# Some Contributions of Economics to the Study of Personality

In *Handbook of Personality: Theory and Research* (New York, NY: Guilford Press, 2019), 853–892

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# Measuring Cognitive and Noncognitive Skills

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# Cognitive Skills

# Measuring Noncognitive Skills

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# A Task-Based Framework for Identifying and Measuring Skills

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> *Personality traits are the relatively enduring patterns of thoughts, feelings, and behaviors that reflect the tendency to respond in certain ways under certain circumstances. (Roberts, 2009, 140)*

- Roberts' definition of personality ("non-cognitive") skills, and the one favored by Almlund et al. (2011), suggests that all psychological measurements are calibrated on measured behaviors or "tasks" broadly defined.
- Tasks include taking IQ tests, answering personality questionnaires, performing a job, attending school, completing secondary school, participating in crime, or performing in an experiment run by a social scientist.

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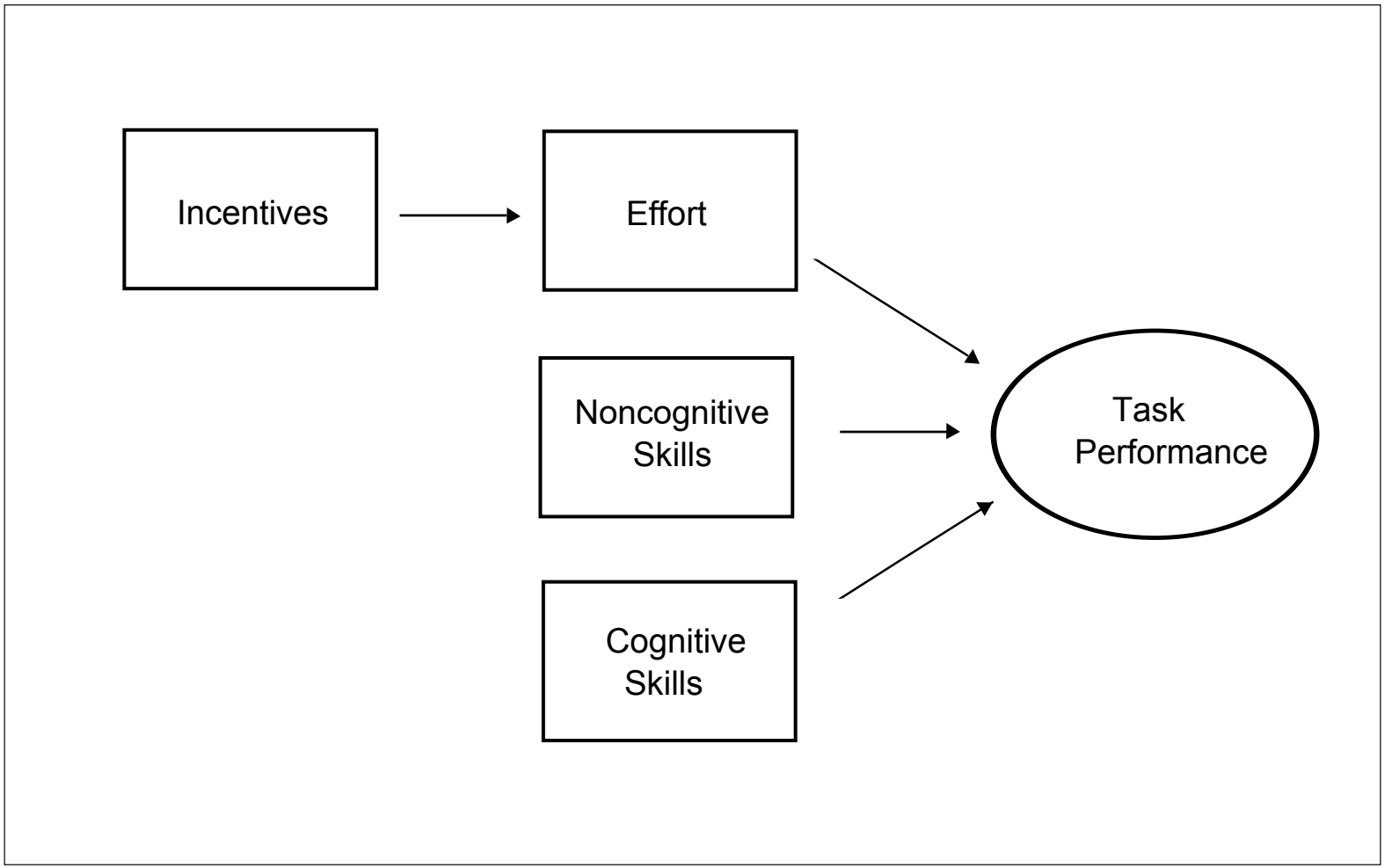
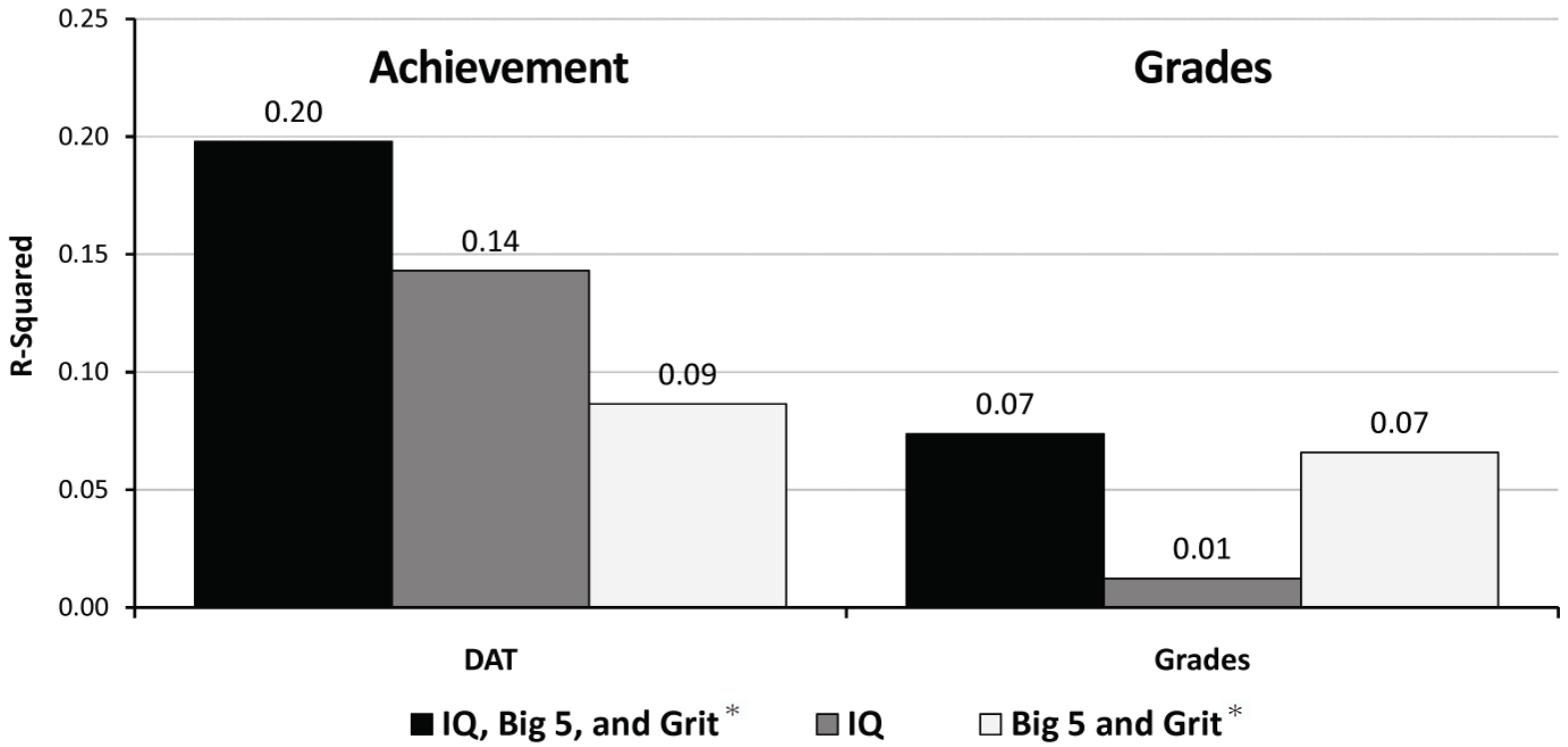
- Figure 1 depicts how performance on a task can depend on incentives, effort, and cognitive and non-cognitive skills.
- Performance on different tasks depends on these components to different degrees.
- People can compensate for their shortfalls in one dimension by having strengths in other dimensions.

## Figure 1: Determinants of Task Performance



- The recent literature shows that non-cognitive skills predict standardized achievement test scores, which some psychologists assume are good measures of intelligence.
- Figure 2 (based on Dutch data) shows how the variability across persons in the scores on one achievement test, the Differential Aptitudes Test (DAT), are determined by IQ and non-cognitive measures.

Figure 2: Decomposing Variance Explained for Achievement Tests and Grades into IQ and Noncognitive Skills: Stella Maris Secondary School, Maastricht, Holland



