

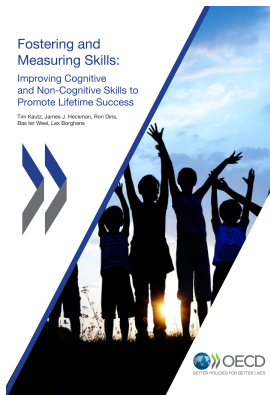
# Fostering and Measuring Skills

by Kautz, Tim, Heckman, James J., Diris, Ron, ter Weel, Bas, and Borghans, Lex.  
(2014) "Fostering and Measuring Skills: Improving Cognitive and Non-Cognitive Skills to Promote Lifetime Success." Report for the Organisation of Economic Co-operation and Development, Paris.

James J. Heckman

AEA Continuing Education Program  
ASSA Course: Microeconomics of Life Course Inequality  
San Francisco, CA, January 5-7, 2016

**James J. Heckman, Tim Kautz, Ron Diris,  
Bas ter Weel, and Lex Borghans**  
**Fostering and Measuring Skills:  
Improving Cognitive and Noncognitive Skills to Promote  
Lifetime Success**  
**OECD, 2014**



## Main Points

- Many important life skills are not captured by scores on achievement tests
- A sole focus on achievement test scores (e.g., NCLB, PISA and Iowa tests) gives an incomplete picture of what schools, families, and communities do and how to evaluate schools and other life cycle skill interventions.
- Socioemotional skills—character, etc.—are important
- These skills can be measured
- They are malleable, and there are effective interventions to promote them
- Soft skills more malleable than cognitive skills at later ages

- Older (“established”) measurement systems such as the Big Five do **not** capture the rich range of behaviors and traits that children and adults exhibit
- Need comprehensive measures of traits
- Instead of relying exclusively or mainly on self-reported “Big Five measures,” we should use approaches based on behaviors
  - Teacher reports and assessments as encoded in school system records and interviews
  - Eliciting preference parameters from observed choices in the field and in controlled choice experiments and behaviors:
    - Risk aversion
    - Time preference
    - Ambiguity aversion
    - Trust
    - Reciprocity (positive and negative)
- For all measurement systems, we should adjust for incentives and other traits

*“To value schools, by length instead of quality, is a matchless absurdity. Arithmetic, grammar, and the other rudiments, as they are called, comprise but a small part of the teachings in a school. The rudiments of feeling are taught not less than the rudiments of thinking. The sentiments and passions get more lessons than the intellect. Though their open recitations may be less, their secret rehearsals are more.”*

—Horace Mann (1838)

## Cognitive Skills

- Measuring Non-cognitive Skills

## Traditional Approach to Measurement: *The Big Five*

**Table 1:** The Big Five Traits**OCEAN**

Trait	Definition of Trait
I. <b><u>O</u>penness to Experience</b>	The tendency to be open to new aesthetic, cultural, or intellectual experiences.
II. <b><u>C</u>onscientiousness</b>	The tendency to be organized, responsible, and hardworking.
III. <b><u>E</u>xtraversion</b>	An orientation of one's interests and energies toward the outer world of people and things rather than the inner world of subjective experience; characterized by positive affect and sociability.
IV. <b><u>A</u>greeableness</b>	The tendency to act in a cooperative, unselfish manner.
V. <b><u>N</u>euroticism</b>	Neuroticism is a chronic level of emotional instability and proneness to psychological distress. Emotional stability is predictability and consistency in emotional reactions, with absence of rapid mood changes.



**New approaches to measuring character and cognitive skills  
go well beyond the Big Five**

## Definition of Personality

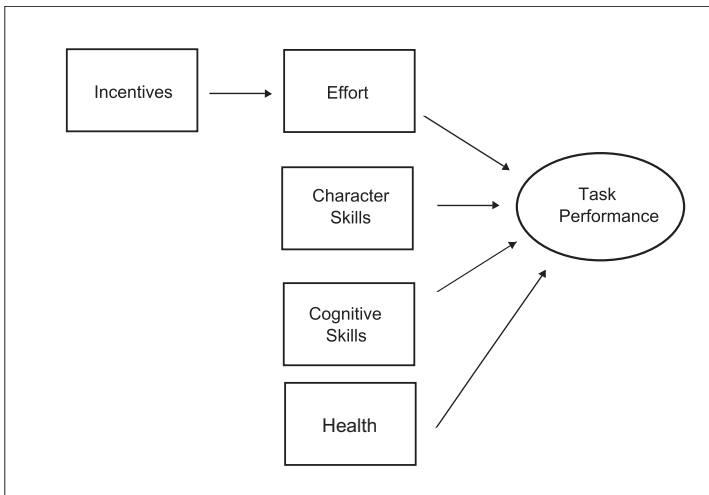
*Personality traits are the relatively enduring patterns of thoughts, feelings, and behaviors that reflect the tendency to respond in certain ways under certain circumstances.*

—Roberts (2009, p. 140)

