1979 and 1997 National Longitudinal Surveys of Youth. The coefficients for cognitive ability decline marginally with the addition of socioeconomic background measures, including family-of-origin income averaged over several years, and wealth. In contrast, socioeconomic background coefficients decline substantially with the addition of cognitive ability. Net of educational attainment, cognitive ability has sizable effects on occupational attainment and income. Net of socioeconomic background, education and occupation, a one-standard-deviation difference in ability corresponds to a sizable 43% difference in positive wealth at around age 35 in the older cohort and a 25% increase in the younger cohort. Therefore, contrary to dominant narratives, cognitive ability is important to a range of social stratification outcomes, and its effects cannot be attributed to socioeconomic background or educational attainment.

1. Introduction

The central contention of modernization theory is that, as societies modernize, socioeconomic origins become less important to occupational and economic attainments, and education becomes more important (Goldthorpe, 1996; Knigge, Maas, van Leeuwen, & Mandemakers, 2014; Treiman, 1970). The related meritocratic thesis is that with modernization, merit - typically defined as ability plus effort - becomes the most important factor in influencing educational and socioeconomic attainments. The term 'meritocracy' was first coined by British sociologist Michael Young (1958/2004) in his dystopian novel, *The Rise of the Meritocracy*.

According to Wooldridge (2021), the 'meritocratic ideal' has shaped the modern world. The idea that important positions in society should be based on merit rather than on nepotism, cronyism and patronage was a common theme among Enlightenment philosophers. It was an important principle in the French and American revolutions, and from the late 18th century guided educational and civil reforms in France, Germany, Britain, the US, and elsewhere (Wooldridge, 2021). Meritocratic orientations are important to economic growth, excellence in the sciences and arts, and societal wealth (Rindermann, 2018). Meritocracies were understood as not just optimal for economic growth but also socially fair, and thus enjoyed support from both sides of politics, though this has since dissipated (Goldthorpe & Jackson, 2008; Wooldridge, 2021).

It has been claimed that contemporary Western societies are, to a substantial extent, meritocratic (Herrnstein & Murray, 1994, pp. 511–512; Saunders, 1995, 2002; Kingston, 2006; Marks, 2014, pp. 236–237). Against this, there is a more recent, and with the exception of Herrnstein and Murray's *The Bell Curve*, a more prominent literature arguing that in contemporary Western societies, meritocracy is a myth, and that myth is detrimental to social justice (Markovits, 2019; Sandel, 2021; Stiglitz, 2015).

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An important corollary of the meritocracy thesis is that cognitive ability is important to educational and subsequent socioeconomic attainments in contemporary societies. This contention is an anathema to the dominant sociopolitical paradigm. Some of the more prominent criticisms are: the concept of cognitive ability is too nebulous and ill-defined to be useful (Gould, 1981/1996, p. 269); there are multiple intelligences (Gardner, 2006; Sternberg, 1985); it cannot be measured[1] (Lucas, 2018, p. 2); intelligence tests are culturally biased (in response, see Guterman, 1979; Jensen, 1984); and the isolation of general cognitive ability or *g* through factor analysis of intelligence test items is especially problematic (Gould, 1981/1996, pp. 264–365).

It has also been asserted that intelligence tests do not measure cognitive ability, but rather something else. According to Richardson (2002, p. 283) IQ tests are, in effect, "a measure of social class background". Similarly, Fischer et al. (1996, p. 58) contend that the Armed Forces Qualification Test (AFQT) in the 1979 National Longitudinal Survey of Youth (NLSY79) used extensively by Herrnstein and Murray (1994) in *The Bell Curve* "is a better measure of social background than of 'native' intelligence". This view is echoed by Currie and Thomas (1999, pp. 317–318): "One might argue that AFQT scores are a better indicator of the socioeconomic status of the mother and her family when she was an adolescent". Others have claimed that the AFQT measures the home environment (Korenman & Winship, 2000, p. 151); mastery of the school curricula and the quality of instruction (Fischer et al., 1996, pp. 59, 62); human capital (Currie & Thomas, 1999, p. 302); and 'human, financial, and social capital' (Cooksey, 1997, p. 251).

These criticisms have been largely discredited in mainstream cognitive psychology (Carroll, 1995; Deary, 2012; Gottfredson, 1997; Neisser et al., 1996; Ritchie, 2015; Warne, 2020). According to Warne (2020, pp. 25–27), after many decades of disagreement, there is now much consensus in cognitive psychology about the conceptualization and measurement of cognitive ability, and the existence of *g*.

For social stratification - which encompasses the range of socially recognized accomplishments, from performance at school, through educational and occupational attainment, to income and household wealth - cognitive ability is generally considered unimportant, especially compared to socioeconomic background (or class background in the UK and Europe).The associations between parents' and their children's education and socioeconomic attainment is explained by Social Advantage and Disadvantage, or the 'SAD thesis' (Bond & Saunders, 1999, p. 218). This view is widespread in academia and is commonly held among non-university researchers, government bureaucrats and policymakers, journalists, social commentators, politicians, political activists, and educated publics.

The point of this article is to demonstrate that cognitive ability is important to a range of social stratification outcomes - far too important to blithely ignore.

2. Arguments discounting the importance of cognitive ability for social stratification

This section discusses the various types of arguments commonly employed to dismiss, discount or discredit, the role of cognitive ability in social stratification. There are four general arguments:

1. Socioeconomic (or class) background is the dominant influence on educational and stratification outcomes. Ability is only of minor importance, if at all.
2. If cognitive ability appears important, that is only because important socioeconomic and social background factors have been omitted.
3. It is not possible to compare the relative importance of socioeconomic background and cognitive ability.
4. Ability is endogenous to socioeconomic background and education.

2.1. Socioeconomic background (or Class) is the dominant influence on stratification outcomes

It is often asserted that educational and socioeconomic attainments are overwhelmingly due to socioeconomic background. For example, Geiser (2020, p. 31), from the Center for Studies in Higher Education at Berkeley, claimed that "Student socioeconomic characteristics now account for about 40% of the variance in SAT/ACT scores among California high school graduates who apply to UC".[2] This view has filtered through to the media with SAT and ACT scores being reflexively attributed to family income and wealth (Golberg, 2022; Goldfarb, 2014).

Socioeconomic background is also understood as the central influence on student performance in student achievement studies (see Broer, Bai, & Fonseca, 2019; Hopfenbeck et al., 2018; Volante, Schnepf, Jerrim, & Klinger, 2019). The OECD's Programme for International Student Assessment (PISA) largely focuses on students' socioeconomic background and ignores cognitive ability (see Marks & O'Connell, 2021).

For educational attainment, the research focus is on persistent inequality, the supposedly substantial and persistent socioeconomic inequalities in education (Goldthorpe, 1996; Pfeffer, 2008; Shavit & Blossfeld, 1993; Shavit, Yaish, & Bar-Haim, 2007). The persistent inequality thesis has generated a large research literature that rarely considers cognitive ability. The concept of persistent inequality has been extended to 'persistent' socioeconomic inequalities in occupational attainment, income and wealth (Piketty, 2000).

For occupational attainment, Breen and Goldthorpe (2002) claim that ability plays only a minor role in explaining social class inequalities, their central concern. This is despite the fact that the addition of measures of ability (and motivation) to their analyses increased the variance accounted for in occupational attainment from 7 to 24% and reduced the coefficients for class background by about 40% (2002, p. 579). In much educational and occupational attainment research, the main theoretical interest in cognitive ability is not the extent to which it accounts for variance in stratification outcomes, but the degree to which it mediates the effects of class background (Betthäuser, Bourne, & Bukodi, 2020; Bourne, Bukodi, Betthäuser, & Goldthorpe, 2018; Erikson, 2016).

For the US, it was assumed that the intergenerational correlation between parents' and their adult children's earnings and incomes is quite weak, around 0.20 or less (Sewell & Hauser, 1975, p. 93; Jencks et al., 1979, p. 327; Becker & Tomes, 1986). This conclusion was overturned by Solon (1992) and Zimmerman (1992) who estimated higher correlations around 0.40 or more. The logic was that one year's income does not measure 'permanent income', that is, income stripped of its transitory components. Averaging incomes over a three- or five-year period to obtain a more accurate measure of permanent income increases the intergenerational correlation. According to Bowles and Gintis (2002b), the high US intergenerational income correlation confirms their general ideological position that the intergenerational transmission of economic status in the US is considerable, and that radical reforms are therefore required. They claimed that parental income is as important for offspring's income, as educational attainment (2002b, pp. 3–4). Later studies estimated even higher correlations, approaching 0.6, by averaging incomes over longer periods of time (Mazumder, 2005). The high intergenerational correlations generated a research literature that maintains, or at least implies, that the ultimate source of income inequalities in Western countries is father's or parental income, especially

[1] Lucas (2018, p. 2) argues that ability is a capacity so cannot be measured. He makes a bizarre analogy with empty, partially full and full buckets.

[2] In that study, socioeconomic characteristics encompass family income, parental education, and race/ethnicity

in the US (Corak, 2005; OECD, 2011; Blanden, 2013; OECD, 2018, p. 53).[3] Again, cognitive ability is considered one of several mediating variables that account for the intergenerational income correlation, although educational attainment apparently plays the dominant role (Blanden, Gregg, & Macmillan, 2007).

Similarly for wealth, the focus is on its intergenerational transmission (Pfeffer & Killewald, 2018). The correlation of wealth across generations in the US is roughly 0.3 to 0.4, like the intergenerational persistence for other stratification variables. Direct transfers of wealth account for less than 20% of the intergenerational association in wealth (Killewald, Pfeffer, & Schachner, 2017, p. 394).

Bowles and Gintis (2002a, p. 22) claim that IQ is not a major contributor to earnings inequality in the US. In contrast, “parental income and wealth are strong predictors of the likely economic status of the next generation” (2002a, p. 22). In their meta-analysis (2002b, p. 5), they concluded that, when considering education, a one-standard-deviation difference in cognitive ability translates to a 0.15 standard deviation difference in logged earnings. That estimate was contrasted with the somewhat larger 0.22 estimate for years of education. Analyzing the NLSY79, Zagorsky (2007) found no relationship between ability and respondents' wealth.

2.2. *If cognitive ability appears important, it is only because important predictors have been omitted*

In response to the reports of only moderate effects of socioeconomic background on education and occupational attainment in prominent sociological studies of late 1960s and early 1970s, Bowles (1972), and later Bowles and Gintis (2002a) argue that in such studies, the estimates of effects of socioeconomic origins are downwardly biased because income and wealth are not included. Similarly, Pfeffer (2011) argues that conventional measures of family background in status attainment research, comprising parent's education and occupation, and family income, are inadequate because they do not include family wealth. There is research showing that household wealth is associated with student achievement, educational and occupational attainment, and labor market outcomes, often net of other socioeconomic background factors, but mostly not net of cognitive ability (see citations in Killewald et al., 2017, pp. 390–391).

A common response to Herrnstein and Murray's (1994) comparison of the relative effects of cognitive ability and SES - measured as a combination of parental occupational status, father's education and family income - on a range of social outcomes, is that the estimates are spurious because their socioeconomic index is inadequate (Goldberger & Manski, 1995, pp. 768–769; Hauser & Carter, 1995; Heckman, 1995; Fischer et al., 1996, pp. 77–80; Korenman & Winship, 2000).