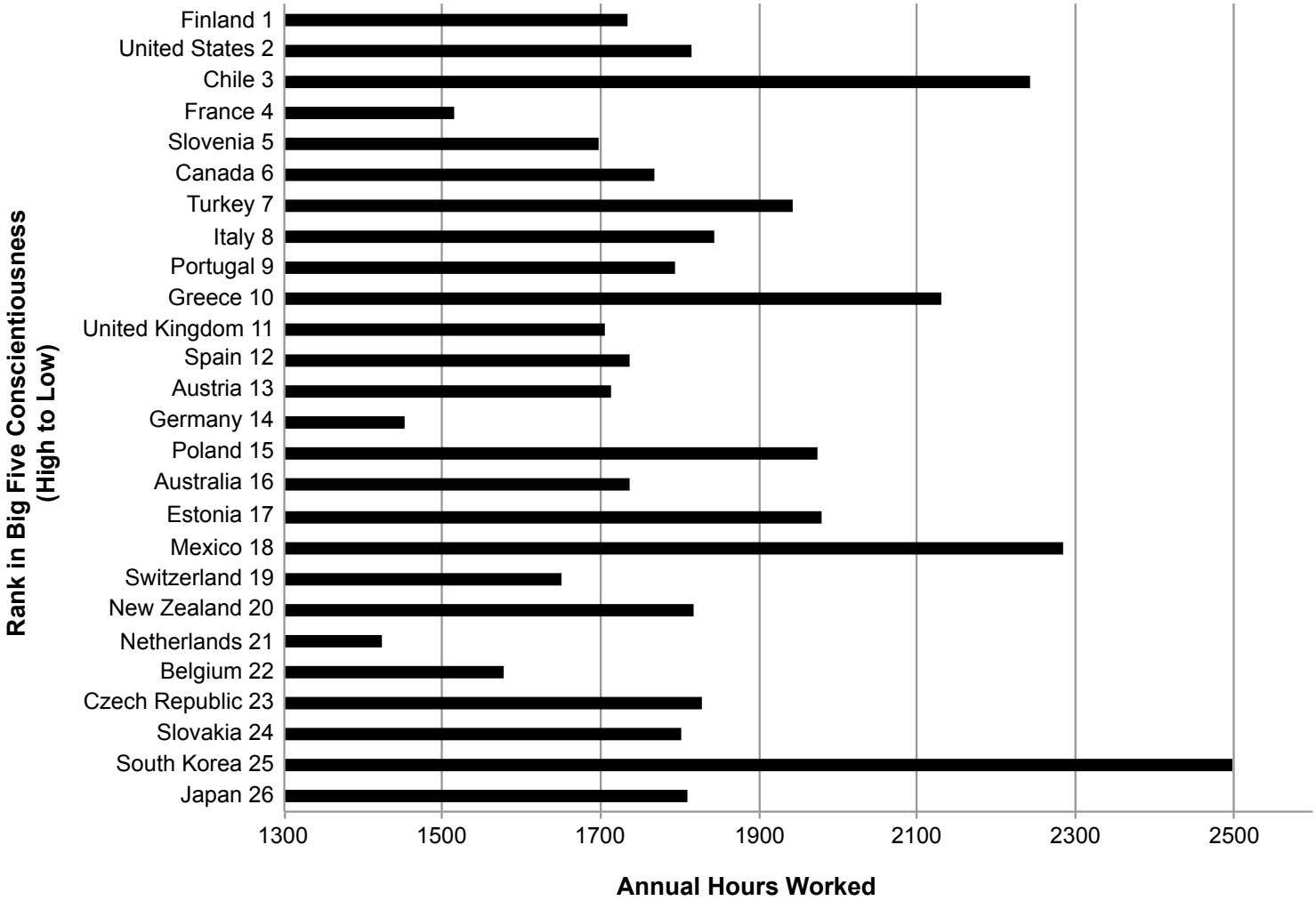

*Source*: Borghans et al. (2011).
*Note*: Grit is a measure of persistence on tasks (Duckworth et al., 2007).

- Non-cognitive skills explain a substantial portion of the variability across persons in DAT scores.
- Non-cognitive skills explain the variance in achievement scores above and beyond the variance that IQ explains when both measures of non-cognitive skill and IQ are included in a regression.
- These findings caution the interpretation that standardized achievement tests only measure cognitive ability.
- They also capture non-cognitive skills.

# Reference Bias

- This measurement problem—sometimes called reference bias—is empirically important.
- Schmitt et al. (2007) administer a Big Five personality questionnaire to groups of people in a variety of different countries.
- Using their estimates, Figure 3 shows how Organization of Economic Cooperation of Development (OECD) countries rank (from high to low) in conscientiousness—the tendency to be hard-working and persistent.
- The bars display the average number of hours that people work in the country.

# Figure 3: National Rank in Big Five Conscientiousness and Average Annual Hours Worked



# Studies Measuring Skills Using Behaviors

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- Figure 1 suggests that all tasks or behaviors can be used to infer a skill as long as the measurement accounts for other relevant skills and incentives of the situation in which the task is performed.
- Self-reported scales should not be assumed to be more reliable than behaviors, although personality psychologists often assume so.
- The question is which measurements are most predictive and which can be implemented in practice.
- The literature suggests that there are objective measurements of non-cognitive skills that are not plagued by reference bias.

# Measuring Economic Preferences

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# Are Economists' Preferences Psychologists' Personality Skills?

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# Are Noncognitive Skills Stable across Situations?

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# The Predictive Power of Noncognitive Skills

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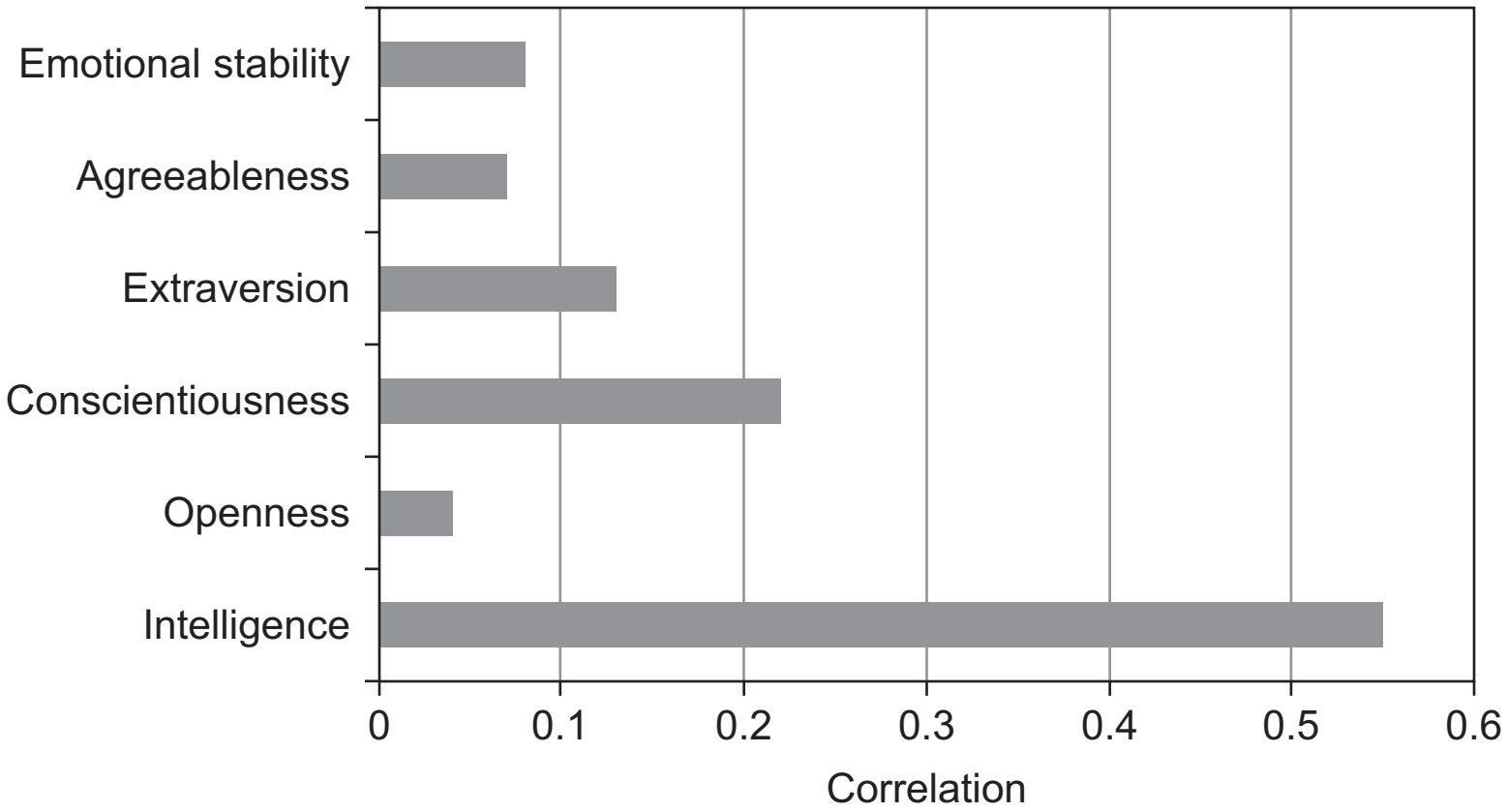
# Correlational Evidence

## Figure 4: Associations with Job Performance

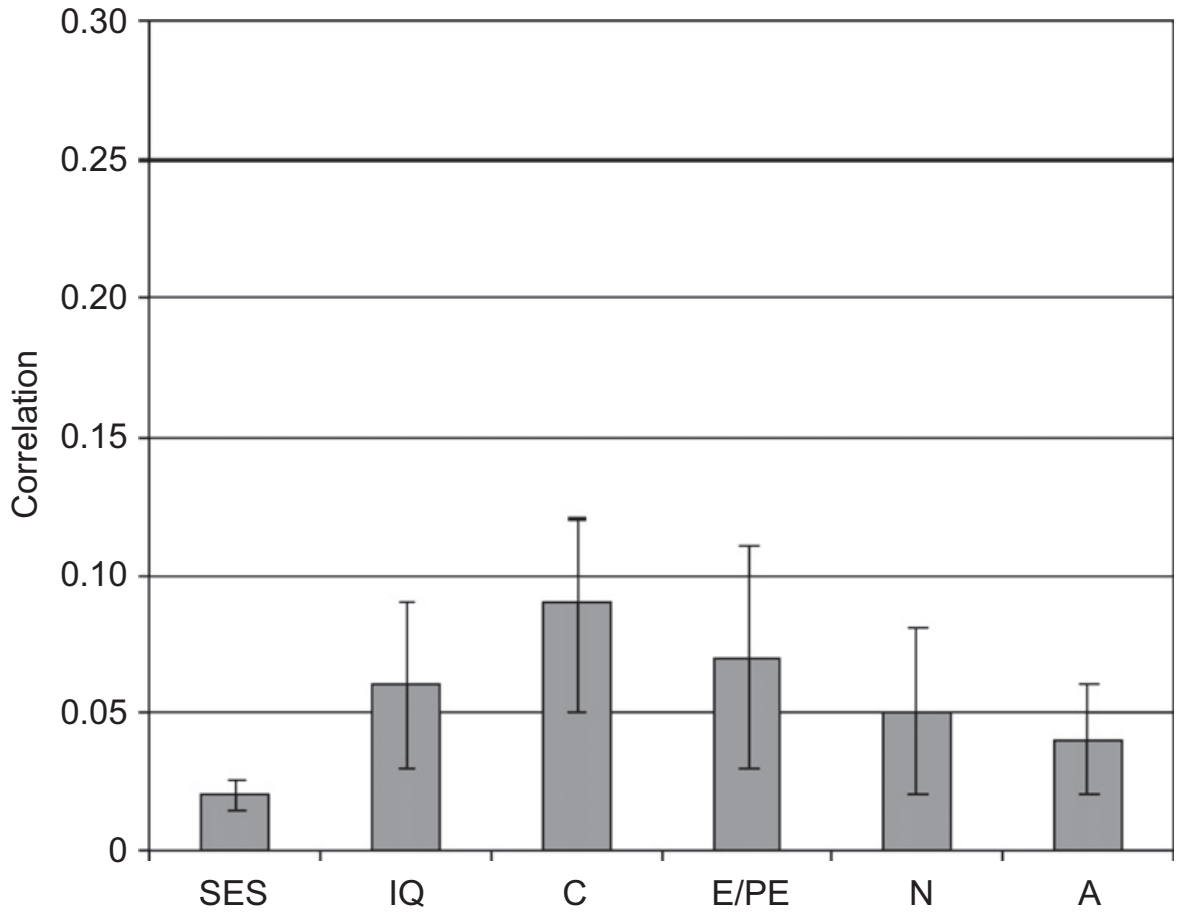



*Source*: The correlations reported for personality skills come from a meta-analysis conducted by Barrick and Mount (1991). The correlation reported for intelligence comes from Schmidt and Hunter (2004).