## A Task-Based Framework for Identifying and Measuring Skills

- Distinction between tasks & tests artificial
- All tests are tasks

**Figure 1: Determinants of Task Performance**



## Modern History of Testing

- Starts with IQ tests

## General Knowledge: The Achievement Test

- What schools add to the capability of students to perform tasks

*“We lean heavily on written examinations, on a few types of objective tests, and on the subjective impressions of teachers. Many other appraisal devices could be used, such as records of activities in which pupils participate, questionnaires, check lists, anecdotal records and observational records, interviews, reports made by parents, products made by the pupils, and records made by instruments (motion pictures, eye-movement records, sound recordings, and the like).”*

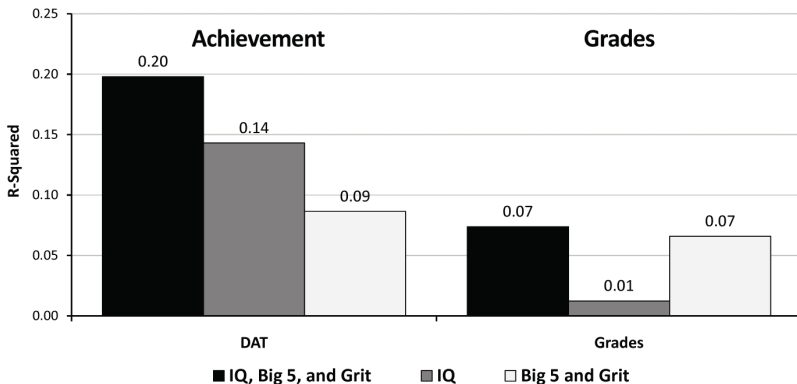
—Ralph Tyler (1940)

# Testing the Tests



- IQ tests and achievement tests are typically validated in a circular fashion, using other measures of cognition

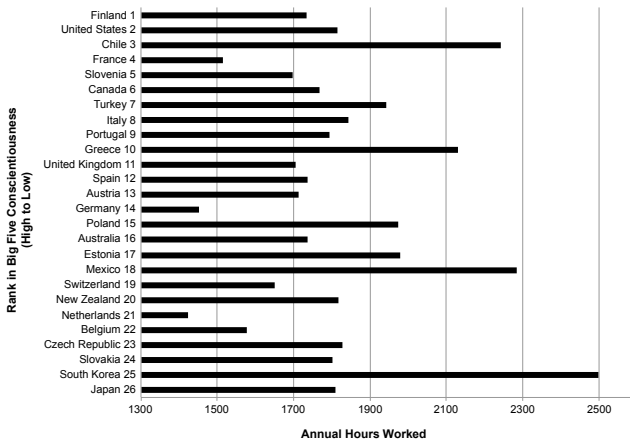
## Figure 2: Decomposing Variance Explained for Achievement Tests and Grades into IQ and Character: Stella Maris Secondary School, Maastricht, Holland



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

- Self reports
- Teacher (or third party) reports
- Behaviors
  
- Computer games
- Choice experiments as elicited in game theory and experiments
- Use school records / teacher reports (available from public school records)
- Grades much more predictive than SAT

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

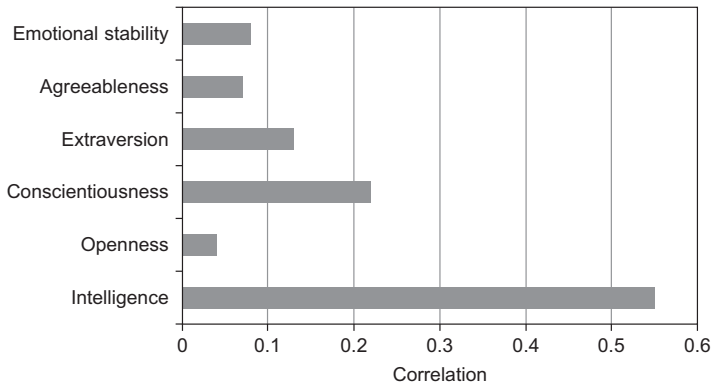


Source: The Conscientiousness ranks come from Schmitt et al. (2007). These measures were taken in 2001 (Schmitt, 2002). The hours worked estimates come from Organisation of Economic Cooperation and Development (2001). Note: Several countries are omitted due to lack of data.

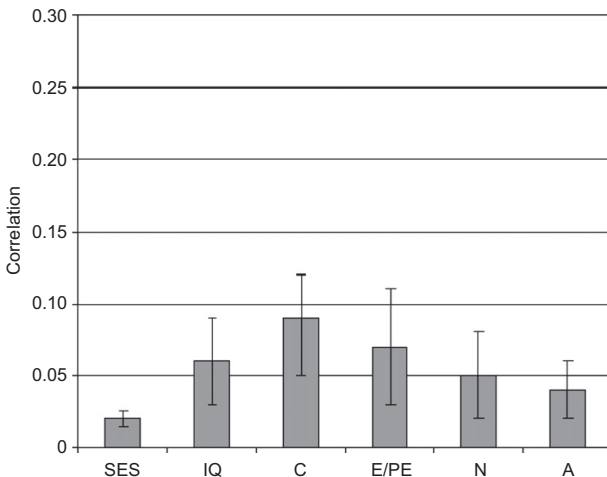
## Are Non-Cognitive Skills Stable?