Korenman and Winship (2000, pp. 139,156) endeavor to demonstrate that the effects of AFQT scores are negligible. Their measure, ‘family background’, includes very disparate variables: race, sex, ethnicity; residency; family arrangement and family size; magazines and newspaper readership; library card ownership; foreign birth; and age of mother at birth. Together with standard socioeconomic background measures, a latent measure of family background was generated. Contrary to their expectations, Korenman and Winship (2000, p. 158) concede that after the addition of the family background factor, “the effect of AFQT is virtually unchanged”.

If ability is mostly a function of family background, then a sibling fixed-effects analyses will substantially reduce, or remove, the effects of ability. Sibling fixed-effects analyses is a powerful method for controlling for family background, since it captures all factors common to siblings in the same family (Korenman & Winship, 2000, p. 150). In their fixed-effects analyses of the NLSY79, the effects of ability are essentially the effects of differences in siblings' AFQT scores. However, sibling fixed-effects analyses did not remove, or even substantially reduce, the effects of cognitive ability. Korenman and Winship (2000, p. 151) found it “surprising that for many outcomes the fixed-effect estimates for AFQT are similar to the standard estimates”.

Similarly, Fischer et al. (1996, pp., 77–88, 233) attempt to explain away the effects of AFQT score on poverty. Nielsen (1997, pp. 702–703) notes that this exercise, designed to demonstrate the unimportance of cognitive ability, failed since the ability estimates remained non-trivial despite controlling for 28 variables. Nielsen (1997, p. 703) comments that “Readers are likely to be more impressed by the statistical resilience of the cognitive ability variable in the face of massive model over-specification than by the authors' claim that it does not really matter”.

Overspecification is sometimes used to ‘prove’ that ability effects are trivial. For example, for educational attainment, it is a simple matter to substantially reduce the estimates for ability by controlling for variables that are themselves strongly predicted by ability, for example test scores in reading and mathematics, school grades, educational aspirations and curriculum track or stream.

2.3. *It is not possible to compare the effects of SES and ability*

Articles in psychology journals often include a correlation matrix of the study variables so readers can assess the relative strength of the relationships between variables. Structural Equation Model (SEM) studies typically report standardized effects and include the correlation matrix analyzed, allowing interested researchers to perform their own analyses. During the 1970s and 1980s, journal articles in education and sociology would routinely report correlations and standardized effects. However, reporting correlations and standardized effects has become much less common. Pearson correlations are inappropriate for dichotomous and non-normally distributed ordinal variables, although there are alternatives. Standardized coefficients can be misleading in comparisons between samples. Standardized effects have been likened to comparing apples and oranges (Bring, 1994; Kim & Ferree, 1981; King, 1986).

Issues surrounding standardized effects are exploited to argue that the magnitudes of the effects of socioeconomic background and cognitive ability cannot be compared. The so-called ‘race of the variables’ is presented as theoretically irrelevant, and perhaps even contemptible (Breen & Goldthorpe, 1999, 2002; Lucas, 2018). Breen and Goldthorpe (2002, p. 581) view standardized coefficients and measures of variance explained (i.e., R Square) as “highly questionable”.

Although there are statistical issues in assessing the comparative weight of predictors, some predictors are simply more important than others. Standardized coefficients are useful for comparing the relative strength of influence of two independent variables on the dependent variable in a single sample (Menard, 2011, p. 1045). If the difference is large enough, a variety of statistical procedures—partial correlations, semi-partial correlations, standardized coefficients, standardized independent variables, t values, changes in variance explained—will lead to the same conclusion. Many factors have small effects on social outcomes and in large enough samples these effects will typically be statistically significant. There are no benefits to theory or policymaking to conclude that many variables have statistically significant associations with an outcome but not to indicate which are more or less important. Without accompanying standardized coefficients, the coefficients for cognitive ability when finely measured (e.g., IQ) will appear misleadingly small, but highly significant.

2.4. *Ability is endogenous to socioeconomic background and education*

Another common argument is that ability is endogenous to

[3] It is interesting that the higher intergenerational earnings correlations (or conversely lower earnings mobilities) in the US and UK that were so often highlighted in the academic literature and the commentariat, often attributed to free market economic policies, are not nearly as evident in the OECD's (2018, p. 36) most recent report.

socioeconomic background. According to the status attainment model in sociology, parents' socioeconomic status generates a cascade of inequalities among their offspring: first in IQ, then years of education, then occupational status, then income (Gottfredson, 2016, pp. 118–119). In the UK and Europe, cognitive ability is routinely specified as a function of social class (Connelly & Gayle, 2019). Specifying cognitive ability as a function of socioeconomic or class background is obviously incorrect since genetics contributes to between 40 and 60% of the variance in cognitive ability in children and up to 80% in adults (Bouchard Jr., 2009; Deary, 2012; Plomin & Deary, 2015; Willoughby, McGue, Iacono, & Lee, 2021).

A related argument is that cognitive ability is a consequence, rather than an influence, on education. Since NLSY79 respondents were aged 15 to 23 when administered the AFQT, there are positive correlations of AFQT score with age (r = 0.16) and a much stronger correlation with years of education (r = 0.54) completed at the time of testing (Fischer et al., 1996, p. 60). This led Fischer et al. (1996, p. 59) to claim that the AFQT is really a test of instruction or schooling. Focusing on the AFQT in the NLSY79, Winship and Korenman (1997, p. 231) explicitly disagreed with Fischer et al.'s (1996) contention that the effects of education on IQ are considerably more important than the effect of early IQ on later IQ. They conservatively conclude that the impact of early IQ on later IQ is more than twice that of education (1997, pp. 231–232). Winship and Korenman's (1999), p. 63) preferred causal estimate for the impact of AFQT score on years of education was 0.53 (a standardized effect), which is close to the bivariate correlation. AFQT score influences schooling, but there is also a weaker reciprocal effect of schooling on AFQT score (Winship & Korenman, 1999, p. 73).

3. The present investigation

Many of the studies cited above reinforce false narratives that cognitive ability is unimportant to education and subsequent socioeconomic attainments, and that social stratification is mostly about socioeconomic background. Nielsen (1997, p. 704) notes that, contrary to the evidence, this literature confirms existing ideological preferences and reinforces "a comfortable state of denial". Little has changed since the mid-1990s, despite the accumulation of far more evidence contrary to these narratives. Unfortunately, they have permeated from academia into wider publics including government bureaucracies, the media and the commentariat. Importantly, these narratives are consistent with prominent political ideologies which view Western societies as characterized by large and entrenched educational and socioeconomic inequalities, which can only be addressed by stronger interventions by the state, or the dismantling of market capitalism.[4]

These prominent and pervasive critiques of cognitive ability's role in education and social stratification are highly detrimental to the accumulation of scientific knowledge. Many academic journal editors and referees accept these critiques unquestionably, not because the contentions of the critiques are the products of careful and objective science (they are not), but because they are compatible with their pre-existing political ideologies.[5] Strong and robust effects of cognitive ability seriously undermine these political ideologies, so are summarily rejected.

The purpose of this study is to demonstrate that for social stratification, cognitive ability is too important to ignore. This study focuses on seven educational and socioeconomic outcomes: grades at school, SAT and ACT achievement scores, educational and occupational attainment, and income and wealth with appropriate measures of socioeconomic background and mediating influences. The aims of this study are:

1. To compare the explanatory power of cognitive ability and socioeconomic background.
2. To assess the extent that the relationships between cognitive ability, and educational and socioeconomic attainments, can be attributed to socioeconomic background.
3. To examine if more comprehensive measures of socioeconomic background that include income averaged over several years, and wealth, account for the effects of cognitive ability.
4. To estimate the effects of cognitive ability on occupational attainment, income and wealth, net of education and relevant proximal influences.
5. To assess if there have been changes in the relative importance of cognitive ability and socioeconomic background on social stratification in the 1997 NLSY cohort compared to the 1979 cohort.

Specialists in cognitive psychology are generally aware that cognitive ability is important for social stratification outcomes, especially for student achievement and educational attainment. However, no previous study has comprehensively addressed the range of arguments used to discredit the importance of cognitive ability, especially arguments about the measurement of socioeconomic background and the impact of ability vis-à-vis more proximate influences. The aim of this study is to demonstrate that these arguments are not credible.

4. Materials and methods

4.1. Sample and data

The data analyzed for this study are from the 1979 and 1997 NLSY studies. Each is a nationally representative, longitudinal study with high response rates, frequent follow-ups with large numbers of variables (BLS, 2022f; Cooksey, 2018).[6] Both studies have extensive bibliographies (BLS, 2022d).

The NLSY79 originated as a household probability sample of 12,686 adolescents aged range 14 to 21 on December 31, 1978, thus born between 1957 and 1964. The age range applies to when the sample was drawn; interviews occurred several months later, so that there were a few 22-year-old respondents at first interview. The NLSY79 contained 6111 respondents from the original household probability sample, 5295 respondents who were part of the minority and 'poor white' oversample, and 1280 respondents who were part of the military sample. Respondents were interviewed annually from 1979 to 1994 and since 1994 biennially (BLS, 2022e; Cooksey, 2018). Over 77% of those still living participated in round 26 interviews conducted in 2014 and 2015. It appears that attrition in the NLSY79 does not lead to biased estimates in models of important economic relationships (Aughinbaugh, Pierret, & Rothstein, 2017). The most recent round of data analyzed for the present study were collected in 2018 and 2019.

The NLSY97 study is an approximate replication of the NLSY79 study, for a cohort born almost two decades later. It is a household probability sample of adolescents born between 1980 and 1984. At the time of first interview, respondents' ages ranged from 12 to 18. The original sample size was 8984. Respondents were interviewed annually from 1997 to 2011, and since 2011 biennially. More than 77% (6947) of the round 1 sample were interviewed in round 19 conducted in

[4] Among political activists and some sections of academia, socialism is understood as the obvious solution to the intergenerational reproduction of educational and socioeconomic inequalities. Socialism is advocated even when the intergenerational reproduction of socioeconomic inequalities is concluded as weak, for example Jencks et al.'s (1972, pp. 253–265) chapter "What is to be done". Socialism is also the solution proposed for social inequalities attributable to genetic differences (Harden, 2021).

[5] When cognitive ability is involved, referee reports are often little more than unhinged ideological rants. Such reports are uncritically endorsed by the editors who commissioned them. The great pretence is that this process constitutes acceptable scholarly behavior in the pursuit of scientific knowledge.

[6] NLSY data files are publicly available and can be downloaded (https://www.nlsinfo.org/investigator/pages/login).

2019–2020, a low attrition rate. The original sample included 6748 respondents from a cross-sectional household probability sample, and another 2236 in a minority oversample (BLS, 2022f). Survey questions in NLSY97 are like those in the NLSY79, and often the original instrumentation was maintained (BLS, 2022f; Cooksey, 2018). The most recent data analyzed for the present study were collected in 2019 and 2020.