- Figure 4 presents correlations of the Big Five and IQ with job performance.
- Of the Big Five factors, conscientiousness is the most strongly associated with job performance but is about half as predictive as IQ.
- Conscientiousness, however, may play a more ubiquitous role than IQ.
- The importance of IQ increases with job complexity (the information processing requirements of the job).

- Measures of non-cognitive skills rival IQ and measures of socioeconomic status in predicting longevity.
- Figure 5 presents results from their analyses.

Figure 5: Correlations of Mortality with Noncognitive Skills, IQ, and Socioeconomic Status (SES)




*Source*: Roberts et al. (2007).

- Conscientiousness is a stronger predictor of longevity than any other Big Five skill and a stronger predictor than either IQ or socioeconomic status.
- In general, skills related to conscientiousness, openness to experience, and agreeableness are associated with longer lives.

- As with most studies in personality psychology, the evidence presented in Figures 4–5 and most of the literature do not address the question of causality; that is, do measured skills *cause* (rather than just predict) outcomes?
- Empirical associations are not a reliable basis for policy analysis.
- As previously noted (see Figure 1), multiple skills and effort all generate performance in a given task.
- Many studies in personality psychology do not control for all of the factors that produce performance on measured tasks.
- They equate measures of outcomes with the skill being measured.
- This practice can lead to a substantial bias in inference about the importance of any particular skill.

# The Skills Needed for Success in the Labor Market

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# Evidence from the GED Testing Program

- Table 1 displays the "validity" of the GED test as analyzed by psychometricians.
- It gives correlations between GED scores and other achievement test scores.
- GED test scores are strongly correlated with scores on other standardized achievement tests.
- The correlations range from 0.61 with the General Aptitude Test Battery (GATB) to 0.88 with the Iowa Test of Educational Development, the progenitor of the GED.
- By the standards of psychometrics, the GED test is "valid."

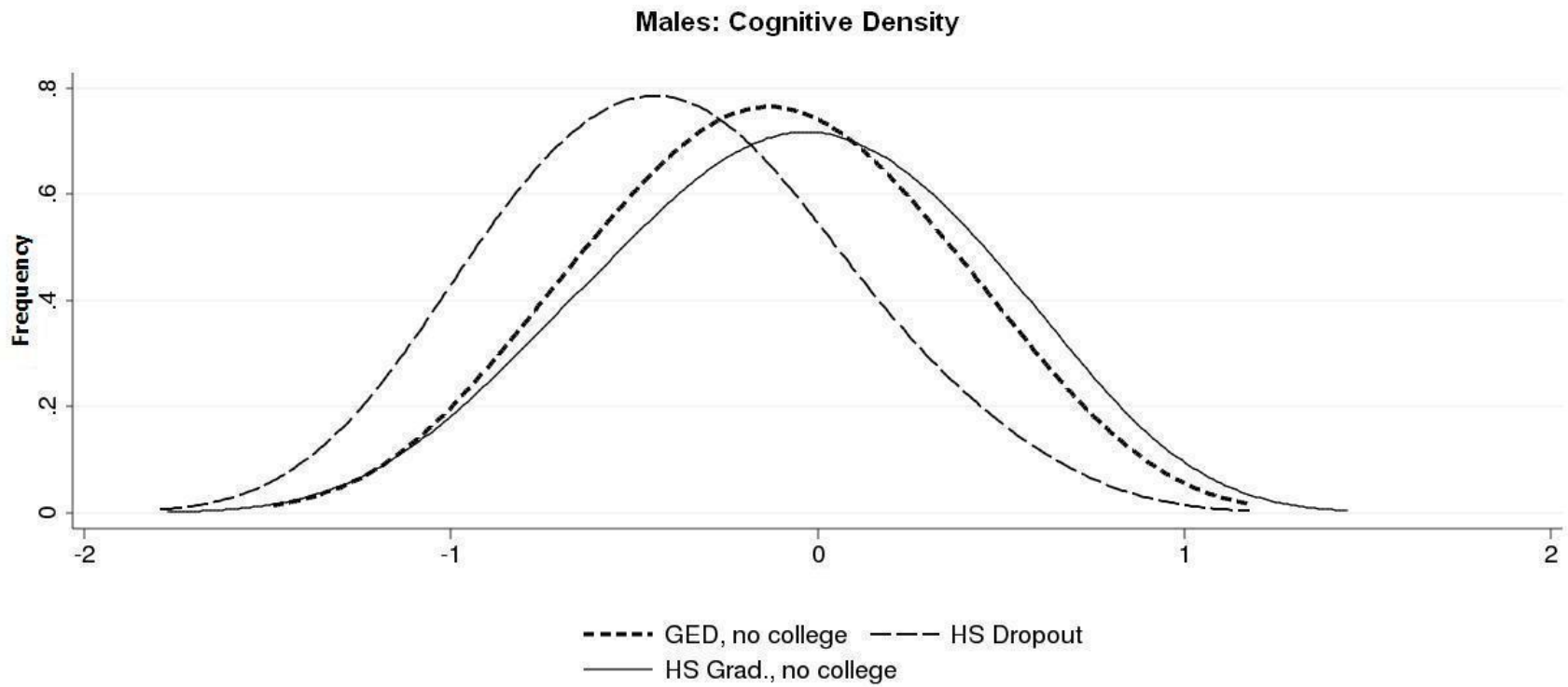
# Table 1: Validities of GED Test

| Test | Correlation | Source(s) |
|---|---|---|
| Armed Forces Qualification Test (AFQT) | 0.75 - 0.79 † | Means and Laurence (1984) |
| Iowa Test of Educational Development | 0.88 † | Means and Laurence (1984) |
| ACT | 0.80 † | Means and Laurence (1984) |
| Adult Performance Level (APL) Survey | 0.81 † | Means and Laurence (1984) |
| New York's Degrees of Reading Power (DRP) Test | 0.77 † | Means and Laurence (1984) |
| Test of Adult Basic Education (TABE) | 0.66-0.68† | Means and Laurence (1984) |
| General Aptitude Test Battery (GATB) | 0.61-0.67† | Means and Laurence (1984) |
| National Adult Literacy Survey (NALS) factor | 0.78 ‡ | Baldwin (1995) |

† Uses mean GED subtest scores
‡ Uses a general GED factor

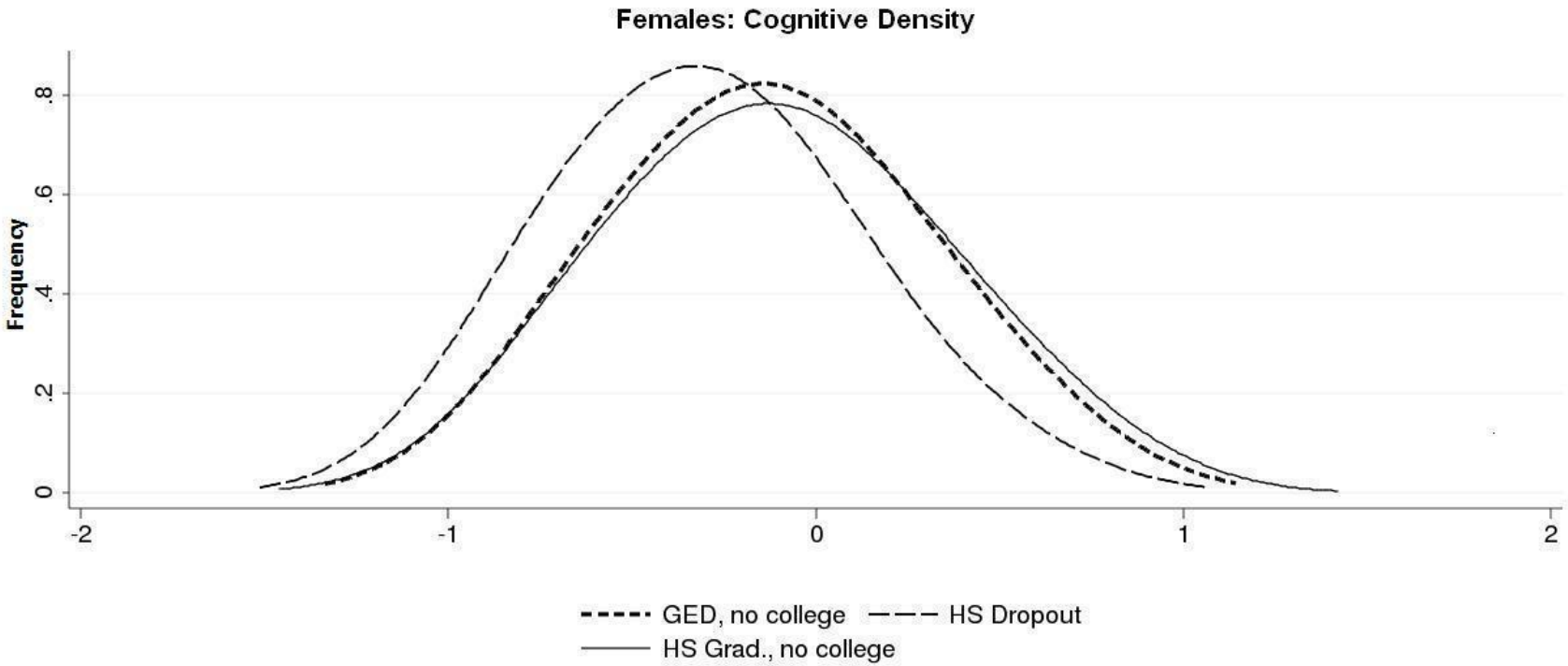
- By psychometric standards, GED recipients have higher skills than other dropouts.
- Figures 6a and 6b show the distributions of a factor extracted from the components of the Armed Services Vocational Aptitude Battery (ASVAB) for male high school dropouts, GED recipients, and high school graduates.
- The sample excludes people who attend post-secondary education.
- The distribution of the scores of GED recipients is much more like that of high school graduates than that of high school dropouts.