## Correlational Evidence

Figure 4: Associations with Job Performance



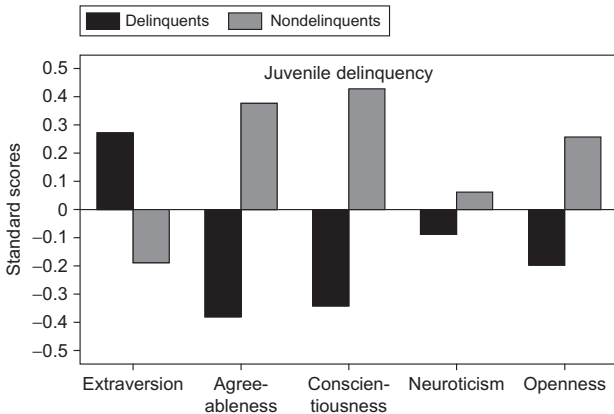
**Figure 5:** Correlations of Mortality with Character, IQ, and Socioeconomic Status (SES)



Source: Roberts et al. (2007).



Figure 6: Juvenile Delinquency and the Big Five



Source: John et al. (1994).

# Evidence from the General Educational Development (GED) Programme

**Figure 7:** Distribution of Cognitive Ability by Educational Status

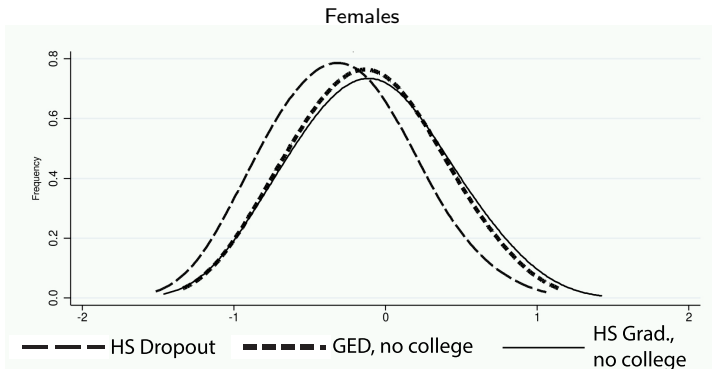
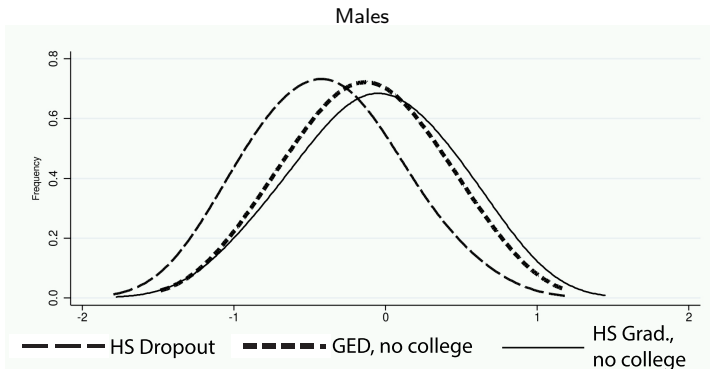
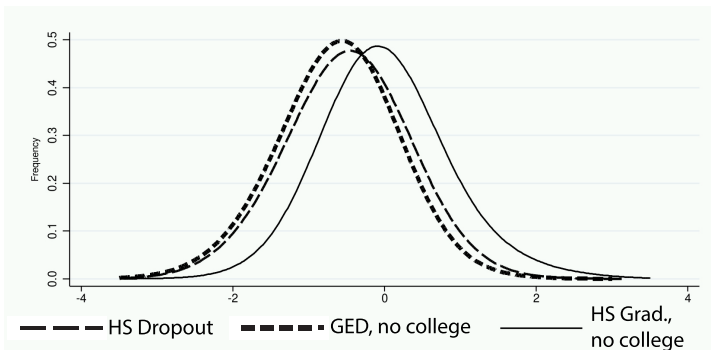


Figure 7: Distribution of Cognitive Ability by Educational Status

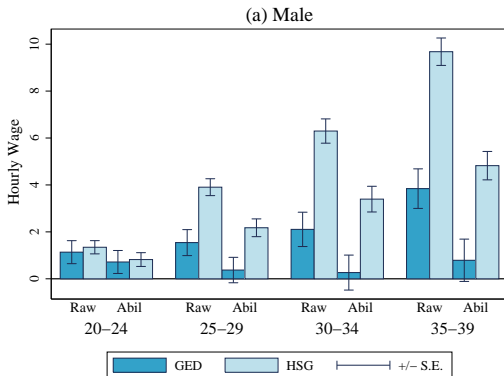


**Figure 8:** Distribution of Character Skills by Education Group



Measures of Character Skills Based on **Behaviors** in Early Teenage Years: Outcomes are for Adult Years

**Figure 9:** Hourly Wage Differences of GED Recipients and Traditional Graduates Compared to Uncertified Dropouts—Ages 20–39



**Figure 9:** Hourly Wage Differences of GED Recipients and Traditional Graduates Compared to Uncertified Dropouts—Ages 20–39