Although both studies oversampled minorities and for the NLSY79 poor whites, the analyses for this study are not weighted. There is no need to weight when the focus is on regression coefficients, not on univariate distributions (see Solon, Haider, & Wooldridge, 2015). Preliminary analyses indicated that weighting makes little difference to the estimates presented here.

4.2. Measures

4.2.1. Cognitive ability

In 1980, NLSY79 respondents were administered the Armed Services Vocational Aptitude Battery (ASVAB) when they were aged between 15 and 23. The ASVAB comprises 10 subtests that measure knowledge and skill in a variety of areas including Arithmetical Reasoning, Paragraph Comprehension, Numerical Operations and Electronics (BLS, 2022b). A latent general cognitive ability *g* was isolated by SEM from responses to the 10 subtests. Subtest loadings ranged from 0.68 for knowledge of 'Shop Information' to 0.89 for Word Knowledge and General Science (Table 1).

Most studies of cognitive ability in the NLSY79 use the Armed Formed Qualification Test (AFQT) measure which is the sum of scores in the arithmetic reasoning, word knowledge and paragraph comprehension subtests along with half the score in the numeric operations subtest. In 1989 the scores were modified, and modified again in 2006 - 'renormed' controlling for respondents' age (BLS, 2022a). Beasley (2013) constructed a Gaussified measure. According to Cawley, Heckman, and Vytlacil (2001), p. 424) there is little difference in explanatory power between *g* isolated from all 10 ASVAB tests and the AFQT, which is a function of just four ASVAB tests; the difference in R square is typically less than 0.02. The correlation between *g* and full-test IQ score is around 0.95 (Jensen, 1998, p. 90). In these data, the correlations between *g* and the three AFQT measures ranges between 0.92 and 0.96.

Most NLSY97 respondents participated in the administration of the computer-adaptive form of the ASVAB in 1997–98 (BLS, 2022a). There were 12 subtests instead of 10. The NLSY79 Auto and Shop Information was split into two subtests and an Assembling Objects subtest was added (Cucina, Peyton, Su, & Byle, 2016). For these analyses, general cognitive ability *g* was isolated by SEM of responses to the 12 subtests. General cognitive ability accounted for 59% of the total variance. The loadings are similar to those reported by Nyborg (2009, p. 85; 2015, p. 47).

The loadings of the subtests on *g* common to both the NLSY79 and the NLSY97 are very similar (Table 1). The measures of *g* were adjusted for age by taking the residuals from regressions on the age respondents took the tests. The resulting adjusted *g* measures are uncorrelated with age. The age adjusted *g* measures exhibited slightly stronger correlations with, and effects on, outcomes than the corresponding *g* measures unadjusted for age. The age-adjusted and the unadjusted measures of *g* correlate at around 0.95.

The *g* factor is robust across samples; *g* factors isolated from different intelligence tests correlate very highly, often above 0.95 (Jensen, 1998, pp. 81–83; Johnson, Bouchard Jr., Krueger, McGue, & Gottesman, 2004; Johnson, Nijenhuis, & Bouchard Jr, 2008; Floyd, Reynolds, Farmer, & Kranzler, 2013). Therefore, the NLSY79 and NLSY97 *g* measures isolated are highly comparable, allowing comparison of the effects of cognitive ability.

Table 1
SEM Loadings of ASVAB Subtests for the National Longitudinal Surveys of Youth.

Subtest	1979	1997
Arithmetic Reasoning	0.86	0.87
Assembling Objects		0.71
Automotive Information		0.59
Automotive and Shop Information	0.68	
Coding Speed	0.63	0.59
Electronic Information	0.82	0.80
General Science	0.89	0.88
Mechanical Comprehension	0.79	0.81
Mathematical Knowledge	0.83	0.86
Numerical Operations	0.69	0.64
Paragraph Comprehension	0.82	0.86
Shop Information		0.63
Word Knowledge	0.89	0.87

4.2.2. Grades at school

For the NLSY79, grades were obtained from the 1979 High School Transcript Survey. Grades were recoded for a total of 64 subjects for grades 9 to 12, scored on a five-point scale ranging from 0 for an E, F or fail, to 4 for an A (BLS, 2022h). The small proportion coded 6 (pass) were declared missing. For these analyses, average high school grade was simply the average of all grades recoded without regard to grade level, subject difficulty, calendar year, or high school attended.

For the NLSY97, respondents' grades were also obtained were from a High School Transcript Survey. Two measures were constructed - average Grade 8 grade, and average high school grades. Grade 8 grades were collected between 1997 and 2002, and high school grades between 1997 and 2004. Grades were scored on an eight-point scale ranging from 1, mostly below Ds, to 8, mostly As. (BLS, 2022g).

4.2.3. SAT and ACT

For the SAT and the ACT, the numbers of respondents whose test scores were recoded are small - around 1000 for the NLSY79, and 13 to 14 hundred for the NLSY97. It is not possible to estimate how representative these samples are from the respective populations of SAT and ACT test takers. The uncertainty about the representativeness of the samples is unlikely to substantially alter the relationships of SAT and ACT with the other variables.

4.2.4. Educational and occupational attainment

Educational attainment is measured by highest grade completed (number of years of education) as of May 1 of the survey year. The measures range from zero to 20. The final measure was obtained by averaging respondents' responses between age 25 and 39, so that the measures are comparable across cohorts. Averaging respondents' responses also reduces recording error.

Occupational status is measured by socioeconomic index (SEI) scores. SEI scores were originally developed by Duncan (1961) from census occupational codes; they essentially score narrowly defined census occupational groups by the incomes and educations of their incumbents.

For the NLSY79, respondents' occupations were coded according to the 1980 census occupational classification for NLSY79 survey waves conducted between 1984 and 2000. The 1980 occupational codes were recoded to SEI scores using correspondence tables (Featherman, Sobel, & Dickens, 1975; Nakao & Treas, 1994). For the 2000 classification, the codes are first converted to the 2010 occupational schema (there were only minor changes) and converted to SEI scores according to the correspondences detailed by Hout, Smith, and Marsden (2014).

The NLSY97, occupations were coded according to the 2002 schema which differed very slightly from the 2000 classification schema. Occupational codes were recoded to the 2010 classification schema and then assigned Duncan SEI scores as for the NLSY79.

For these analyses, Duncan SEI measures for ages 25 to 39 were averaged, again so that the measures are comparable across cohorts. SEI scores were calculated for 93% of NLSY79 respondents and 88% of NLSY97 respondents.

4.2.5. Income and wealth

From both surveys personal income was the sum of employment and farm or business income. For each survey year, incomes for the previous calendar year were adjusted to 2020 dollars using the consumer price index (BLS, 2022c). Incomes were then logged using the inverse hyperbolic sine transformation (IHS) detailed below. The final income measure was the mean (IHS transformed) income for ages 25 to 39. Ages at which zero incomes were recoded were not included in the calculation of mean IHS transformed income.

For the years 1985–1990, 1992–2000, 2004, 2008, 2012 and 2016 NLSY79 respondents were asked about their savings, debt, home, and vehicle ownership from which measures of wealth or net worth were constructed. The wealth measures are far more highly skewed than the income measures and include negative values. To enable comparisons with the NLSY97 data, the NLSY79 wealth measure is average wealth at ages 35 and 36. At ages 35 and 36, 15% of respondents' households had negative wealth and 6% zero wealth. The wealth measures were also adjusted to 2020 dollars and IHS transformed. The advantage of the IHS transformation compared to the commonly employed logarithmic transformation is that it retains zero and negative values. The interpretation of IHS transformed income is the same as for logged income (Friedline, Masa, & Chowa, 2015).[7]

The NLSY97 included constructed measures of family wealth at ages 20, 25, 30 and 35. Only the age 35 wealth measure was used, adjusted to 2020 dollars and IHS transformed. At age 35, 15% of respondents' households had negative wealth and 2% zero wealth.

The IHS transformed wealth distributions are bimodal with excessive numbers of zero values. The distributions of positive and negative wealth approximate normal distributions. For these analyses, the wealth measures were not adjusted for the number dependents, relationship status or marital history. To provide simpler interpretations of the relationships of wealth with other variables, measures of 'positive wealth' were constructed which exclude zero and negative values.

4.2.6. Parental education and occupation, family-of-origin income and wealth

Parents' education tends to have stronger associations than other socioeconomic indicators on their offspring's educational and occupational attainment (Hällsten & Thaning, 2018; Blossfeld, 2019, p. 1352; Ballarino, Meraviglia, & Panichella, 2021). Both the NLSY79 and NLSY97 collected data on highest grade ever completed for father's and mother's education. Parental education was constructed by averaging the father's and mother's education. Father's and mother's education are too highly correlated to include separate measures in these models.[8]

For the NLSY79, separate measures for father's and mother's socioeconomic index were constructed from 1970 occupational codes. In 2002 and subsequent waves, both father's and mother's occupations were coded according to the 2000 census occupational classification. SEI scores were constructed in the same way as respondents' occupations. The NLSY97 did not collect data on parental occupation.

For the NLSY79, family income was for the year 1979, adjusted for the consumer price index and IHS transformed. To respond to the criticism that one year's income is unreliable so downwardly biases the importance of economic origins (e.g., Solon, 1992), a second measure comprised of average family income (IHS transformed) for the years 1979 to 1986 was included.

For the NLSY97, family income was for the year 1979 (IHS transformed). A broader measure of family income for the NLSY97 could not be constructed since household income for the years 1998 to 2002 was only asked of households of respondents not living with their parents.

4.3. Statistical methods

Research on the process of socioeconomic attainment processes can be traced to the pioneering work of Blau and Duncan (1967), to who the term the 'status attainment research' is attributed. This model links causal pathways from socioeconomic origins to adult socioeconomic outcomes, via educational attainment. The pathways are arranged in a temporal sequence - for example, socioeconomic background influences educational attainment, which in turn influences occupation and earnings. These analyses include cognitive ability as an exogenous variable.

4.3.1. Models

The first group of analyses investigates if there have been changes in the role of cognitive ability on educational and subsequent socioeconomic outcomes. For each outcome, a number of models were estimated. The first model comprises two socioeconomic background measures - the average of parents' years of education, and family income in 1979 or 1997. Model 2 comprises cognitive ability allowing comparison the explanatory power of the two models. Model 2 quantifies the total effects of cognitive ability. Model 3 comprises parents' years of education, family income and ability. To facilitate comparisons of the relative importance of socioeconomic background and cognitive ability, the standardized coefficients for model 3 are included. For occupational attainment, income and wealth, model 4 adds education. For analyses of income and wealth, model 5 adds occupational attainment and for analyses of wealth, model 6 adds income. Across cohorts the models are identical and the measures, as far as possible, the same.

The second group of analyses examine if stronger and more comprehensive measures of socioeconomic background account for the effects of *g*. For the NLSY79, the extended socioeconomic models (of models 1 and 3) comprise average parental education, father's and mother's occupational status, average family income 1979 to 1986 and average family wealth for 1979 and 1980. For the NLSY97, it was not possible to include parents' occupational status or family income averaged over several years, but an accurate measure of family-of-origin wealth is available. If wealth is as important as some authors contend, it should have substantial effects, and may account for the effects of cognitive ability, beyond that accounted for by parents' education and family income. The estimates from the extended model 1 are referred to in the text for the NLSY79 only. The estimates for the extended model 3 for both cohorts are presented in the appendix.