# Figure 6a: Cognitive Ability by Educational Status




*Source*: Reproduced from Heckman et al. (2011), which uses data from the National Longitudinal Study of Youth 1979 (NLSY79).

# Figure 6b: Cognitive Ability by Educational Status




*Source*: Reproduced from Heckman et al. (2011), which uses data from the National Longitudinal Study of Youth 1979 (NLSY79).

- If they have the same cognitive ability as high school graduates, then why do they drop out of high school?
- Success in school requires other skills.
- On a variety of other dimensions, GED recipients behave much more like other dropouts.
- Figure 7 shows measures of early adolescent drug use, crime, sex, and violence extracted from three data sources.

Figure 7: Measures of Adolescent Behaviors for Male Dropouts, GED Recipients, and High School Graduates

(a) Smoking and Drinking

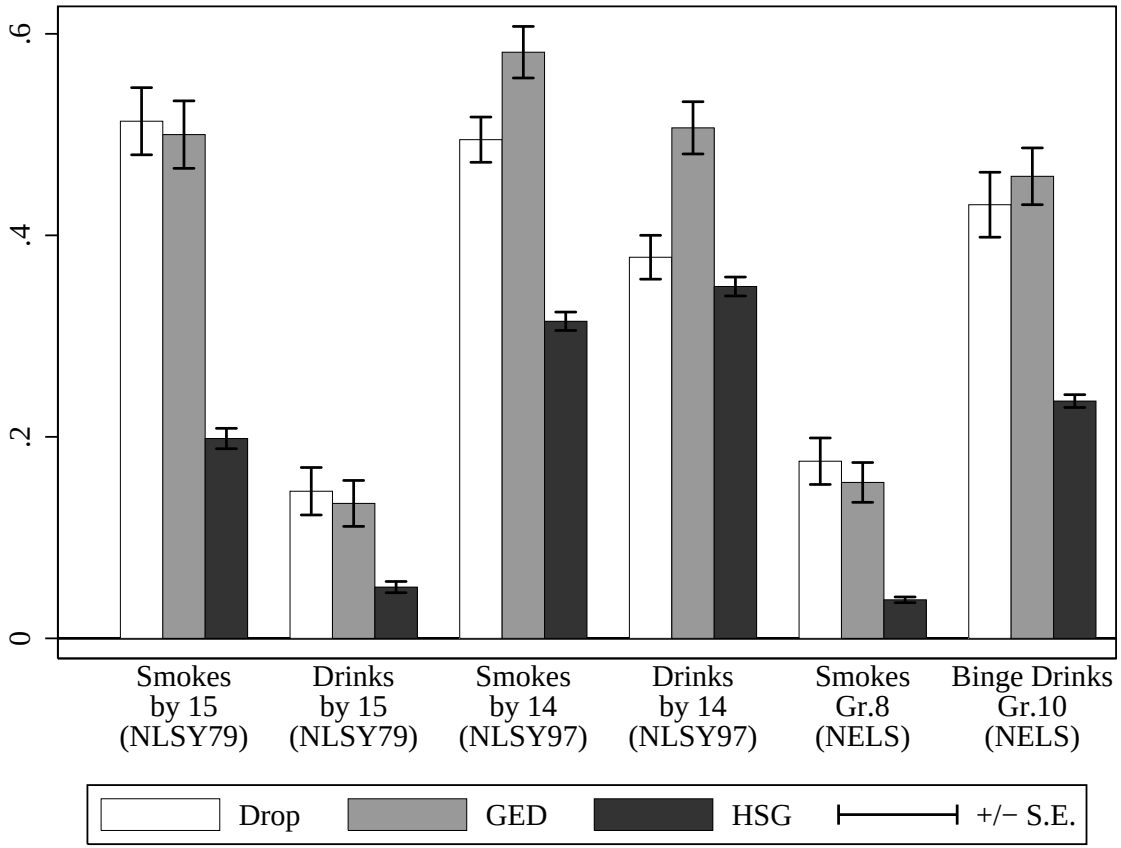


Figure 7: Measures of Adolescent Behaviors for Male Dropouts, GED Recipients, and High School Graduates, Cont'd

(b) Sex and Violent Behavior

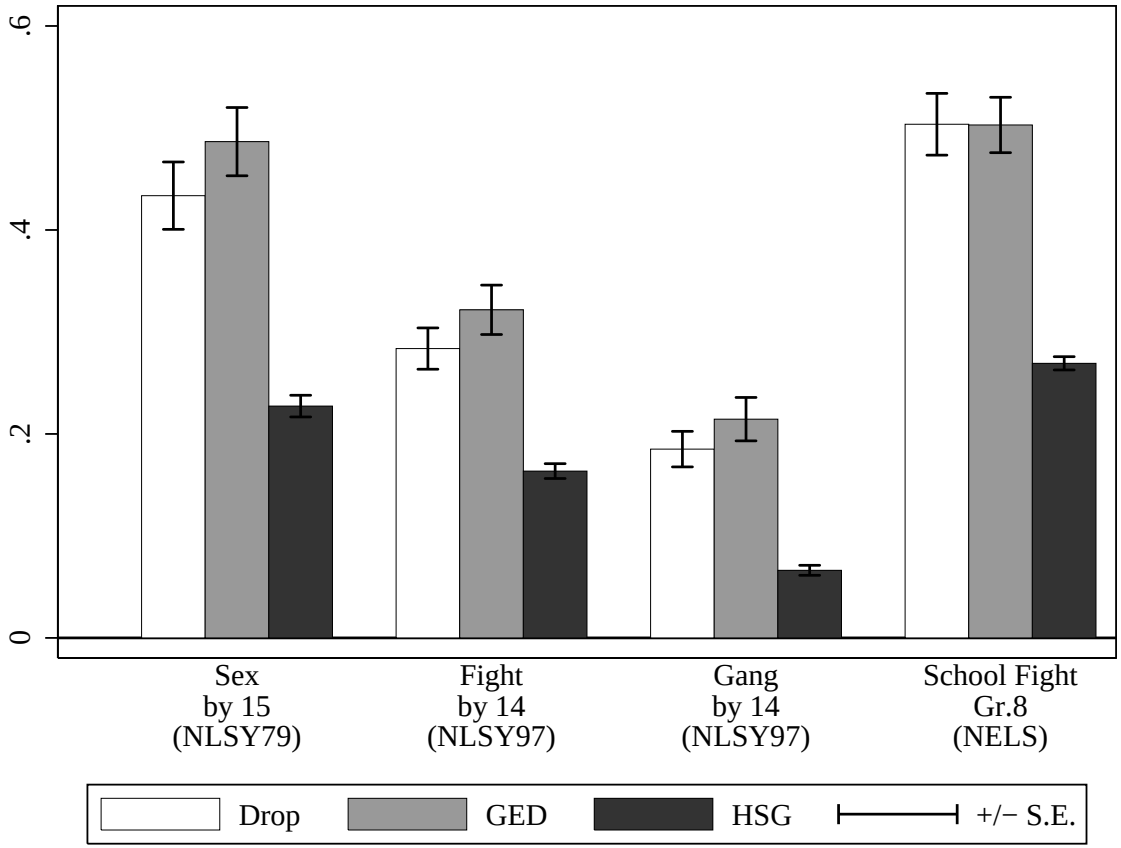
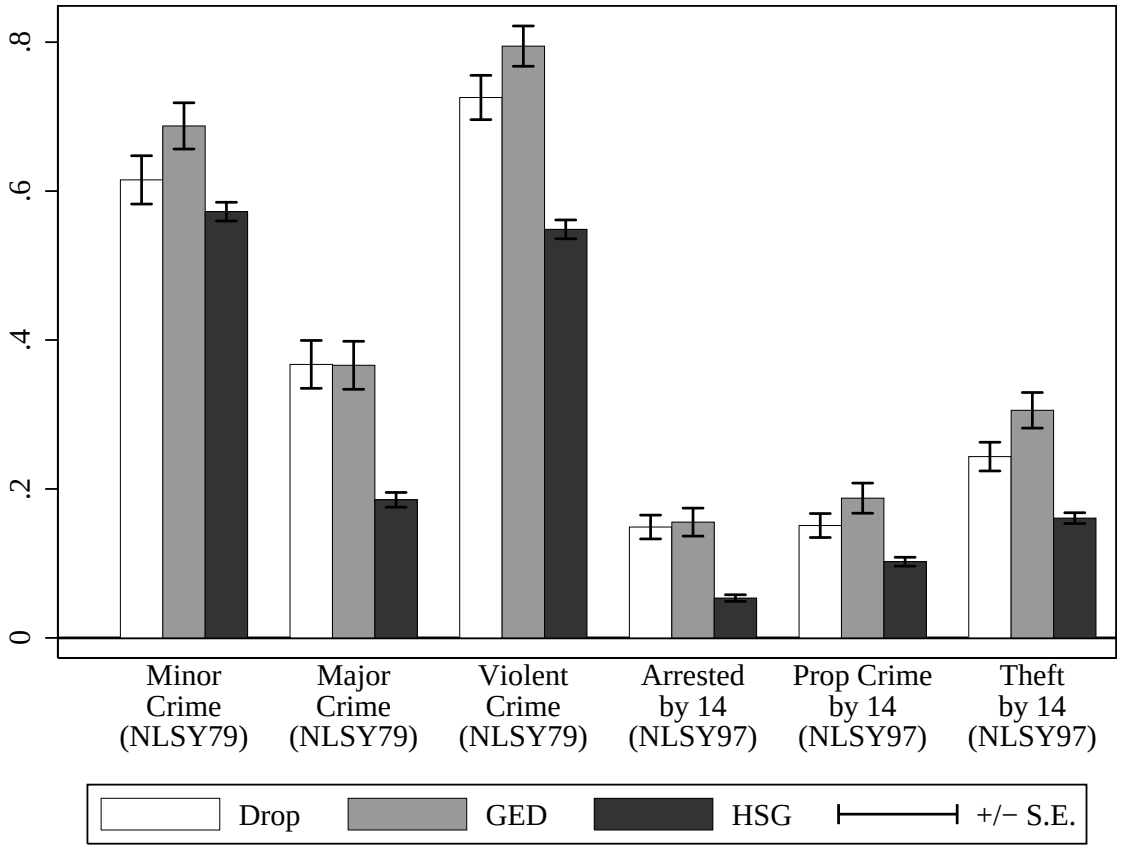