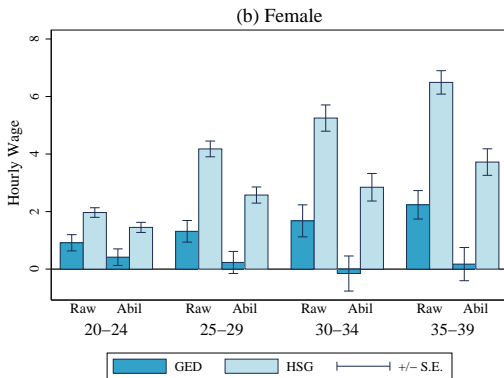




Figure 10: Distribution of Character Skills by Education Group

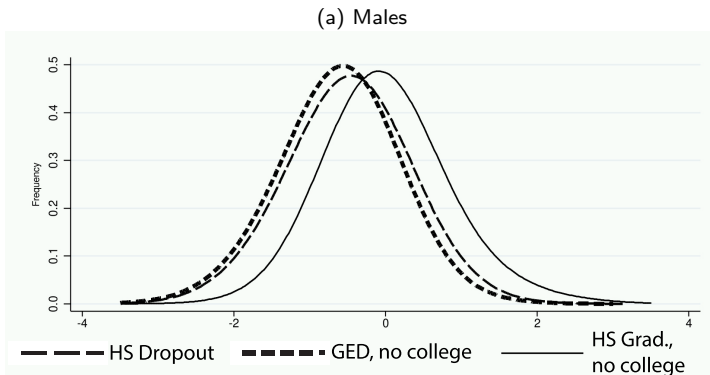
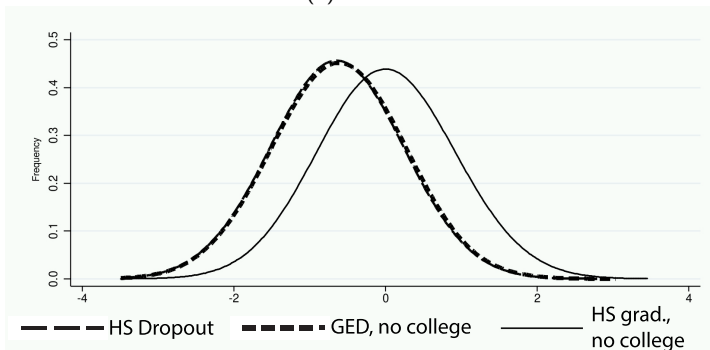


Figure 10: Distribution of Character Skills by Education Group

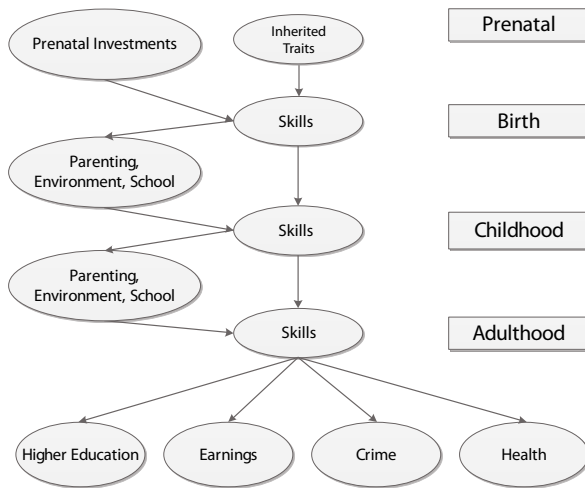
(b) Females



# The Skills Needed for Success in the Labour Market

# A Framework for Understanding Interventions

Figure 11: Framework for Understanding Skill Development



# Summary of Empirical Evidence on the Efficacy of Interventions

# Early-life Interventions That Begin With Before Formal Schooling

**Table 2: Summary of Effects for Main Interventions**  
**Participant/Evaluation Characteristics**

<b>Program</b>	<i>Age</i>	<i>Duration</i>	<i>Target</i>	<i>Selection</i>	<i>Follow-Up</i>	<i>Sample</i>	<i>RCT Eval</i>
<i>Elementary</i>							
LA's Best	5–6	6Y	SES	Schl	12Y	19,320	No
CSP	5–13	5Y	Behav	Refer	35Y	510	Yes
SSDP	6–7	6Y	Crime	Pgrm	21Y	610	Yes
<i>Adolescence</i>							
BBBS	10-16	1Y	SES	Self	1Y	960	Yes
IHAD	11–12	7Y	SES	Pgrm	8Y	180	Yes
EPIS	13–15	3Y	Schl	Schl	2Y	45,070	No
xl club	14	2Y	Schl	Schl	2Y	261,420	No
SAS	14–15	5Y	Schl, SES	Schl	6Y	430	No
STEP	14–15	2Y	Schl, SES	Self	4Y	4,800	Yes
QOP	14–15	5Y	Schl	Pgrm	10Y	1,070	Yes
Academies	13–16	4Y	Schl, SES	Self	12Y	1,460	Yes
CLUBS	16–18	1Y	Behav	Schl	2Y	1,000	Yes



**Table 2: Summary of Effects for Main Interventions**

Program	Components				
	Home	Health	Parental	On Site	Group
<u>Elementary</u>					
LA's Best	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
CSP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
SSDP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<u>Adolescence</u>					
BBBS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IHAD	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
EPIS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
xl club	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
SAS	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
STEP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
QOP	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Academies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
ChalleNGe	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Job Corps	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