The SEM procedure in SAS, Proc Calis, was used to analyze most outcomes (Banoo Madhanagopal & Amrhein, 2019). The estimates are equivalent to the estimates obtained from multiple regression with adjustments for missing data (see below).

Wealth was analyzed using a finite mixture model, where the data are described as a mixture of different distributions (Kessler & McDowell, 2012). In these analyses, IHS-transformed wealth was specified as two normal distributions, positive and negative, and a third excess zero distribution.[9] If the model is not overdispersed, the Pearson fit statistic should roughly equal the number of cases minus the number of parameters (Stokes, Chen, & So, 2011, p. 5).

Statistical significance is indicated in the usual manner. The 95% confidence intervals are included to enable between-model and between-cohort comparisons. Standardized coefficients (β) are presented for the final model. The intercepts are included in the tables, but their statistical significance and associated confidence intervals are not included.

[7] The Inverse Hyperbolic Sine transformation is calculated as follows: $IHS(x) = \log(x + \sqrt{x^2 + 1})$.

[8] The correlations between father's and mother's education were 0.61 for the NLSY79 and 0.66 for the NLSY97. In contrast, in the NLSY79 the correlation between father's and mother's occupational status was 0.4.

[9] The percentages of zeros are not consistent with the two normal distributions.

4.3.2. Missing data

Missing data were treated as Missing at Random (MAR) and handled through Full Information Maximum Likelihood Estimation (FIML). FIML handles missing data by filtering out missing values when they are present and using only the data that are not missing in a row of data, estimating parameters that best generate the observed data. FIML uses all the available information in the data to estimate the parameters in the SEM. FIML is generally superior to multiple imputation for missing data with minor violations from multivariate normal distributions (Yuan, Yang-Wallentin, & Bentler, 2012). For extended model 3 analyses of wealth, FIML was also used for analysis of positive (IHS transformed) wealth.

5. Results

5.1. Correlations and associations

Table 2 presents the univariate statistics and bivariate correlations for the main study variables. The below and above diagonal correlations are for the NLSY79 and NLSY97 studies, respectively. The correlations are not dissimilar to the inter-correlations of social stratification variables in other US data (Blau & Duncan, 1967, p. 169; Jencks, Crouse, & Mueser, 1983, pp. 8–9; Hauser, Warren, Huang, & Carter, 2002, pp. 187,191–192). The intergenerational correlations for educational attainment are 0.45 for the NLSY79 and 0.41 for the NLSY79, 0.36 and 0.31 for father's and mother's occupational status (NLSY79 only) and weaker for income (0.25 for the NLSY79, 0.21 for the NLSY97) and positive wealth (0.18, 0.24). Generally, the correlations among stratification variables are slightly weaker for the NLSY97 compared to the NLSY79.

Cognitive ability is most strongly correlated with performance in the SAT (0.87, 0.81) and ACT (0.80, 0.82) tests, followed by years of education (0.59, 0.56), occupational status (0.54, 0.46), income (0.38, 0.41) and positive wealth (0.38, 0.41).

For the NLSY79, the correlations in Table 2 are comparable with correlations reported in the literature. Hauser et al. (2000, p. 207) reported correlations of AFQT score with educational attainment of 0.66 for ‘nonblack’ men and 0.62 for ‘nonblack’ women. The correlations of AFQT with occupational status were between 0.50 and 0.55 for nonblack men and between 0.38 and 0.46 among nonblack women. Ganzach (2000, p. 426) reported correlations of raw household income with educational attainment (0.31) and cognitive ability (0.29). The correlations of father's and mother's educational attainment with educational attainment were 0.44 and 0.45, 0.48 and 0.44 for cognitive ability and 0.33 and 0.29 for family income. Zagorsky (2007, p. 493) reported lower correlations of ability with raw income (0.30) and wealth (0.16) than the IHS-transformed measures in Table 2. Judge, Klinger and Simon (2010, p. 97) reported correlations of general mental ability of 0.60 with educational attainment, 0.47 with occupational status and 0.38 with income - both aggregated over a 28-year time frame. The strong correlations (≈0.7 to 0.8) of cognitive ability with performance in both the SAT and ACT are consistent with the literature (Frey, 2019; Frey & Detterman, 2004; Koenig, Frey, & Detterman, 2008).

There are far fewer comparable studies of the NLSY97. Coyle and Pillow (2008, p. 726) reported a correlation of 0.87 between SAT and ACT test scores. Ganzach (2014, p. 114) reported correlations between a constructed AFQT score measure of 0.42, 0.45 and 0.44 with mother's and father's education, and logged family income.[10] Cucina et al. (2016) reported lower correlations (0.37 to 0.40) between *g* and school grades than that estimated in this study (0.47, 0.44). Andrade and Thomsen (2018, p. 104) estimate a correlation of 0.47 between parents' and offspring's education in the NLSY97 compared to 0.41 here with similar

[10] The higher correlation in Ganzach (2014) may be because there was no adjustment for age. Families with older children tend to have higher incomes.

Table 2
Correlations and univariate statistics of study variables.

	Par Educ	Fath Occ	Moth Occ	Family Inc	Fam Wealth	g	Grade 8 Grades	HS School Grades	SAT	ACT	Years ED	. Occupation	Income	Wealth	Positive Wealth
Average Parents' Education				0.31	0.18	0.44	0.25	0.26	0.36	0.34	0.41	0.30	0.19	0.02	0.22
Father's Occupation	0.56														
Mother's Occupation	0.51	0.41													.
Family Income (IHS) 1979/1997	0.36	0.34	0.28		0.22	0.30	0.15	0.15	0.22	0.20	0.26	0.21	0.21	0.09	0.24
Family Wealth (IHS)	0.08	0.11	0.07	0.18		0.22	0.14	0.13	0.15	0.11	0.19	0.16	0.15	0.06	0.17
Cognitive Ability (*g*)	0.49	0.43	0.38	0.36	0.16		0.47	0.44	0.81	0.82	0.56	0.46	0.41	0.07	0.41
Year 8 Grades	0.29	0.27	0.27	0.25	0.11	0.60		0.62	0.42	0.51	0.55	0.37	0.24	0.06	0.31
Average High School Grades	0.29	0.27	0.27	0.25	0.11	0.60			0.46	0.51	0.57	0.38	0.26	0.08	0.31
SAT Score	0.39	0.35	0.29	0.29	−0.04	0.87		0.59		0.87	0.39	0.29	0.19	0.11	0.24
ACT Score	0.33	0.28	0.18	0.23	0.08	0.80		0.56	0.87		0.46	0.51	0.57	0.38	0.26
Years of Education	0.45	0.40	0.33	0.27	0.09	0.59		0.58	0.48	0.42		0.87	0.39	0.29	0.19
Average Occupation age 25 to 39	0.35	0.36	0.31	0.25	0.10	0.54		0.47	0.48	0.39	0.67		0.46	0.09	0.42
Average Income age 25 to 39 (IHS)	0.19	0.17	0.17	0.25	0.26	0.38		0.24	0.25	0.14	0.34	0.43	–	0.19	0.51
Wealth at age 35/36 (IHS)	0.17	0.16	0.13	0.20	0.23	0.28		0.23	0.16	0.06	0.21	0.24	0.31		1.00
Positive Wealth at age 35/36 (IHS)	0.25	0.22	0.21	0.25	0.18	0.38		0.31	0.28	0.24	0.31	0.35	0.35	1.00	
NLSY79 N	12,241	8679	6884	7204	3971	11,509		8916	951	1127	12,240	11,579	11,550	6359	5373
Mean	10.83	36.04	33.64	10.11	4.50	0.00		2.29	427.4	17.49	12.77	43.66	10.68	8.76	11.36
Std	3.27	23.47	21.70	0.95	5.97	1.00		0.87	113.1	6.25	2.35	14.24	1.06	6.66	2.17
NLSY97 N	8351			6250	6619	7008	8781	8247	1407	1301	8341	7915	8121	6321	5232
Mean	12.57	.	.	10.99	9.80	0.00	5.58	5.55	500.2	21.00	13.53	39.72	10.85	7.92	11.46
Std	2.87	.	.	1.74	5.33	1.00	1.71	1.62	106.2	4.94	2.86	17.57	0.92	8.09	1.73

NLSY79 Below Diagonal, NLSY97 Above Diagonal. Occupation = Duncan Socioeconomic Index of Occupation. Family Income 1979 for NLSY79 and 1997 for NLSY97. Wealth averaged for ages 35 and 36 for NLSY97, at age 35 for NLSY97.

Table 3
Bivariate association between ability and wealth (Finite Mixed Models).

	NLSY79		NLSY97	
	Est	95% Confidence Limits	Est	95% Confidence Limits
Positive Wealth				
Intercept	11.45		11.54	
Ability	0.75***	(0.71, 0.80)	0.68***	(0.63, 0.72)
Negative Wealth				
Intercept	−7.57		−10.53***	
Ability	−0.72***	(−1.11, −0.33)	−0.32***	(−0.44, −0.21)
N of Cases	5908		5042	
N of Parameters	8		8	
Pearson Statistic	5910.4		5039.5	

0.05>P>0.01; ** 0.01>P>0.001, *** P<0.001. Estimates from 3 component Finite Mixture Model, positive and one negative normal distributions plus excess zeros.

Table 4
School grades on ability and socioeconomic background.

	Model 1		Model 2		Model 3			
	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	β	95% Confidence Limits
NLSY79 High School Grades								
Intercept	−0.10		2.24		2.24			
Ability (*g*)			0.53***	(0.52, 0.55)	0.51***	(0.49, 0.53)	*0.58*	*(0.56, 0.60)*
Parents' Education	0.06***	(0.06, 0.07)			0.00	(0.01, 0.01)	*0.01*	*(−0.01, 0.03)*
IHS Family Income 1979	0.17***	(0.14, 0.19)			0.05***	(0.03, 0.07)	*0.06*	*(0.03, 0.08)*
N of Complete Observations		5636		8276			5263	
N of Incomplete Observations		6916		3873			7388	
R Square		0.12		0.37			0.37	
NLSY97 Year 8 Grades								
Intercept	3.09		5.59		5.26			
Ability (*g*)			0.80***	(0.77, 0.84)	0.76***	(0.72, 0.80)	*0.45*	*(0.43, 0.47)*
Parents' Education	0.13***	(0.12, 0.15)			0.03***	(0.02, 0.04)	*0.05*	*(0.03, 0.07)*
IHS Family Income 1997	0.07***	(0.05, 0.10)			−0.00	(−0.03, 0.02)	*−0.00*	*(−0.03, 0.02)*
N of Complete Observations		5829		6892			4775	
N of Incomplete Observations		3147		2005			4203	
R Square		0.07		0.22			0.22	
NLSY97 High School Grades								
Intercept	3.14		5.55		5.04			
Ability (*g*)			0.72***	(0.69, 0.76)	0.67***	(0.63, 0.71)	*0.41*	*(0.39, 0.44)*
Parents' Education	0.13***	(0.12, 0.14)			0.04***	(0.03, 0.05)	*0.07*	*(0.05, 0.09)*
IHS Family Income 1997	0.07***	(0.04, 0.09)			0.00	(−0.02, 0.03)	*0.00*	*(−0.02, 0.03)*
N of Complete Observations		5503		6522			4432	
N of Incomplete Observations		3448		2211			4537	
R Square		0.07		0.20			0.20	

0.05>P>0.01; ** 0.01>P>0.001, *** P<0.001. High School Grades averaged, grade 9 grade 12. Metric and Standardized Estimates (β). 95%CL-95% Confidence Limits. IHS=Inverse Hyperbolic Sine Transformation.

measures. Brown et al. (2021, p. 1348) reported R square values for regressions on a constructed AFQT measure which are equivalent to correlations of 0.50 for educational attainment, 0.39 for occupational attainment and 0.25 for annual logged income.