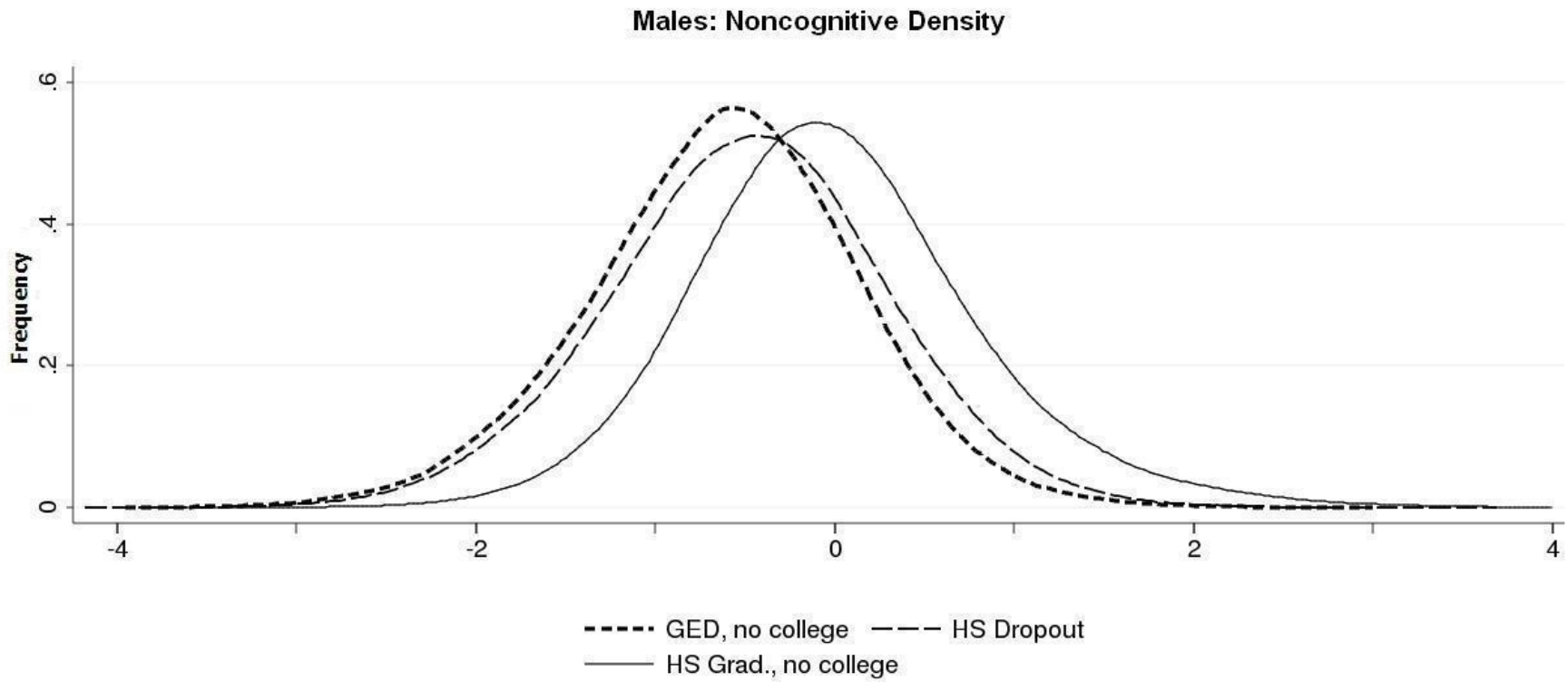
Figure 7: Measures of Adolescent Behaviors for Male Dropouts, GED Recipients, and High School Graduates, Cont'd

(c) Criminal Behavior



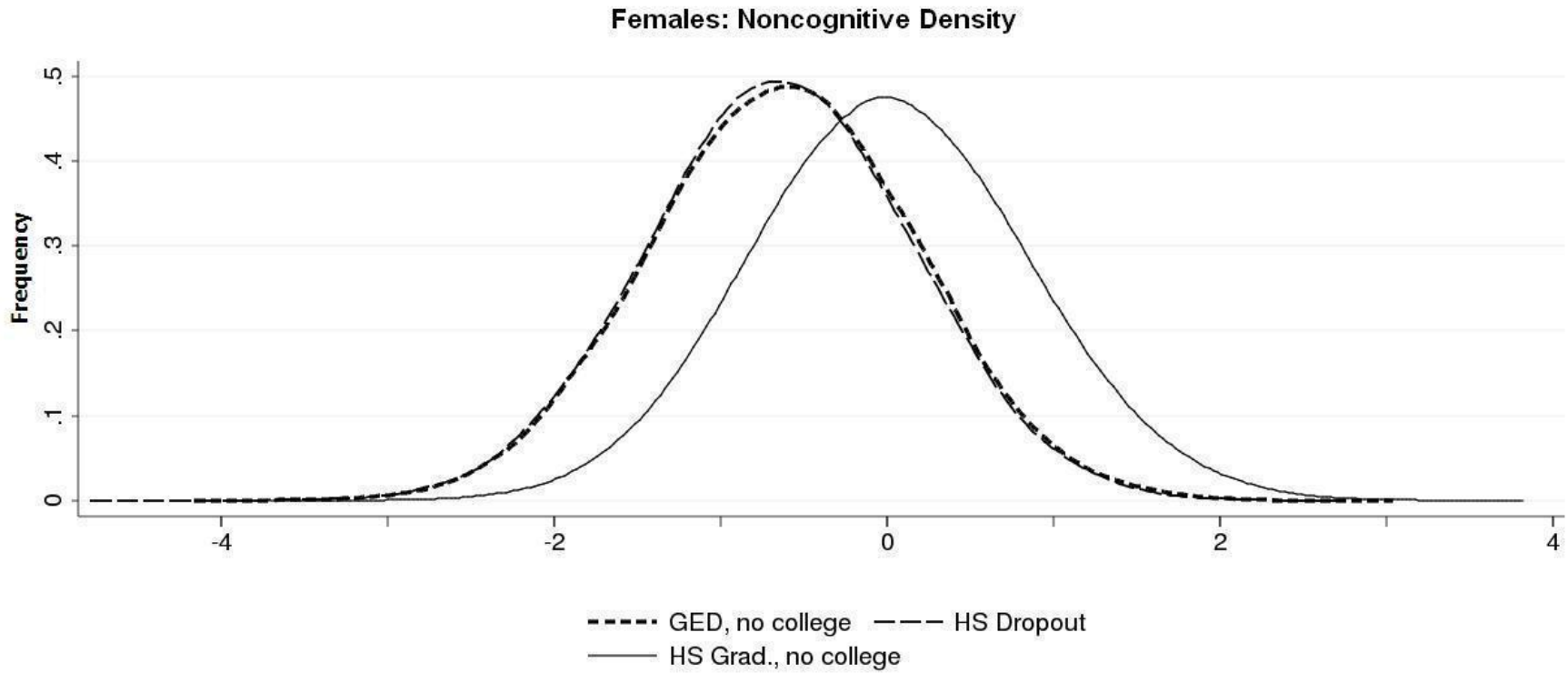
- Male high school graduates perform better on all measures than high school dropouts or GED recipients.
- GED recipients are much more similar to dropouts, but in several cases are statistically significantly *more likely* to engage in risky behaviors than other dropouts.
- On no outcome measure in that figure are dropouts statistically significantly more likely to engage in risky behaviors compared to GED recipients.
- Figures 8a and 8b summarize these adolescent behaviors using a single factor and shows that unlike the cognitive summary measures, the distribution of the noncognitive (personality) summary measure of GED recipients is much closer to that of dropouts than to that of high school graduates.

Figure 8a: Distribution of Noncognitive Skills by Education Group and Distribution of a Summary Measure of Noncognitive Ability by Education Group




*Source*: Reproduced from Heckman et al. (2011), which uses data from the National Longitudinal Study of Youth 1979 (NLSY79).

Figure 8b: Distribution of Noncognitive Skills by Education Group and Distribution of a Summary Measure of Noncognitive Ability by Education Group




*Source*: Reproduced from Heckman et al. (2011), which uses data from the National Longitudinal Study of Youth 1979 (NLSY79).

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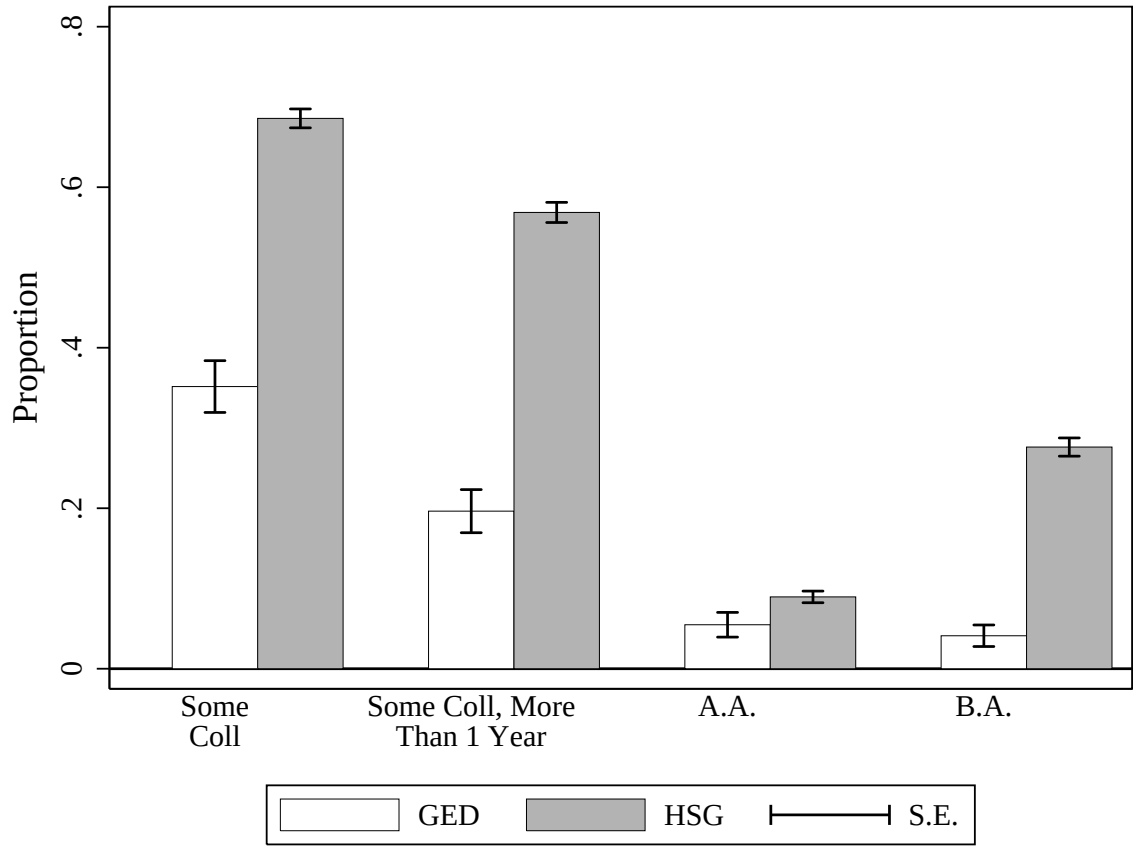
- Figures 8a and 8b show the distribution of a factor summarizing the diverse measures of adolescent risky behavior for dropouts, GED recipients, and high school graduates.
- On this index, GED recipients are nearly identical to high school dropouts.