## Table 2: Summary of Effects for Main Interventions

Program	Effects on Outcomes						Return/Benefits		
	IQ	School	Character	Education	Health	Crime	Earnings	Return	Benefit / Cost
<i>Elementary</i>									
LA's Best	.	●	.	●	.	○	.		0.9
CSP	.	.	○	.	⊗	○	.		
SSDP	.	●	●	●	●	●	○		3.1
<i>Adolescence</i>									
BBBS	.	◐	○	.	◐	○	.		1.0
IHAD	.	.	.	●	.	.	.		
EPIS	.	●	.	.	.	.	.		0.9–3.0
xl club	.	○	.	.	.	.	.		
SAS	.	●	○	●	.	.	.		
STEP	.	○	.	○	.	.	○		
QOP	.	○	.	●	○	⊗	○		
Academies	.	●	○	○	○	●	◐		

**Table 2: Summary of Effects for Main Interventions**

Program	Participant/Evaluation Characteristics						
	Age	Duration	Target	Selection	Follow-Up	Sample	RCT Eval
<i>Early</i>							
NFP	< 0	2Y	SES	Prgm	19Y	640	Yes
ABC	0	5Y	SES	Refer	30Y	90	Yes
IHDP	0	3Y	Health	Prgm	18Y	640	Yes
FDRP	0	5Y	SES	Prgm	15Y	110	No
PCDC	1	2Y	SES	Prgm	15Y	170	Yes
JSS	1–2	2Y	Health	Prgm	22Y	160	Yes
Perry	3	2Y	SES, IQ	Prgm	37Y	120	Yes
Head Start	3	2Y	SES	Prnt	23Y	4,170	Yes
CPC	3–4	2Y	SES	Prnt	25Y	1,290	No
TEEP	3,5	2Y	SES	Prgm	22Y	260	Yes
STAR	5–6	4Y	SES	Prgm	22Y	11,000	Yes



**Table 2:** Summary of Effects for Main Interventions

Program	Components				
	Home	Health	Parental	On Site	Group
<i>Early</i>					
NFP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
ABC	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
IHDP	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
FDRP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
PCDC	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
JSS	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Perry	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Head Start	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
CPC	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
TEEP	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
STAR	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**Table 2: Summary of Effects for Main Interventions**

Program	Effects on Outcomes						Return/Benefits		
	IQ	School	Character	Education	Health	Crime	Earnings	Return	Benefit / Cost
<i>Early</i>									
NFP	●	◐	●	○	◐	◐	.	2.9	
ABC	●	●	◐	◐	◐	◐	◐	3.8	
IHDP	◐	◐	◐	○	○	○	.		
FDRP	○	◐	◐	.	.	●	.		
PCDC	◐	◐	●	.	.	.	.		
JSS	●	●	●	◐	●	.	●		
Perry	◐	●	●	◐	○	●	◐	7–10	7.1–12.2
Head Start	◐	◐	○	●	●	◐	●		
CPC	.	●	●	●	●	●	●	18	10.8
TEEP	◐	●	●	●	.	.	.		
STAR	.	◐	●	●	.	.	●	6.2	

## Infant Programmes and Model Preschools

- Nurse-Family Partnership

**Table 3: Summary of Effects of the Nurse-Family Partnership**

Outcome	Treatment	Control	Treatment Effect
<b>Age 6<sup>(1)</sup></b>			
Vocabulary Skills(ES)			0.17**
Internalizing Disorders(%)	12.6	14.7	-2.1
Externalizing Disorders(%)	17.4	20.2	-2.8
<b>Age 9<sup>(2)</sup></b>			
GPA(ES)			0.09
Antisocial Behavior(%)			-0.03
Grade Retention(%)	16.0	12.4	3.6
<b>Age 12<sup>(3)</sup></b>			
GPA			0.08
Achievement Tests <sup>(a)</sup>			1.09
Grade Retention(%)	24.9	20.8	4.1
Internalizing Disorders(%) <sup>(b)</sup>	22.1	30.9	-8.8**
Externalizing Disorders(%) <sup>(c)</sup>	19.7	17.8	1.9
Used Substance Last 30 Days(%)	1.7	5.1	-3.4**
Ever Arrested(%)	3.1	3.1	0.0
Welfare Benefits Mother <sup>(d)</sup>	8772	9797	-1025**
<b>Age 19<sup>(4)</sup></b>			
Ever Arrested(%)	21.3	37.4	-16.1**
Arrested in Last Year(%)	8.2	5.5	2.7
Illicit Drug Use(%)	48.7	51.9	-3.2
Has HS Diploma(%)	70.6	74.5	-3.9
Economically Productive(%) <sup>(e)</sup>	71.4	68.3	3.1



*Notes:* The estimates are coefficients from regressions that control for sample member characteristics. % refers to treatment effects in terms of changes in prevalence in outcome variable in percentage points. ES indicates Effect Size, reporting the treatment effect in standard deviations of the outcome variable. The Age 6–12 estimates come from the Memphis site. The Age 19 estimates come from the Elmira site. (a) Is based on group reading and math achievement test scores and is in percentile units. (b) Uses student self-reports on domains such as anxiety, depression, somatization, and withdrawal to assess if students pass a clinical threshold, based on the Achenbach Child Behavior Checklist (Achenbach and Rescorla, 2001). (c) Uses student, teacher, and parent reports on domains such as conduct problems, aggression, and total problems to assess if students pass a clinical threshold, based on the Achenbach Child Behavior Checklist. (d) Measures the average yearly receipt of welfare during the child's first 12 years of life, in US\$. (e) Measures if someone is involved in education, a job, the military, or job training.