It is clear from Table 2 that *g* has stronger correlations with respondent's stratification outcomes than parents' education, father's and mother's occupation (NLSY79 only), and family income and family wealth. The correlations of *g* with positive wealth are not trivial - 0.38 for the NLSY79 and 0.41 for the NLSY97 - again substantially higher than that for single variable measures of socioeconomic background.

The importance of cognitive ability for wealth is evident from Table 3. A one-standard deviation difference in cognitive ability is associated with a sizable 75% difference in positive wealth in the NLSY79 and 68% in the NLSY97. Ability also has negative associations with negative wealth although the 95% confidence limits are very large.

5.2. *Grades at school*

Table 4 presents the estimates from the analyses of grades at school. Model 1 shows that parents' education and family income poorly explain grades: 12% of the variance for high school grades in the NLSY79, and 7% for grade 8 and high school grades in the NLSY97.

In contrast, ability accounts for 37% of the variance for high school grades in the NLSY79 and about 20% in the NLSY97. For the NLSY79, the variance explained by the extended model 1 is 2 percentage points higher than that for model 1, 14%. Since grades are measured differently in the two studies, it is not possible to compare the metric coefficients across the two cohorts. Comparison of the standardized *g* coefficients indicates that *g* is a weaker predictor for high school grades in the NLSY97 (β = 0.41) than the NLSY79 (β = 0.58). The 95% confidence intervals do not overlap, so the difference is statistically significant.

Model 3 includes all three variables. Compared to model 2, the variance explained is unchanged indicating the parents' education and family income provide no additional explanatory power beyond that from *g*. Furthermore, the effects of *g* decline only marginally. The addition of parents' education and family income decreased the coefficient for *g* by 4% in the NLSY79 and by 5% for grade 8 grades and 7% for high school grades in the NLSY97.

In contrast, the addition of cognitive ability substantially reduces the coefficients for parents' education and family income. In model 3 for the NLSY79, the coefficient for parents' education is zero and the coefficient for family income is very small: a doubling of family-of-origin income is associated with only a 5% increase in school grades. For model 3 in the NLSY97, the standardized estimates of parents' education are small (0.05 and 0.07) and the coefficients for family income are zero.

There is little difference between model 3 and the extended model 3 (Table A1). For the NLSY79, the variance explained is 37%, the same as in Model 3. The *g* coefficients decline very marginally, and not significantly, from 0.51 (β = 0.58) in model 3 to 0.50 (β = 0.57) in the extended model. In the extended model 3, the estimates for father's and mother's occupation, and family wealth are not statistically significant. The coefficient for family income decreases slightly from 0.05 to 0.04.

For the NLSY97, the *g* coefficients in the extended model 3 are only marginally smaller and not significantly different from those in model 3. For grade 8 grades, the *g* coefficients are 0.76 in model 3 and 0.75 in the extended model 3, and for high school grades, 0.67 and 0.65.

If ability is mostly a function of socioeconomic background, then the strong effects of ability on grades would largely disappear. In contrast, they decline only marginally. The estimates for *g* are remarkedly robust.

5.3. SAT and ACT scores

Table 5 presents the analyses of SAT scores. Parents' education and family income account for 18% of the variance in SAT scores in both studies (model 1). For the NLSY79, the variation in SAT scores accounted for by the extended model 1 is only 1% higher, 19%.

In contrast to model 1, cognitive ability accounts for a very large 81% of the variance in SAT scores in the NLSY79 and 75% in the NLSY97 (model 2). In model 2, the *g* coefficient is smaller in the younger cohort, but the confidence intervals just overlap, indicating the decline was not statistically significant.

With the addition of parents' education and family income (model 3), the coefficient for cognitive ability declines only marginally by around 3%. The estimates for cognitive ability in model 3 are within the 95% confidence limits of its estimates in model 2. The addition of cognitive ability reduces the coefficients for parental education by about two-thirds. The coefficients for family income are negative and not statistically significant. The standardized coefficients show that cognitive ability has very much stronger effects on SAT scores (0.86 for the NLSY79 and 0.84 for the NLSY97) than parents' education (0.09, 0.08). Comparison of the standardized coefficient suggest no decline in the impact of *g* on SAT scores.

For the NLSY79, the coefficient for cognitive ability declines very marginally in the extended model 3 compared to model 3 (113.1 vs. 113.2). The variance explained is unchanged. Except for parents' education, none of the socioeconomic background coefficients effects are statistically significant. For the NLSY97 the addition of family wealth in the extended model very marginally reduces the coefficient for cognitive ability (104.1 vs. 104.2). The coefficient for family wealth is not statistically significant.

The results of the analyses of the ACT are very similar (Table 6). Socioeconomic background variables account for 15% (NLSY79) and 18% (NLSY97) of the variance, whereas ability accounts for 75% and 76% (models 1 and 2). With the addition of parents' education and family income (model 3) the *g* coefficients decline marginally and not significantly. Net of cognitive ability, the coefficients for parental education decline precipitously: by 83% and 74% (model 3 vs model 1). The family income coefficients for model 3 are not statistically significant in both studies. The standardized coefficients indicate that ability is far more powerful predictor (0.84 and 0.83) than parents' education (0.05, 0.08). Comparison of the standardized coefficient suggest no decline in the impact of *g* on ACT scores.

For the NLSY79, the variation in ACT scores accounted for in the extended model 3 is 75% the same as in model 3. The coefficient for cognitive ability was slightly larger. None of the coefficients for socioeconomic background variables are statistically significant, including parents' education. For the NLSY97, the extended model 3 marginally increased the variance explained from 0.76 to 0.77. The coefficient for cognitive ability was also slightly larger in the extended model 3. Of the socioeconomic background variables, only the coefficient for parents' education was statistically significant (Table A1).

Table 5
SAT scores on ability and socioeconomic background.

	Model 1		Model 2		Model 3			
	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	β	95% Confidence Limits
NLSY79								
Intercept	84.24		331.6		318.3			
Ability (*g*)			116.7***	(112.3, 121.1)	113.2***	(108.4, 117.9)	*0.86*	*(0.84, 0.87)*
Parents' Education	12.4***	(8.2, 14.6)			3.75***	(2.34, 5.17)	*0.09*	*(0.06, 0.13)*
IHS Family Income 1979	17.5***	(9.5, 35.6)			−3.05	(−10.4, 4.34)	*−0.02*	*(−0.08, 0.03)*
N of Complete Observations		587		905			564	
N of Incomplete Observations		11,856		10,650			12,073	
R Square		0.18		0.81			0.82	
NLSY97								
Intercept	209.0		431.5		388.5			
Ability (*g*)			107.9***	(103.4, 112.3)	104.2***	(99.5, 108.9)	*0.84*	*(0.81, 0.86)*
Parents' Education	12.26***	(10.2, 14.4)			3.57***	(2.10, 5.04)	*0.08*	*(0.05, 0.12)*
IHS Family Income 1997	10.5***	(5.3, 15.7)			−0.43	(−4.27, 3.42)	*−0.01*	*(−0.06, 0.05)*
N of Complete Observations		984		1180			855	
N of Incomplete Observations		7708		6055			8028	
R Square		0.18		0.75			0.76	

0.05>P>0.01; ** 0.01>P>0.001, *** P<0.001. Metric and Standardized Estimates (β). 95%CL-95% Confidence Limits. IHS=Inverse Hyperbolic Sine Transformation.

Table 6
ACT scores on ability and socioeconomic background.

	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Beta	95% Confidence Limits
NLSY79								
Intercept	1.78		12.29		9.27			
Ability (*g*)			6.44***	(6.14, 6.73)	6.27***	(5.96, 6.59)	*0.84*	*(0.81, 0.86)*
Parents' Education	0.64***	(0.50, 0.78)			0.11*	(0.02, 0.20)	*0.05*	*(0.01, 0.09)*
IHS Family Income 1979	0.72**	(0.02, 1.43)			0.17	(−0.32, 0.65)	*0.02*	*(−0.04, 0.08)*
N of Complete Observations		652		1053		616		
N of Incomplete Observations		11,795		10,530		12,023		
R Square		0.15		0.75		0.75		
NLSY97								
Intercept	7.72***		18.34***		14.41***			
Ability (*g*)			4.98***	(4.78, 5.18)	4.82***	(4.60, 5.03)	*0.83*	*(0.81, 0.86)*
Parents' Education	0.61***	(0.50, 0.72)			0.16***	(0.09, 0.23)	*0.08*	*(0.04, 0.12)*
IHS Family Income 1997	0.42***	(0.23, 0.62)			0.05	(−0.05, 0.17)	*0.01*	*(−0.02, 0.05)*
N of Complete Observations		974		1121		871		
N of Incomplete Observations		7707		6067		8008		
R Square		0.18		0.76		0.77		

Beta = Standardized Coefficients. IHS=Inverse Hyperbolic Sine Transformation.

5.4. Educational attainment

Table 7 presents the estimates from the analyses of educational attainment. Model 1 shows that together parents' education and family income account for 22% of the variance in educational attainment in the NLSY79 and 19% in the NLSY97. For the NLSY79, the variation in years of education accounted for by extended model 1 is 25%, 3% higher than in model 1. Cognitive ability accounts for 35% of the variance in years of education in the NLSY79 and 32% in the NLSY97 (model 2). A one-standard deviation difference in cognitive ability was associated with a difference of 1.4 years of education in the NLSY79 and 1.6 years of education in the NLSY97.

With the addition of parents' education and family income in model 3, the coefficients for cognitive ability decline by 19% in the NLSY79 and 18% in the NLSY97 (model 3 vs. model 2). Compared to model 2, the addition of the two socioeconomic background measures increased the explained variance by 3 and 4%.

With the addition of ability, the effects of parents' education declined by 63% in the NLSY79 and by 50% in the NLSY97 (model 3 vs. model 2). The coefficients index weak relationships. A one-year difference in average parents' education is associated with less than 0.2 of a year difference in offspring's years of education. A doubling of family income is associated with about a 0.1 of a year of education. The standardized coefficients for cognitive ability (0.48, 0.46) are more than twice that of parents' education (0.21,0.18). The standardized coefficients for family income are trivial (0.03,0.06).

In the extended model 3 for the NLSY79, there are significant effects for father's and mother's education and average wealth. However, the variance accounted for was the same as in model 3 (39%). Compared to model 3, the coefficient for *g* declined slightly (1.08 in the extended model and 1.13 in model 3). The coefficients for father's and mother's occupation were very small, a one-unit difference in occupational status is associated with 0.01 of a year of education. Compared to model 3, in the extended model 3 the coefficient for parents' education is smaller

Table 7
Educational attainment on ability and socioeconomic background.