- The skills that cause GED recipients to drop out of high school manifest themselves in many other life outcomes.
- One potential benefit of the GED certificate is that it opens doors to post-secondary education.
- Figure 9 shows post-secondary educational attainment for GED recipients and high school graduates.

Figure 9: Postsecondary Educational Attainment across Education Groups through Age 40 (NLSY79)—Males



- GED recipients lack persistence in a variety of tasks in life.
- Figure 10 shows the survival rates in employment (overall), employment in a given job, marriage, and in the condition of not having been incarcerated.
- GED recipients tend to exit employment, become divorced, and enter jail at rates similar to those of high school dropouts, while high school graduates are much more persistent.

Figure 10: Survival Rates in Various States for Male Dropouts, GED Recipients, and High School Graduates

Figure 10: Survival Rates in Various States for Male Dropouts, GED Recipients, and High School Graduates, Cont'd

(b) Survival Rate in Staying on a Job

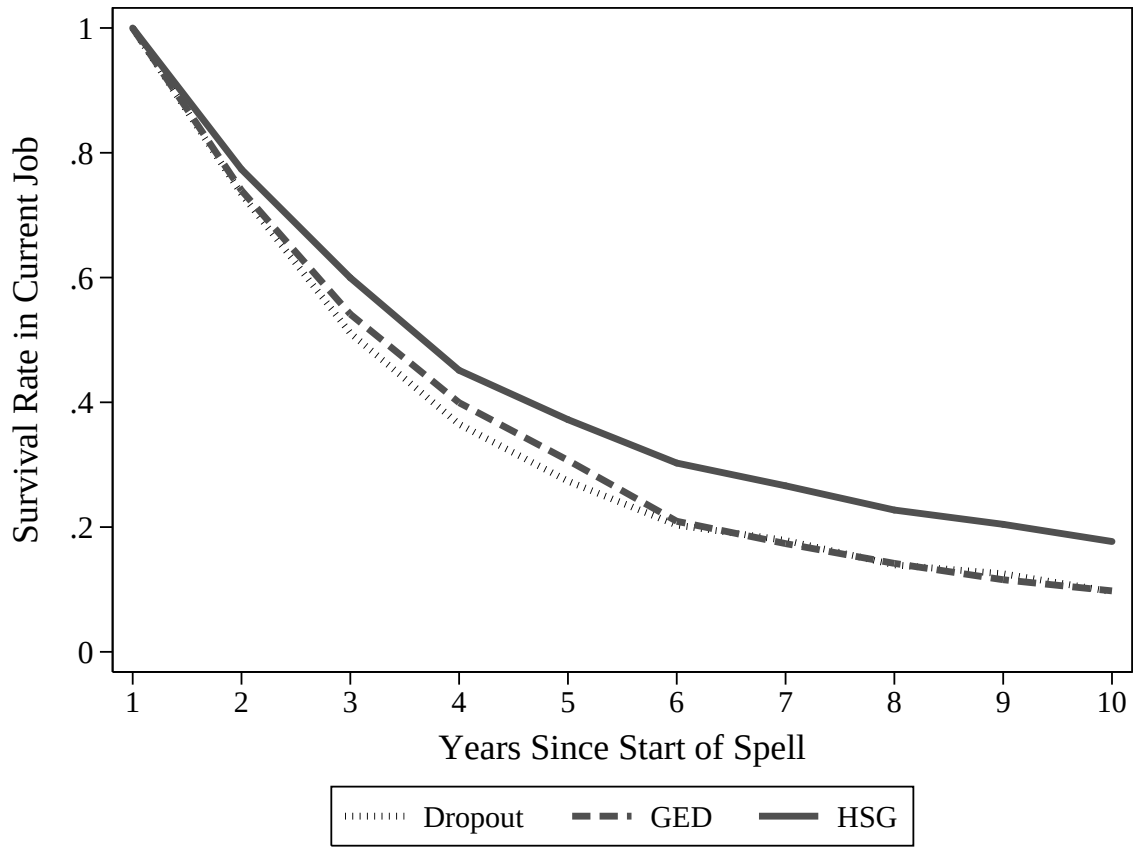


Figure 10: Survival Rates in Various States for Male Dropouts, GED Recipients, and High School Graduates, Cont'd

(c) Survival Rate in Marriage

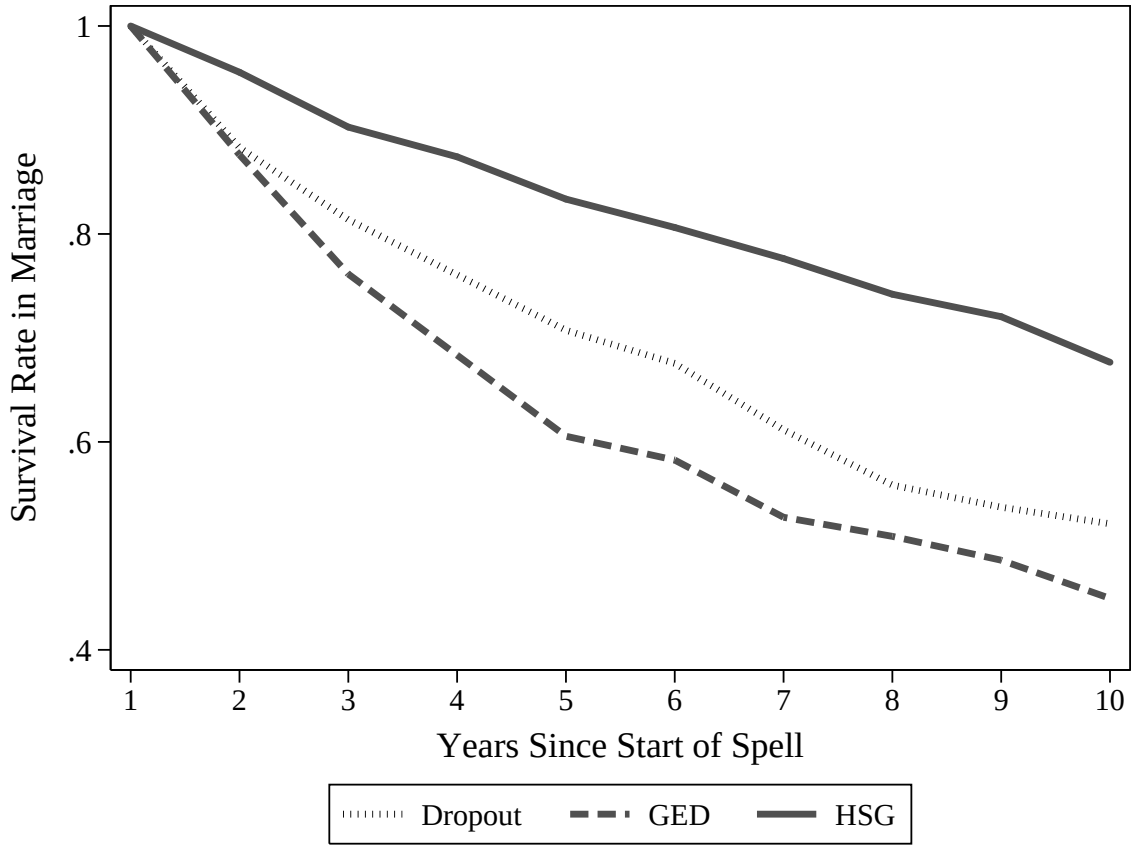
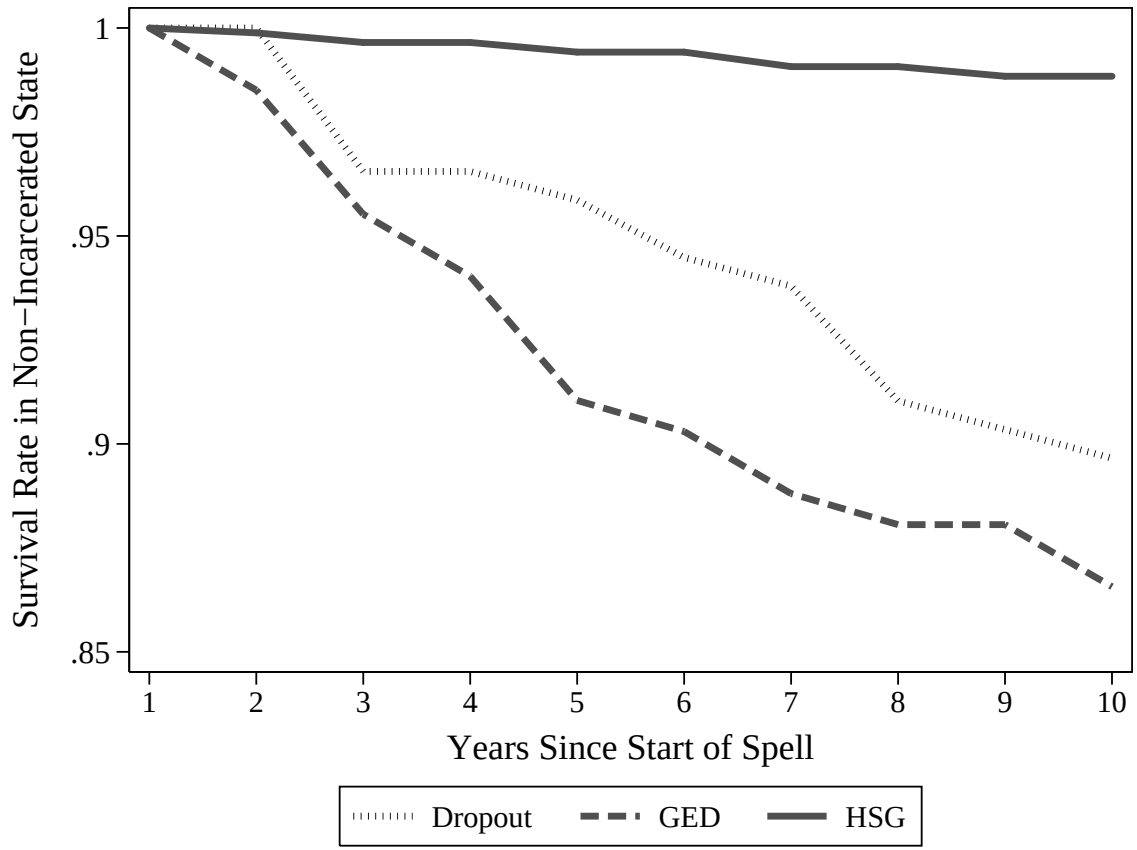


Figure 10: Survival Rates in Various States for Male Dropouts, GED Recipients, and High School Graduates, Cont'd

(d) Survival Rate in Staying Out of Jail



- Adjusting for their differences in cognitive ability, male GED recipients perform virtually the same as high school dropouts in the labor market.
- Figure 11 shows the hourly wages and annual earnings of male GED recipients and high school graduates compared to high school dropouts for different age groups.