\*\*Attains 5% significance level.

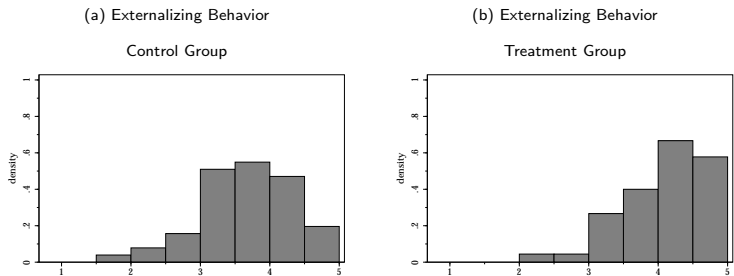
*Sources:*(1) The estimates at Age 6 come from Olds et al. (2004). (2) The estimates at Age 9 come from Olds et al. (2007). (3) The estimates at Age 12 come from Kitzman et al. (2010). (4) The estimates at Age 19 come from Eckenrode et al. (2010).



## Jamaican Study

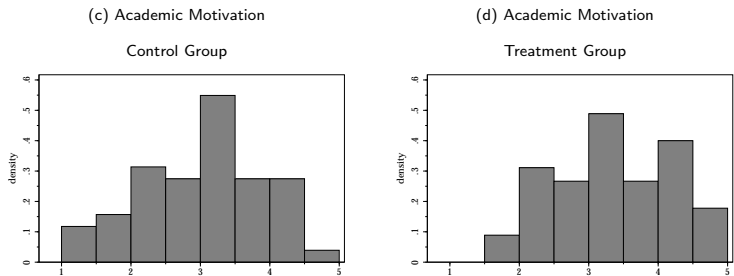
# Perry Preschool Programme

## Figure 12: Histograms of Indices of Noncognitive Skills and CAT Scores



Source: Heckman et al. (2013).

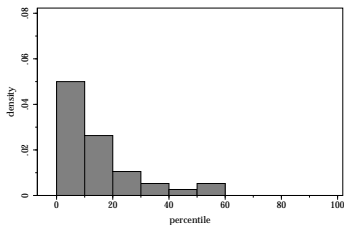
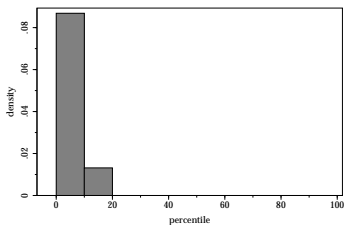
Figure 13: Histograms of Indices of Noncognitive Skills and CAT Scores



Source: Heckman et al. (2013).

## Figure 14: Histograms of Indices of Noncognitive Skills and CAT Scores

( Rank in Terms of Position in the National Distribution )



Source: Heckman et al. (2013).

*Notes:* Indices for Externalizing Behavior and Academic Motivation are based on items of the Pupil Behavior Inventory (PBI), teacher ratings of student behavior. The units are expressed in terms of standard deviations. The scale on “Externalizing Behavior” is normalized so that a higher score corresponds to better behavior. The PBI includes whether the student disrupts classroom. “CAT” is the California Achievement Test score expressed in percentiles of the general population distribution of the scores. The one-sided  $p$ -values for difference in means are 0.001, 0.043, and 0.000 for Externalizing Behavior, Academic Motivation, and CAT scores, respectively. Histograms are based on the pooled sample of males and females.

# Abecedarian Programme

## Large-Scale Infant and Young Child Programmes

- Head Start
- Chicago Child-Parent Center



# Education and Interventions in Kindergarten and Elementary School

# Targeted Non-Cognitive Skill Interventions

# The Seattle Social Development Project (SSDP)

**Table 4:** Summary of Treatment Effects from the Seattle Social Development Project

Outcome	Age			
	Age 18 <sup>(h)</sup>	Age 21 <sup>(i)</sup>	Age 24 <sup>(j)</sup>	Age 27 <sup>(j)</sup>
GPA	0.24*			
CAT(ES) <sup>(a)</sup>	0.05			
Grade Repetition(%)	-8.7**			
Dropout(%)	-7.3			
School Misbehavior <sup>(b)</sup>	-1.41**			
Violent Crime(%)	-11.4**			
Ever Arrested(%)	-6.0			
Arrested past year(%)		-2.0	1.0	1.0
Smoking(%)	-0.7			
Pregnancy(%)	-9.3*		-9.0	-8.0
Anxiety(%) <sup>(c)</sup>		-2.0		
Depression(%) <sup>(c)</sup>		-8.0*		
High School Graduate/GED(%)		10.0***	6.0	6.0
More than 2 Years of College(%)		8.0***		
Self-efficacy <sup>(d)</sup>		0.17***	0.13*	-0.01
Associate's Degree(%)			12.0*	12.0*
Bachelor's Degree(%)			7.0	6.0
Substance Abuse Index <sup>(e)</sup>			3.0	-3.0
Mental Health Disorder Index <sup>(f)</sup>			-9.0*	-11.0**
Income(in thousands) <sup>(g)</sup>			3.51	3.12