	Model 1		Model 2		Model 3			
	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Beta	95% Confidence Limits
NLSY79								
Intercept	6.53		12.80		10.48			
Ability (*g*)			1.39***	(1.36, 1.43)	1.13***	(1.09, 1.17)	*0.48*	*(0.46, 0.50)*
Parents' Education	0.41***	(0.39, 0.42)			0.15***	(0.13, 0.16)	*0.21*	*(0.19, 0.22)*
IHS Family Income 1979	0.13***	(0.11, 0.16)			0.07***	(0.02, 0.12)	*0.03*	*(0.01, 0.05)*
N of Complete Observations		6836		11,199		6350		
N of Incomplete Observations		5840		1351		6334		
R Square		0.22		0.35		0.39		
NLSY97								
Intercept	6.47		13.60		10.30			
Ability			1.61***	(1.51, 1.66)	1.32***	(1.26, 1.38)	*0.46*	*(0.44, 0.48)*
Parents' Education	0.36***	(0.34, 0.38)			0.18***	(0.16, 0.20)	*0.18*	*(0.16, 0.20)*
IHS Family Income 1997	0.23**	(0.19, 0.27)			0.10***	(0.06, 0.14)	*0.06*	*(0.04, 0.08)*
N of Complete Observations		5555		6590		4583		
N of Incomplete Observations		3402		2169		4388		
R Square		0.19		0.32		0.35		

0.05>P>0.01; ** 0.01>P>0.001, *** P<0.001. Metric and Standardized Estimates (β). 95%CL-95% Confidence Limits. IHS=Inverse Hyperbolic Sine Transformation.

Table 8
Occupational attainment (SEI) on ability, socioeconomic background and education

	Model 1		Model 2		Model 3		Model 4			
	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Beta	95% Confidence Limits
NLSY79										
Intercept	6.82		43.72***		33.01		−1.05			
Ability (*g*)			7.73***	(7.51, 7.96)	6.76***	(6.49, 7.03)	3.08***	(2.60, 3.13)	*0.22*	*(0.20, 0.24)*
Parents' Education	1.30***	(1.21, 1.38)			0.47***	(0.39, 0.55)	−0.03	(−0.10, 0.04)	*−0.01*	*(−0.02, 0.01)*
IHS Family Income 1979	2.25***	(1.88, 2.61)			0.56**	(0.21, 0.90)	0.38***	(0.08, 0.68)	*0.03*	*(0.01, 0.05)*
Years of Education							3.21***	(3.11, 3.32)	*0.53*	*(0.52, 0.55)*
N of Complete Observations		6641		10,622		6176			6175	
N of Incomplete Observations		6018		1844		6504			6509	
R Square		0.14		0.29		0.30			0.48	
NLSY97										
Intercept	6.40		39.87		25.97		−4.58			
Ability (*g*)			8.10***	(7.73, 8.47)	6.99***	(6.56, 7.42)	3.15***	(2.72, 3.58)	*0.18*	*(0.16, 0.20)*
Parents' Education	1.55***	(1.41, 1.68)			0.62***	(0.47, 0.77)	0.09	(−0.04, 0.22)	*0.01*	*(−0.01, 0.04)*
IHS Family Income 1997	1.19***	(0.92, 1.46)			0.57***	(0.31, 0.83)	0.29*	(0.06, 0.52)	*0.03*	*(0.01, 0.05)*
Years of Education							2.98***	(2.84, 3.11)	*0.48*	*(0.46, 0.50)*
N of Complete Observations		5259		6256		4628			4315	
N of Incomplete Observations		3684		2411		4339			4660	
R Square		0.10		0.21		0.23			0.38	

0.05>P>0.01; ** 0.01>P>0.001, *** P<0.001. Metric and Standardized Estimates (β). 95%CL-95% Confidence Limits. IHS=Inverse Hyperbolic Sine Transformation. SEI = Socioeconomic Index for Occupations.

(0.11 compared to 0.15).

For the NLSY97, again there was no increase in the variance explained (35%) with the extended model 3 compared to model 3. The coefficient for *g* declined slightly (1.30 compared to 1.32 in model 3). The coefficient for family wealth was statistically significant, but translates to a very small effect: a doubling of family wealth is associated with 0.03 of year of education.

So, the extended model 3 does alter the main conclusion, very strong effects for cognitive ability and much weaker effects for the socioeconomic measures.

5.5. Occupational attainment

Model 1 in table 8 shows that the parents' education and family income account for 14% of the variance in occupational attainment in the NLSY79 and 10% in the NLSY97. A one-year difference in average parental years of education is associated with a 1.30 and a 1.55 unit difference in occupational status on a 10-to-97-point measure. A doubling of family income is associated with small 2.25 and 1.19 unit increases in occupational status.

For the NLSY79, the variation in occupational status accounted for by extended model 1 is 19%, explaining 5% more of the variance than parents' education and family income. There are significant effects for father's and mother's occupation (0.11 and 0.08), smaller coefficients for parent's education and family income (0.57, 1.99) than in model 1, and no statistically significant coefficient for family wealth. The coefficients for father's and mother's occupation (0.07 and 0.04), and parents' education and family income (0.11, 0.49) are considerably smaller when cognitive ability is present (Table A1).

Cognitive ability accounts for about twice as much variance in occupational attainment as the two socioeconomic background measures: 29% for the NLSY79 and 21% for the NLSY97 (model 2). A one standard deviation difference in cognitive ability is associated with a 7.7 unit difference in occupational attainment in the NLSY79 and a 8.1 unit difference in the NLSY97.

Model 3 shows that when controlling for parents' education and family income, the coefficient for cognitive ability declines: by 13% in the NLSY79 and 14% in the NLSY97. The addition of parents' education and family income increases the variance explained by 1 or 2 percentage points. Comparing models 1 and 3, the addition of cognitive ability substantially reduces the coefficients for parents' education: by 64% for the NLSY79 and 60% for the NLSY97. The family income coefficients also decline substantially with the addition of cognitive ability: by 75% and 52%. According to model 3, a doubling of family income is associated with about one-half a unit increase in occupational status.

In the extended model 3, the coefficient for *g* on occupational attainment in the NLSY79 is 7% less than in model 3 and 1% less in the NLSY97. Once again, accurately measured socioeconomic background variables—parent's education, father's and mother's occupational status, average family income and family wealth—cannot account for the effects of cognitive ability. The coefficients for father's and mother's occupational status, and average family income, are statistically significant but very small. The standardized effects are 0.11, 0.08 and 0.03, respectively (not shown). For the NLSY97, the standardized effects of average income and wealth are small: 0.05 and 0.04 (not shown).

Model 4 shows that the strongest influence on occupational attainment is educational attainment with standardized coefficients around 0.5. Ability is associated with occupational attainment, net of parents'

Table 9
Income on ability, socioeconomic background and prior attainments.

	Model 1		Model 2		Model 3		Model 4				Model 5	
	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Beta	95% Confidence Limits	Est	95% Confidence Limits
NLSY79												
Intercept	7.94		10.68		9.40		8.53				8.85	
Ability			0.40***	(0.38, 0.42)	0.36***	(0.34, 0.35)	0.27***	(0.24, 0.29)	*0.25*	*(0.23, 0.28)*	0.11***	(0.09, 0.14)
Parents' Ed.	0.04***	(0.03, 0.05)			−0.01	(−0.01, 0.00)	−0.02***	(−0.03, −0.01)	*−0.06*	*(−0.08, −0.04)*	−0.01***	(−0.02, −0.01)
IHS Fam Inc.	0.23***	(0.20, 0.26)			0.13***	(0.10, 0.16)	0.13***	(0.10, 0.16)	*0.12*	*(0.09, 0.14)*	0.10***	(0.08, 0.13)
Yrs Ed.							0.08***	(0.07, 0.09)	*0.18*	*(0.16, 0.20)*	−0.04***	(−0.05, −0.03)
Occupation (SEI)											0.04***	(0.04, 0.04)
N Compl.		6594		10,596		6132		6131				6128
N Incompl.		6065		1867		6548		6553				6556
R Square		0.07		0.15		0.16		0.17				0.43
NLSY97												
Intercept	9.36***		10.85		10.40		9.59				9.66	
Ability			0.38***	(0.36, 0.40)	0.36***	(0.34, 0.39)	0.26***	(0.23, 0.29)	*0.28*	*(0.26, 0.31)*	0.21***	(0.18, 0.23)
Parents' Ed.	0.04***	(0.04, 0.05)			−0.01	(−0.01, 0.01)	−0.02***	(−0.03, −0.01)	*−0.06*	*(−0.09, −0.04)*	−0.02***	(−0.03, −0.01)
IHS Fam Inc.	0.09***	(0.07, 0.10)			0.05***	(0.04, 0.06)	0.04***	(0.03, 0.06)	*0.08*	*(0.06, 0.11)*	0.04***	(0.02, 0.05)
Yrs Ed.							0.08***	(0.07, 0.09)	*0.24*	*(0.22, 0.27)*	0.03***	(0.02, 0.04)
Occupation (SEI)											0.02***	(0.02, 0.02)
N Compl.		5402		6431		4501		4445				4255
N Incompl.		3549		1690		4469		4530				4720
R Square		0.06		0.17		0.18		0.22				0.28

0.05>P>0.01; ** 0.01>P>0.001, *** P<0.001. Metric and Standardized Estimates (β). 95%CL-95% Confidence Limits. IHS=Inverse Hyperbolic Sine Transformation. SEI=Duncan Hout Socioeconomic Index for Occupations. Income first logged (Inverse Hyperbolic Sine), then averaged for ages 25 to 39, excluding years of zero income.

education, family income and educational attainment. A one-standard deviation difference in cognitive ability is associated with a 3-unit difference in occupational status, equivalent to standardized effects around 0.2. These estimates could be partially explained by the crudeness of the years of education measure since for a given number of years of education, it does not distinguish between high and low status courses and institutions. Compared to model 3, the addition of educational attainment in model 4 reduced the effects of parents' education to statistical insignificance. In contrast, the coefficients for family income are only marginally smaller, but the standardized coefficients are trivial (0.03).

5.6. Income

Parents' education and family income only weakly account for the variation (7% and 6%) in personal (IHS transformed) income in the early and mid-career (Model1, Table 9). The coefficient for parents' education is small: a one-year increase in average parental education is associated with a 4% increase in income. The coefficient for family income can be considered the 'elasticity' for income, net of parental education. A 100% difference in family income (or a doubling) is associated with a 23% difference in offspring's average income in the NLSY79 and 9% in the NLSY97.

For the NLSY79, the extended model 1 accounts for 14% of the variance, twice as much as model 1 (not shown). There are significant effects for average family income (0.24) and average family wealth (0.03). The coefficient for average family income is substantially smaller when considering cognitive ability (0.16, see Table A1).

Cognitive ability accounts for more of the variance in offspring's income than parents' education and family income: 15% in the NLSY79 and 17% in the NLSY97 (model 2). The *g* coefficients were much the same: a one standard deviation difference in ability is associated with a about a 40% increase in average personal income for ages 25 to 39.