# Figure 11: Labor Market Outcome Differences by Age: NLSY79—Males

## (a) Annual Earnings

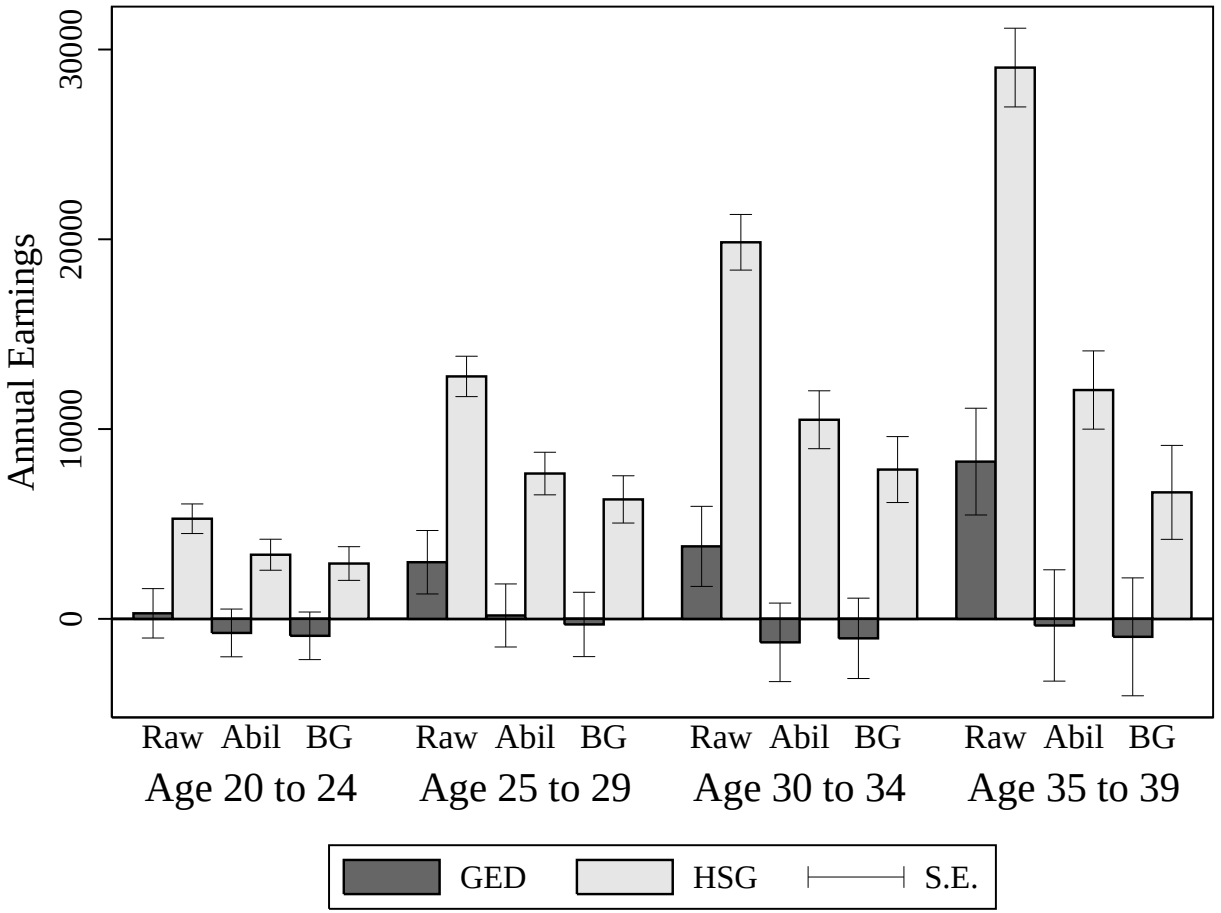
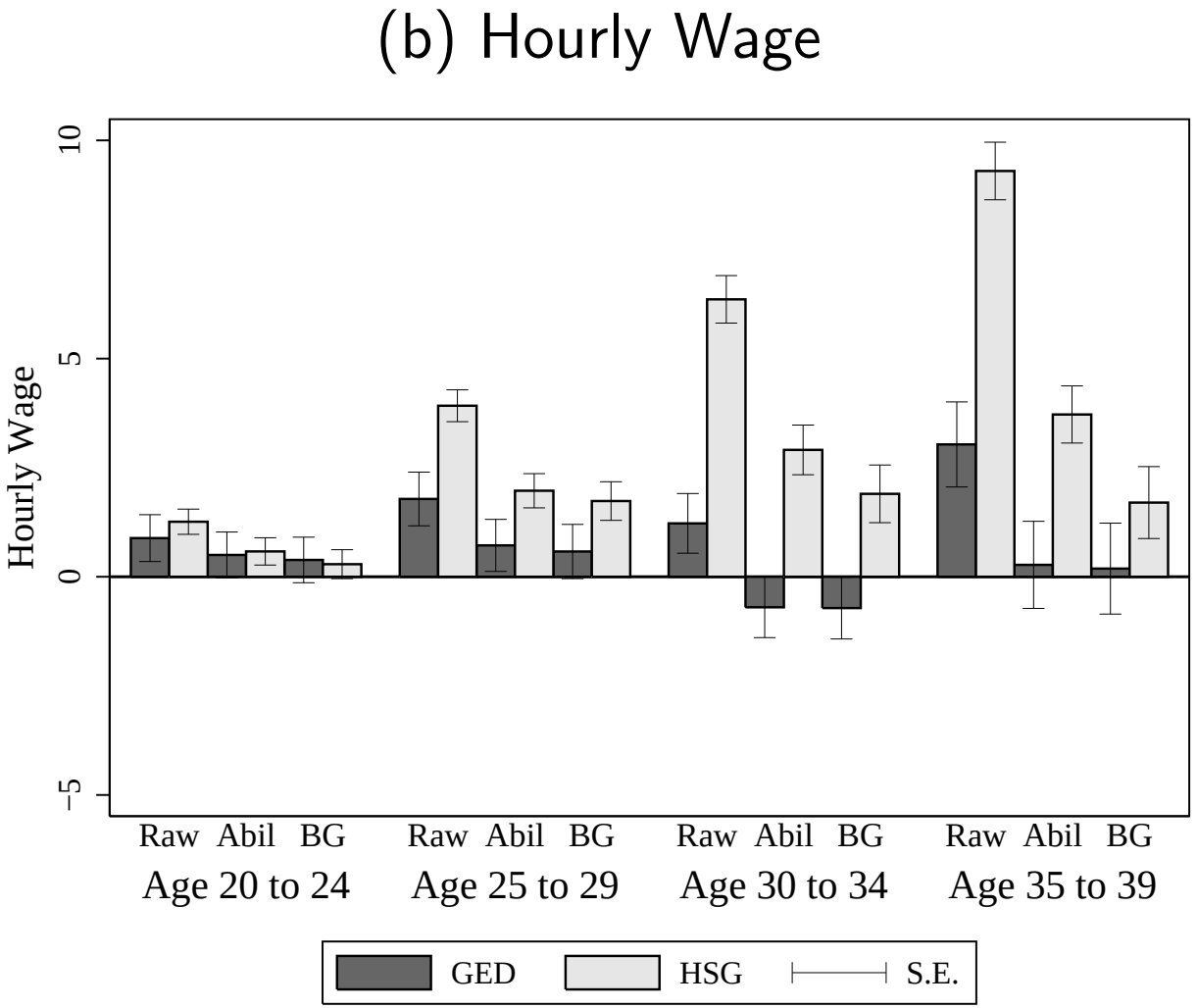


Figure 11: Labor Market Outcome Differences by Age: NLSY79—Males, Cont'd



# Causal Evidence from Intervention Studies

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- Equation (1) shows how an outcome at age $a$, $T_a$, which is the performance on a task, depends on cognition $C_a$, personality $P_a$, other acquired skills such as education and job training $K_a$, and the effort allocated to the task $e_{T_a}$:

$$\underbrace{T_a}_{\substack{\text{Outcome on a}\\ \text{task at age } a}} = \phi_a\Big(\underbrace{C_a}_{\text{Cognition}}, \underbrace{P_a}_{\text{Personality}}, \underbrace{K_a}_{\substack{\text{Other}\\ \text{acquired}\\ \text{skills}}}, \underbrace{e_{T_a}}_{\substack{\text{Effort}\\ \text{devoted to}\\ \text{task}}}\Big) \quad a = 1, \ldots, A. \tag{1}$$

- Equation (2) shows how the effort allocated to task $T_a$ depends on cognition $C_a$, personality $P_a$, other acquired skills $K_a$, incentives $R_{T_a}$, and preferences $\Upsilon_a$:

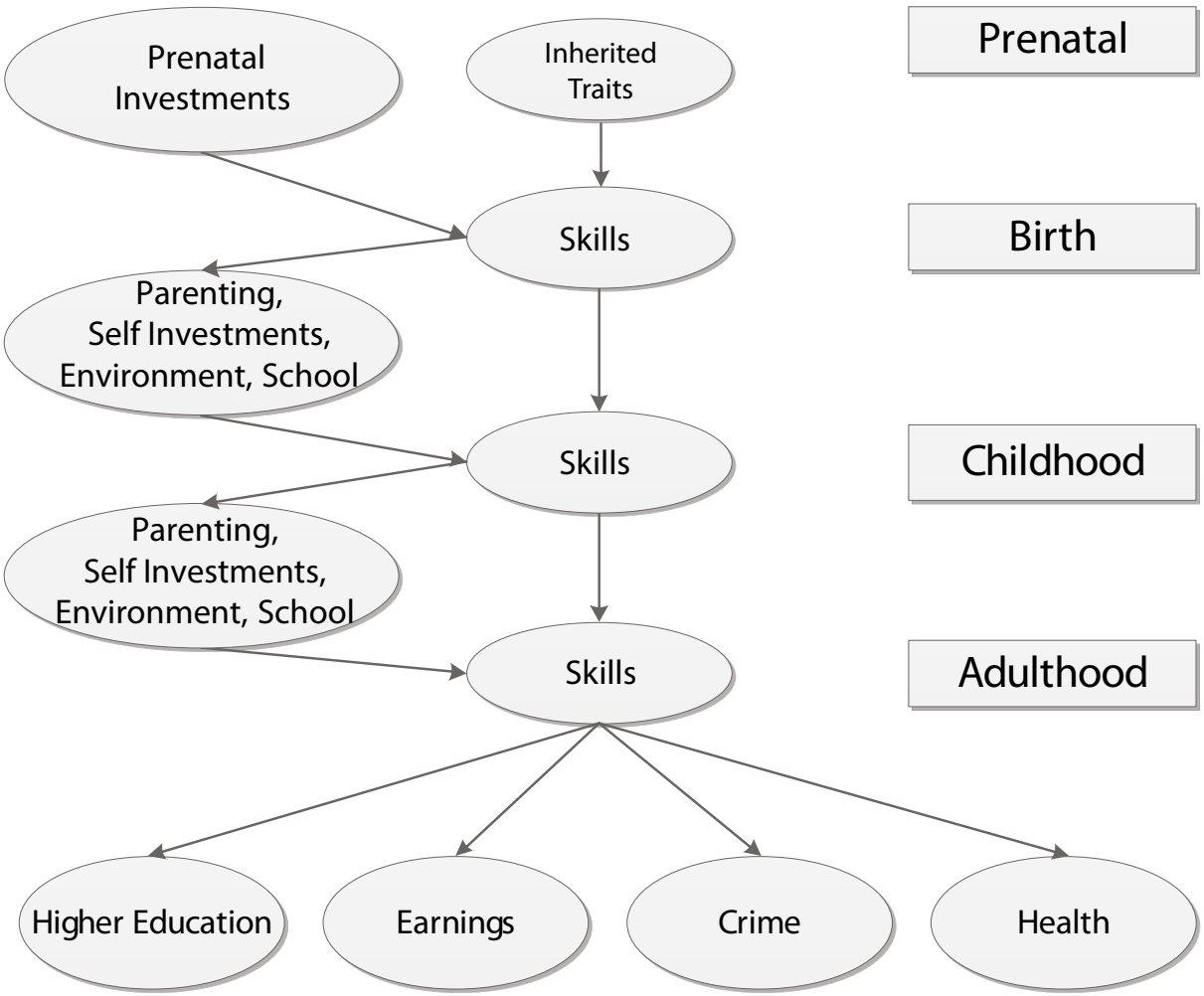
$$e_{T_a} = \psi_{T_a}(C_a, P_a, K_a, \underbrace{R_{T_a}}_{\substack{\text{Incentives} \\ \text{to perform} \\ \text{on task}}}, \underbrace{\Upsilon_a}_{\text{Preferences}}). \tag{2}$$

- Equations (1) and (2) formalize the difficulty in establishing causal relationships between outcomes and skills. Multiple skills and effort generate performance in a given task.
- Many studies in psychology and economics do not control for these inputs and equate measurement of a set of outcomes with the skill the analyst is trying to measure.
- This practice can lead to a substantial bias in inference about any particular skill.

- Skills evolve over time through investment and habituation.
- Equation (3) shows that skills at age $a+1$ are age-dependent functions of cognitive ability, personality skills, other acquired skills, and investment $I_a$ at age $a$.
- In this way, previous levels of skills and acquired skill affect current levels of skills and acquired skill.

$$(C_{a+1},\ P_{a+1},\ K_{a+1}) = \eta_a(C_a,\ P_a,\ K_a,\ \underbrace{I_a}_{\substack{\text{Investment}\\ \text{and}\\ \text{experience}}}),\quad a = 1,\ldots,A. \tag{3}$$

# Figure 12: Framework for Understanding Skill Development



- Figure 12 illustrates why understanding the effects attributable to specific interventions is such a challenging task.
- Most empirical studies only investigate the interventions aimed at one slice of the life cycle.
- They do not connect the links in the figure or correct for the effects of later investment in producing the outcomes attributed to early investments.
- One important area for future research on skill formation is to better document how early interventions influence the efficacy of later interventions.

- An important extension of this modelling approach is that performance on current tasks themselves can depend directly on performance of past tasks independently of a person's skills or effort (habituation).
- Formally, Equation (1) can be modified as:

$$T_a = \phi_a'(C_a, P_a, K_a, e_{T_a}, T_{a-1}') \tag{4}$$

where $T_{a-1}'$ might represent a fundamentally different task that measures the same set of skills.

- More generally, task $T_{a-1}'$ captures something other than the underlying skills of students that can affect performance on $T_a$.

- This framework recognizes that different skills might be relatively easy to shape at different stages of the life cycle.
- *Sensitive Periods*: Investments are relatively more productive.
- *Critical Periods*: Investment during any other period is not productive.

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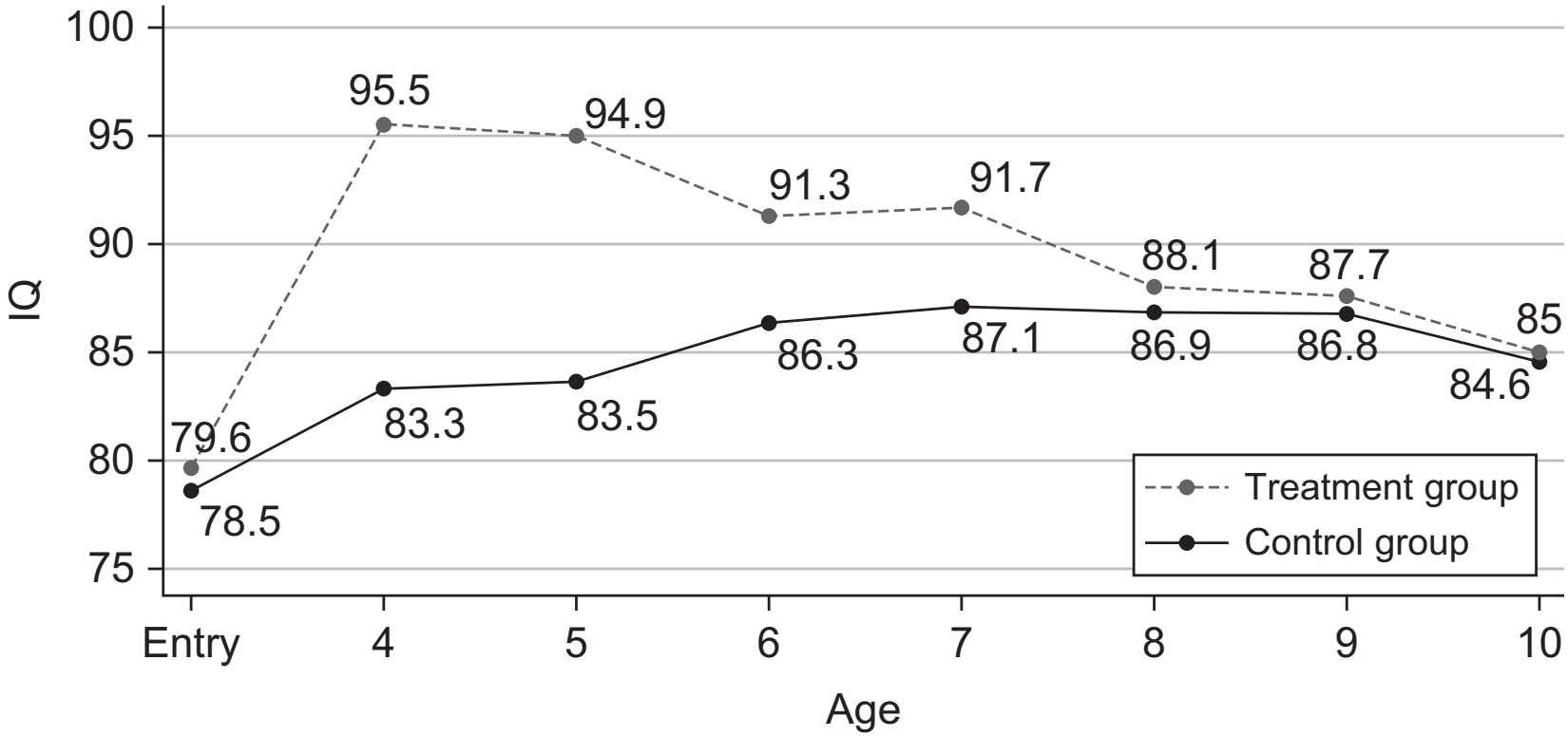
# Evidence from the Perry Preschool Program and Other Interventions

- The program did not improve IQ scores in a lasting way.
- Figure 13 shows that, by age ten, treatment and control groups had the same average IQ scores.
- Many critics of early childhood programs seize on this finding and related evidence to dismiss the value of early intervention studies.
- Similar evidence from Head Start programs and a faith in IQ as a central determinant of life success strongly influenced Arthur Jensen's views about the genetic determination of skills.

## Figure 13: Perry Preschool Program: IQ by Age and Treatment Group




*Source*: Cunha et al. (2006) and Heckman and Masterov (2007) based on data provided by the High Scope Foundation.

- Nevertheless, the program improved outcomes for both boys and girls, resulting in a statistically significant rate of return of around 6-10% per annum for both boys and girls.
- The Perry Preschool Program worked primarily through improving personality skills.
- This evidence supports the evidence previously presented that shows that performance on achievement tests depends in part on personality skills.
- Arthur Jensen's lifetime campaign against early intervention program was based on using faulty measures of relevant lifetime skills.

- Heckman et al. (2006) estimate a version of Equation (3) to analyze the effects of increases in education on measured cognition and non-cognitive measures.
- Controlling for the problem of reverse causality that schooling may be caused by non-cognitive skills, they find that schooling improves both personality and cognitive skills and that these skills, in turn, boost outcomes.

- Cunha et al. (2010) estimate a model of the technology of skill formation using longitudinal data on the development of children with rich measures of parental investment and child skills.
- Their model is a version of Equation (3).
- Skills are self-productive and exhibit dynamic complementarity—current values of skills affect the evolution of future skills through direct and cross effects.
- They find that self-productivity becomes stronger as children become older, for both cognitive and personality skills.
- It is more difficult to compensate for the effects of adverse environments on cognitive endowments at later ages than it is at earlier ages.

# Summary

- This paper reviews recent evidence from economics and psychology on the importance of personality.
- It shows that success in life depends on many skills, not just those measured by IQ, grades, and standardized achievements tests.
- Personality skills predict and *cause* outcomes.