*Notes:* The estimates are coefficients from regressions that control for sample member characteristics. % refers to treatment effects in terms of changes in prevalence in outcome variable in percentage points. ES indicates Effect Size, reporting the treatment effect in standard deviations of the outcome variable. (a) CAT stands for California Achievement Test score and combines reading, language, and mathematics subtests. It has been standardized based on the sample of ninth-grade Seattle students. (b) Measures frequency of occurrence of skipping, cheating, and being sent from class. (c) Anxiety, social phobia, and depression were measured using the *DSM-IV* (American Psychiatric Association, 1994). The mental health disorder index groups this for anxiety, social phobia, posttraumatic stress disorders, and major depressive episodes. (d) Measured as mean score on six items concerning perceived future opportunities, on a scale of 1–4. (e) The Substance Abuse Index measures dependence on substances (tobacco, alcohol, and illicit drugs) using *DSM-IV* criteria. (f) The Mental Health Disorder Index summarizes problems of anxiety, social phobia, posttraumatic stress and depression, using *DSM-IV* criteria. (g) Refers to income from all sources, before taxes. Includes zero-earners; income is top-coded at \$200,000. (h) Hawkins et al. (1999). (i) Hawkins et al. (2005). (j) Hawkins et al. (2008).

\* 10% significance; \*\* 5% significance; \*\*\* 1% significance.



# The Montreal Longitudinal Experimental Study (MLES)

# Cambridge-Somerville Program

# Project STAR



## Education and Interventions Targeted Toward Adolescents and Young Adults

# Adolescent Mentorship Programmes

- Quantum Opportunity Program
- Becoming a Man
- Pathways to Education Programme
- Empresários Pela Inclusão Social (EPIS) Program
- H&R Block FAFSA experiment
- Dartmouth College Coaching Program

## Residential-Based Programmes

- Job Corps
- National Guard ChalleNGe

## Work-Based Adolescent Intervention Programmes

- Career Academies

**Table 5:** Summary of Treatment Effects from Career Academies within 96-Month Follow-Up after Scheduled High School Graduation

Outcome	Males	Females
<i>Labor Market (49–96 Months)</i>		
Monthly Earnings (\$) <sup>(a)</sup>	361**	118
Months Employed (#)	2.8***	−0.3
Average Hours Worked per Week (#)	4.1***	0.2
Average Hourly Wages (\$)	0.6	0.7
<i>Educational Attainment (After 96 Months)</i>		
High School Diploma	−0.4	0.2
GED	3.6	1.3
Certificate/License	2.0	0.1
AA Degree	−1.0	1.8
BA Degree	−2.2	−1.6
<i>Family Formation (After 96 Months)</i>		
Married and Living Together	9.0**	1.5
Custodial Parent	11.5***	3.7
Non-Custodial Parent	−6.4**	0.2



*Notes:* Impact estimates are regression-adjusted to control for background characteristics of the sample and for the clustering of students within schools and random assignment years. (a) Nonworkers were assigned a value of “0” for monthly earnings.

\*10% significance; \*\*5% significance; \*\*\*1% significance.

*Source:* Kemple and Willner (2008).



## Year-Up Programme

- Self-Sufficiency Project
- Apprenticeship Programmes

## Other Curricula That Have Been Applied to Multiple Age Groups

# Tools of the Mind

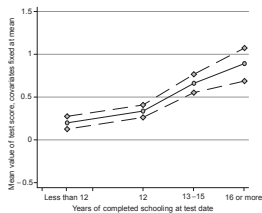
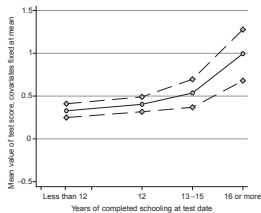
## Studies that Teach the Incremental Theory of Intelligence

## Prevention vs. Remediation

## The Effects of Education and Parental Investment of Cognitive and Non-Cognitive Skill

**Figure 15:** Causal Effect of Schooling on ASVAB Measures of Cognition

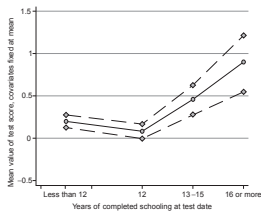
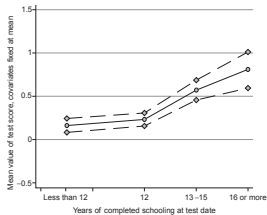
(a) Arithmetic Reasoning      (b) Word Knowledge



Source: Heckman et al. (2006, Figure 4).

**Figure 15:** Causal Effect of Schooling on ASVAB Measures of Cognition

(c) Paragraph Comprehension      (d) Math Knowledge

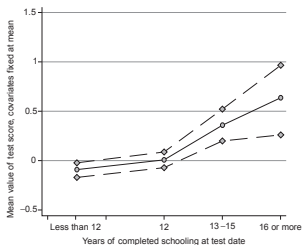


Source: Heckman et al. (2006, Figure 4).