Comparing model 3 to model 1, the coefficients for parents' education on income are no longer statistically significant when considering cognitive ability. The coefficients for family income are almost halved. Conversely, with the addition of parents' education and family income, the coefficients for cognitive ability decline only marginally: 10% for the NLSY79 and only 3% for the NLSY97. The coefficient for *g* in the extended model 3 declines from 0.36 to 0.33 in the NLSY79 but does not decline in the NLSY97.

Model 4 adds educational attainment. The coefficient for education attainment in model 4 corresponds to the 'return to schooling' in human capital theory (Ashenfelter & Rouse, 2000, p. 90; Card, 2012). The rates of return are 8% for both the NLSY79 and the NLSY97, net of parents' education (which has no impact), family income and cognitive ability. The addition of education to the analyses increases the variance accounted for from 16% to 17% in the NLSY79 and from 18% to 22% in the NLSY97.

What is striking about model 4 are the estimates for cognitive ability: a one-standard deviation difference in ability is associated with a 25% and a 28% difference in income, net of years of education and other variables in model 4.

Table A1 indicates parental income and wealth are *not* strong

Table 10
Wealth on ability, socioeconomic background and prior attainments (NLSY79).

	Model 1		Model 3		Model 4		Model 5		Model 6	
	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits
Positive Wealth										
Intercept	6.29		8.74		7.12		7.52		2.04	
Ability			0.66***	(0.59, 0.73)	0.53***	(0.45, 0.60)	0.43***	(0.35, 0.50)	0.33***	(0.25, 0.41)
Parents' Ed.	0.11***	(0.09, 0.12)	0.03*	(0.00, 0.05)	0.01	(−0.01, 0.03)	0.01	(−0.01, 0.03)	0.01	(−0.01, 0.03)
IHS Fam Inc.	0.40***	(0.33, 0.47)	0.24***	(0.17, 0.31)	0.24***	(0.17, 0.31)	0.23***	(0.16, 0.30)	0.20***	(0.13, 0.27)
Yrs Ed.					0.12***	(0.09, 0.15)	0.04*	(0.00, 0.07)	0.06***	(0.03, 0.10)
Occupation (SEI)							0.02***	(0.02, 0.03)	0.01**	(0.01, 0.01)
Avg. Inc. 25–39									0.56***	(0.48, 0.64)
Negative Wealth										
Intercept	−8.38		−14.02		−13.82		−13.89		−14.79	
Ability			−0.80***	(−1.23, −0.37)	−0.79***	(−1.31, −0.27)	−0.73***	(−1.25, −0.20)	−0.78***	(−1.32, −0.25)
Parents' Ed.	−0.07	(−0.18, 0.05)	−0.03	(−0.15, 0.08)	−0.03	(−0.16, 0.10)	−0.03	(−0.16, 0.08)	−0.03	(−0.16, 0.10)
IHS Fam Inc.	−0.04	(−0.35, 0.48)	0.56*	(0.04, 1.08)	0.58*	(0.06, 1.10)	0.59*	(0.07, 1.11)	0.66**	(0.12, 1.19)
Yrs Ed.					−0.03	(−0.24, 0.17)	−0.01	(−0.22, 0.21)	−0.01	(−0.22, 0.22)
Occupation (SEI)							−0.01	(−0.04, 0.02)	−0.01	(−0.05, 0.02)
Avg. Inc. 25–39									0.03	(−0.48, 0.54)
N of Cases	3848		3627		3627		3627		3553	
N of Parameters	10		12		14		16		18	
Pearson Statistic	3839.6		3620.2		3621.2		3616.7		3537.6	

Wealth at ages 35 or 36. 0.05>P>0.01; ** 0.01>P>0.001, *** P<0.001. Estimates from 3 component Finite Mixture Model, two normal distributions plus excess zero distribution. 95%CL-95% Confidence Limits. IHS=Inverse Hyperbolic Sine Transformation. Model 2 is presented in Table 3.

Table 11
Wealth on ability, socioeconomic background and prior attainments (NLSY97).

	Model 1		Model 3		Model 4		Model 5		Model 6	
	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits
Positive Wealth										
Intercept	8.04		9.58		7.67		7.88	(7.39. 8.42)	1.27	
Ability			0.55***	(0.49, 0.62)	0.31***	(0.24, 0.38)	0.25***	(0.18. 0.32)	0.10**	(0.02, 0.16)
Parents' Ed.	0.09***	(0.07, 0.12)	0.03*	(0.01, 0.05)	−0.01	(−0.03, 0.02)	−0.02	(−0.04. 0.01)	−0.00	(−0.03, 0.02)
IHS Fam Inc.	0.21***	(0.17, 0.24)	0.15***	(0.11, 0.19)	0.12***	(0.08, 0.16)	0.12***	(0.07. 0.16)	0.09***	(0.04, 0.12)
Yrs Ed.					0.19***	(0.17,0.21)	0.13***	(0.11. 0.15)	0.11***	(0.09, 0.14)
Occupation (SEI)							0.02***	(0.02. 0.02)	0.01***	(0.01, 0.01)
Avg. Inc. 25–39									0.68***	(0.61, 0.76)
Negative Wealth										
Intercept	−8.9		−9.53		−7.28		−7.43		−5.60	
Ability			−0.27***	(−0.42, −0.12)	−0.07	(−0.22, 0.08)	−0.06	(−0.21, 0.09)	−0.04	(−0.18, 0.12)
Parents' Ed.	−0.09***	(−0.12, −0.04)	−0.06*	(−0.11, −0.00)	−0.01	(−0.07, 0.08)	−0.00	(−0.06, 0.05)	−0.00	(−0.06, 0.05)
IHS Fam Inc.	−0.05	(−0.12, 0.02)	−0.02	(−0.10, 0.05)	−0.00	(−0.07, 0.07)	0.00	(−0.07, 0.07)	0.00	(−0.06, 0.07)
Yrs Ed.					−0.21***	(−0.26, −0.16)	−0.20***	(−0.26, −0.14)	−0.20***	(−0.26, −0.14)
Occupation (SEI)							−0.00	(−0.01, 0.00)	−0.00	(−0.01, 0.01)
Avg. Inc. 25–39									−0.19*	(−0.36, −0.01)
N of Cases	4241		3533		3513		3344		3312	
N of Parameters	10		12		14		16		18	
Pearson Statistic	4240.8		3531.6		3515.9		3346.0		3312.6	

0.05>P>0.01; ** 0.01>P>0.001, *** P<0.001. Estimates from 3 component Finite Mixture Model, two normal distributions plus excess zero distribution. 95%CL-95% Confidence Limits. IHS=Inverse Hyperbolic Sine Transformation. Model 2 is presented in in Table 3.

predictors of income in the NLSY79. A doubling of parental income is associated with a 16% increase in average income from ages 25 to 39. The corresponding effect for parental wealth is 3%. Contrary to Bowles and Gintis's (2002b, pp. 3–4) assertions, parental income is *not* as important for income as educational attainment. Furthermore, the impact of parental wealth is weak. The standardized estimates of 0.25 and 0.28 for cognitive ability in model 4 are considerably larger than the 0.15 estimate in Bowles and Gintis's (2002b, p. 10) meta-analysis from which they concluded that ability is relatively unimportant for income.

The addition of educational attainment in model 4. only marginally reduces the coefficients for family income. A doubling of family income is associated with a 12% increase in personal income In the NLSY79 and 4% in the NLSY97. The standardized coefficients indicate that ability has the strongest influence closely followed by years of education then family income. Family income is far from the dominant influence on offspring's income.

Model 5 shows that cognitive has non-trivial effects on income even when considering occupational status as well as education and family income. This means that within narrowly defined occupational groups, higher ability is associated with higher incomes. In the NLSY79, a standard deviation difference in ability is associated with a 11% difference in personal income, net of occupation, education and socioeconomic background. For the NLSY97, the difference is 21%. Net of occupational status, the effects of education are not significant or are trivial.

5.7. Wealth

Tables 10 and 11 present the estimates from analyses of wealth at ages 34, 35 for the NLSY79 and at age 35 NLSY97. Positive and negative wealth are analyzed simultaneously. Model 1 shows that a one-year difference in parents' education is associated with an 11% increase in positive wealth in NLSY79 and a 9% increase in the NLSY97. Without considering other influences, a doubling of family-of-origin income is associated with a 40% increase in positive wealth in the NLSY79 and a 21% increase in the NLSY97. This compares to increases of 75% and 68% for a one-standard deviation increase in cognitive ability (Table 3).

Comparing model 3 to model 2 (Table 3). controlling for parents' education and family income reduces the coefficient for ability from 0.75 to 0.66 in the NLSY79 (12%) and from 0.68 to 0.55 in the NLSY97 (19%). In the extended model 3, the coefficients for *g* on positive wealth were comparable 0.64 and 0.59, although the two analytical approaches are not strictly comparable.

When considering cognitive ability in model 3, the impact of family income is substantially less than in model 1. In the NLSY79, a doubling of family income is associated with a 24% increase (compared to 40% in model 1) in positive wealth and 15% in the NLSY97 (compared to 21% in model 1). In both cohorts, the parental education coefficients in model 1 decline by about two-thirds with the addition of cognitive ability.

Model 4 adds educational attainment. A one-year increase in educational attainment is associated with a 12% increase in positive wealth in the NLSY79 and a 19% increase in the NLSY97. The effects of cognitive ability on wealth remain substantial. A one-standard deviation difference in cognitive ability is associated with a 53% difference in positive wealth in the NLSY79 and a 31% increase in the NLSY97. There are no significant effects for parents' education on wealth when considering ability and educational attainment. Family income remains statistically significant: a 100% difference in family income is associated with a 24% difference in positive wealth in the NLSY79 and a 12% difference in the NLSY97.

Occupational attainment was added in model 5. Net of education, occupational status and other variables in model 5, a one standard deviation difference in ability is associated with 43% increase in positive wealth in the NLSY79 and a 25% increase in the NLSY97. The coefficients for family income is largely unchanged.

Model 6 adds average income. Not unexpectedly, average income has strong relationships with wealth: a doubling of average income translates to a 56% increase in wealth in the NLYS79 and a 68% increase in the NLSY97. Ability remains significant, net of the variables in model 6. In the NLSY79, a one-standard-deviation difference in ability is associated with a 33% difference in positive wealth. In the NLSY97, the difference was 10%.

In model 6, family income remains statistically significant. A 100% difference in family income is associated with a 20% difference in positive wealth in the NLSY79 and an 9% difference in the NLSY97. Family-of-origin income has a moderate impact on offspring's wealth in the NLYS79 and a significantly smaller impact in the NLSY97. The rate of return to wealth from educational attainment has increased: 11% in the NLSY97 and 6% in the NLSY97 (11%). The coefficient for occupational status is much the same for both cohorts: a one unit increase in occupational status was associated with a 1% increase in wealth.

6. Discussion

The conclusions from this study are contrary to dominant narratives about the reproduction of socioeconomic inequalities in Western countries. Parents' education - which is often considered the most important socioeconomic background factor - together with accurate measures of family income could only account for moderate amounts of the variance in stratification outcomes: about 10% for school grades, 15 to 20% for SAT and ACT scores, around 20% for educational attainment; 15 to 20% for occupational attainment, and less than 10% for income. Cognitive ability is a far more powerful influence, accounting for 3 times more of the variance in school grades, three to five times more variation in SAT and ACT performance, over 30% of the variance in educational attainment, and 20 to 30% of the variance in occupational attainment and income. The 'race of the variables' is not even close.

What is remarkable is the robustness of the effects of cognitive ability. The addition of measures of socioeconomic background only marginally decreases the magnitudes of the coefficients for cognitive ability: by 4 to 7% for grades, 3 to 5% for SAT and ACT performance, nearly 20% for educational attainment, 13 and 14% for occupational attainment and 3 to 10% for income. Importantly, the coefficients for cognitive ability are much the same in the extended family background model compared to the reduced family background model.

The common response to the much lower than expected explanatory power of socioeconomic background is to argue that the measurement of socioeconomic background is flawed, for example one year of family income is too unreliable and should be averaged over several years, and family wealth is an important but neglected aspect of socioeconomic background. However, the extended socioeconomic background model for the NLSY79—comprising father's and mother's occupational status, parental income averaged over 8 years, family wealth averaged over 2 years, as well as the average of parents' education—did not substantially increase explanatory power for high school grades, and SAT and ACT scores. For educational attainment, the extended model accounted for more variance than the standard model, but in the presence of cognitive ability the extended model did not increase the variance explained. For occupational status and income, there are sizable effects for family income and significant effects for family wealth, but when considering cognitive ability these effects are small. So, contrary to conventional wisdom, socioeconomic background is a comparatively weak influence on educational and subsequent socioeconomic outcomes.

Critics may point to some of the moderate effects of socioeconomic background factors on offspring's educational outcomes as evidence for sociological or economic explanations for educational and socioeconomic intergenerational associations. However, parents and their children are also genetically related. Lemos, Almeida and Colom (2011, p. 1062) attribute the association between parents' education with adolescents' ability, not to better family environments but because they and "their parents are brighter". Swagerman et al. (2017, p. 3) conclude that "parents and offspring tend to resemble each other for genetic reasons, and not due to cultural transmission". Murray (2020, p. 237) points out that any measure of parents' socioeconomic characteristics is not only a measure of the child's environment, but also measures parent's abilities and talents, all of which have genetic components. Erola et al. (2021, p. 2) suggest that the correlations between parents' socioeconomic resources and their children's socioeconomic outcomes may simply be because parents and children share genes that impact on how well they succeed in life.

Genetics may, to a considerable extent, account for the main findings of the study: the moderate to strong associations of stratification outcomes with cognitive ability; the robustness of the coefficients for cognitive ability with the addition of socioeconomic background factors; and the substantial declines in the estimates for socioeconomic background factors with the addition of cognitive ability. The 20% decrease in the coefficient for cognitive ability on educational attainment after the addition of parents' education is likely to be because of genetics; the same sets of genes influence parents' and their children's education and cognitive abilities. The correlation between parents' and children's educational attainment (0.41 and 0.45 in these data) is well predicted by its heritability, that is the proportion of the variance in education attributable to genetics.[11]

All the major factors involved in the processes of educational and socioeconomic attainment have sizable heritabilities: cognitive ability (Deary, 2012; Plomin & Deary, 2015), student achievement (de Zeeuw, de Geus, & Boomsma, 2015), educational attainment (Branigan et al., 2013; Pokropek & Sikora, 2015; Silventoinen et al., 2020), occupational attainment (Lichtenstein, Pedersen, & McClearn, 1992; Miller, Mulvey, & Martin, 1996; Roos & Nielsen, 2019), income and wealth (Hyytinen, Ilmakunnas, Johansson, & Toivanen, 2019; Roos & Nielsen, 2019) and SES itself (Walsh, 2014, pp. 125–146). The major stratification variables have genetic correlations with cognitive ability and each other (Marks, 2017; Ørstavik et al., 2014; Rowe, Vesterdal, & Rodgers, 1999). This, and other evidence for the importance of genetics for social stratification variables is not compatible with the SAD thesis.

This study indicates that, to a considerable extent, the US is meritocratic. Ability has substantial effects on each outcome, net of socioeconomic background and relevant proximal influences. Whether this is fair, just, or desirable are different questions.

Substantial effects for cognitive ability does not mean socioeconomic background is irrelevant; it may be especially important for those at each end of the socioeconomic continuum. Sizable effects for cognitive ability do not necessarily mean greater socioeconomic mobility. If cognitive ability is equally distributed across (parental) socioeconomic continuums, then strong effects of cognitive ability will promote socioeconomic mobility. However, if the distribution is skewed towards higher status families, which it tends to be in contemporary Western societies, then there will be much more limited socioeconomic mobility.

Since the 1960s, it has been not infrequently argued in the academic literature that the reproduction of educational, occupational and economic inequalities in Western societies is so egregious and entrenched that it can only be addressed by much greater government intervention and control and, more radically, by dismantling capitalism. This is likely to lead to far more dystopian societies than Young envisioned in his *The Rise of the Meritocracy*. Educational and occupational attainments would be based, not on ability - or even competence - but on political and ideological criteria. Even a partial or imperfect meritocracy is far preferable to societies where nepotism, cronyism, patronage or political ideology govern access to high status, powerful and well-renumerated occupations.

[11] The midparent-child correlation can be predicted from the heritability (h^2):

$$\hat{r}_{pc} = h^2$$

From Nagylaki (1978, p. 134) and Clark (2021, p. 5). The heritability for education is between 0.4 and 0.5 (Branigan, McCallum, & Freese, 2013; Pokropek & Sikora, 2015; Silventoinen et al., 2020), which is close to the observed correlation.

Table A1: Analysis of model 3 with additional socioeconomic background measures (NLSY79).

	High Sch. Grades		SAT		ACT		Education		Occupation		Income		+ve Wealth	
	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits
Intercept	1.76		323.7		11.34		10.86		33.82		8.96		8.09	
Ability	0.50***	(0.48, 0.52)	113.1***	(108.3, 117.9)	6.27***	(5.95, 6.59)	1.08***	(1.04, 1.12)	6.27***	(5.99, 6.55)	0.33***	(0.30, 0.35)	0.64***	(0.57, 0.71)
Std. Effect Ability	*0.57*	*(0.55, 0.59)*	*0.87*	*(0.84, 0.89)*	*0.84*	*(0.81, 0.86)*	*0.46*	*(0.42, 0.48)*	*0.44*	*(0.42, 0.46)*	*0.31*	*(0.29, 0.33)*	*0.29*	*(0.26, 0.33)*
Parents' Education	−0.01	(−0.00, 0.00)	3.52***	(1.75, 5.29)	0.09	(−0.02, 0.21)	0.11***	(0.09, 0.12)	0.11*	(0.02, 0.21)	−0.01*	(−0.01, −0.02)	0.01	(−0.01, 0.04)
Fathers Occupation (sei)	0.00	(−0.00, 0.00)	0.19	(−0.01, 0.40)	0.01	(−0.01, 0.02)	0.01***	(0.01, 0.01)	0.07***	(0.05, 0.08)	−0.00	(−0.00, 0.00)	0.00	(−0.01, 0.01)
Mothers Occupation (sei)	0.00*	(0.00, 0.00)	−0.18	(−0.43, 0.07)	−0.01	(−0.02, 0.01)	0.01***	(0.00, 0.01)	0.04***	(0.03, 0.06)	0.00	(0.00, 0.00)	0.00	−(0.01, 0.01)
IHS Family Income 1979–86	0.04	(0.02, 0.07)	−3.16	(−9.57, 3.24)	−0.04	(−0.36, 0.29)	0.05	(−0.00, 0.10)	0.50**	(0.15, 0.85)	0.16***	(0.13, 0.19)	0.26***	(0.16, 0.35)
IHS Family Wealth 1985–86	0.00	(−0.00, 0.01)	−0.33	(−1.34, 0.68)	0.03	(−0.04, 0.09)	0.03*	(−0.02, 0.00)	−0.01	(−0.07, 0.06)	0.03***	(0.03, 0.04)	0.04***	(0.03, 0.06)
	1179		141		146		1389		1369		1363		678	
	11,491		12,526		12,521		11,295		11,315		11,321		4695	
	0.37		0.82		0.75		0.39		0.32		0.20		0.18	

Education measured by years of education, occupation by Duncan socioeconomic index of occupations, income by average of non-zero (CPI-adjusted), Inverse Hyperbolic Sine (IHS) transformed incomes at ages 25 to 39, wealth from average of wealth at ages 35 and 36, excluding zero and negative wealth.

Table A2: Analysis of model 3 with additional socioeconomic background measures (NLSY97).

	Grade 8 Grades		High Sch. Grades		SAT		ACT		Education		Occupation		Income		+ve Wealth	
	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits	Est	95% Confidence Limits
Intercept	5.23		4.99		389.8		15.73		10.24		25.68		10.29		9.95	
Ability	0.75***	(0.71, 0.79)	0.65***	(0.62, 0.69)	104.1***	(99.4, 108)	4.83***	(4.61, 5.04)	1.30***	(1.24, 1.36)	6.89***	(6.46, 7.32)	0.36***	(0.33, 0.38)	0.59***	(0.53, 0.64)
Std. Effect Ability	*0.44*	*(0.42, 0.46)*	*0.41*	*(0.38, 0.43)*	*0.83*	*(0.81, 0.86)*	*0.84*	*(0.81, 0.86)*	*0.46*	*(0.44, 0.48)*	*0.39*	*(0.37, 042)*	*0.39*	*(0.36, 041)*	*0.35*	*(0.32, 0.38)*
Parents' Ed	0.03***	(0.02, 0.04)	0.04***	(0.03, 0.05)	3.54***	(2.08, 5.01)	0.16***	(0.09, 0.24)	0.18***	(0.15, 0.20)	0.60***	(0.46, 0.75)	−0.01	(−0.01, 0.00)	0.01***	(0.00, 0.04)
IHS Fam Income 1997	−0.00	(−0.03, 0.01)	−0.00	(−0.03, 0.02)	−1.04	(−5.00, 2.92)	0.05	(−0.07, 0.17)	0.08***	(0.04, 0.12)	0.49***	(0.22, 0.75)	0.04***	(0.03, 0.06)	0.12***	(0.08, 0.15)
IHS Fam Wealth 1997	0.01**	(0.00, 0.02)	0.01*	(0.00, 0.02)	0.55	(−0.29, 1.39)	−0.02	(−0.06, 0.03)	0.03***	(0.01, 0.04)	0.15	(0.07, 0.22)	0.01***	(0.00, 0.01)	0.02***	(0.01, 0.03)
N Complete	4303		4097		762		767		4145		3920		4041		2665	
N Incomplete	4678		4877		8154		8146		4883		5056		4937		2567	
R Square	0.22		0.20		0.77		0.77		0.35		0.23		0.18		0.18	

Education measured by years of education, occupation by Duncan socioeconomic index of occupations, income by average of non-zero (CPI-adjusted), Inverse Hyperbolic Sine (IHS) transformed incomes at ages 25 to 39, wealth from average of wealth at ages 35 and 36, excluding zero and negative wealth.

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