## Figure 15: Causal Effect of Schooling on ASVAB Measures of Cognition

### (e) Coding Speed



Source: Heckman et al. (2006, Figure 4).

# Summary

- Many important life skills not captured by scores on achievement tests
- A sole focus on achievement test scores (e.g., NCLB, PISA and Iowa tests) give an incomplete picture of what schools, families, and communities do and how to evaluate schools and other life cycle interventions.
- Socioemotional skills—character, etc.—are important
- These skills can be measured
- They are malleable, and there are effective interventions to promote them
- Soft skills more malleable than cognitive skills at later ages

- Older (“established”) measurement systems such as the Big Five do **not** capture the rich range of behaviors and traits that children and adults exhibit
- Need comprehensive measures of traits
- Instead of relying exclusively or mainly on self-reported “Big Five measures,” we should use approaches based on behaviors
  - Teacher reports and assessments as encoded in school system records and interviews
  - Eliciting preference parameters from observed choices in the field and in controlled choice experiments and behaviors:
    - Risk aversion
    - Time preference
    - Ambiguity aversion
    - Trust
    - Reciprocity (positive and negative)
- For all measurement systems, we should adjust for incentives and other traits

## Supplemental Information

## Example:

**Table 6: Cognitive Ability Validities**

Test	Validation Domain	Estimate(s)	Source(s)
SAT (Achievement)	1st Year College GPA	0.35 - 0.53	Kobrin et al. (2008)
ACT (Achievement)	Early College GPA	0.42	ACT, Inc. (2007)
GED (Achievement)	HS Senior GPA	0.33 - 0.49	GED Testing Service (2009)
DAT (Achievement)	College GPA	0.13 - 0.62 <sup>†</sup>	Omizo (1980)
AFQT (Achievement)	9th Grade GPA	0.54	Borghans et al. (2011)
WAIS (IQ)	College GPA	0.38 - 0.43	Feingold (1982)
WAIS (IQ)	HS GPA	0.62	Feingold (1982)
Various IQ**	9th Grade GPA	0.42	Borghans et al. (2011)
WISC (IQ)	WRAT (Achievement)	0.44 - 0.75 <sup>‡</sup>	Hartlage and Steele (1977)
WISC-R (IQ)	WRAT (Achievement)	0.35 - 0.76 <sup>‡</sup>	Hartlage and Steele (1977)
Various IQ**	AFQT (Achievement)	0.65	Borghans et al. (2011)
Stanford Binet (IQ)	WISC-R (IQ)	0.77 - 0.87	Rothlisberg (1987), Greene et al. (1990)
Raven's (IQ)	WAIS-R (IQ)	0.74 - 0.84	O'Leary et al. (1991)
WIAT (Achievement)	CAT/2 (Achievement)	0.69 - 0.83*	Michalko and Saklofske (1996)

**Notes: Definitions:** WISC – Wechsler Intelligence Scale for Children, WISC-R – Wechsler Intelligence Scale for Children - Revised, WAIS - Wechsler Adult Intelligence Scale, Raven's IQ – Raven's Standard Progressive Matrices, GED – General Educational Development, DAT – Differential Aptitude Test, WIAT – Wechsler Individual Achievement Test, CAT – California Achievement Test, WRAT – Wide Range Achievement Test

<sup>†</sup> Large range is due to varying validity of eight subtests of DAT

<sup>‡</sup> Ranges are given because correlations vary by academic subject

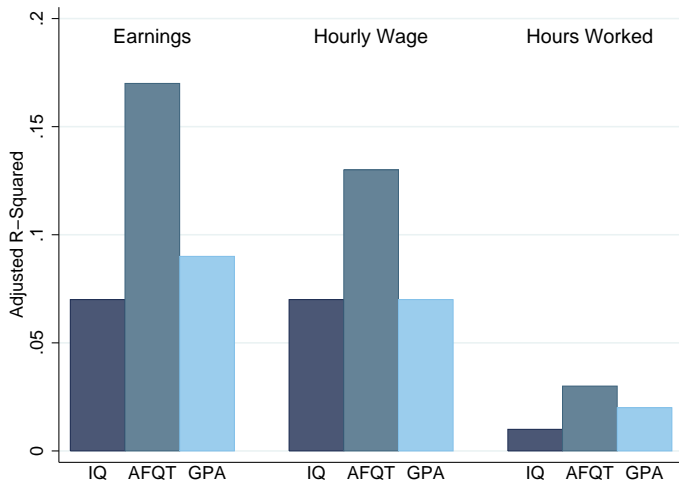
\* Ranges are given because correlations vary by grade level

\*\* IQ test scores in the NLSY79 are pooled across several IQ tests using IQ percentiles

- How well do test scores predict later-life outcomes that matter?
- Prediction is the hallmark of success of any measurement system.

**Figure 16:** Validities of Cognitive Measures in Age-35 Labor Market Outcomes (Adjusted R-Squared)

(a) Males





- Much of the variance in outcomes is not explained. Lots of room for improvement.

**Table 7:** Predictive Validities in Outcomes that Matter (Adjusted R-Squared)

Males	<i>IQ Sample</i>			<i>AFQT Sample</i>		
	IQ	Personality	Both	AFQT	Personality	Both
Earnings at Age 35	0.07	0.05	0.09	0.17	0.07	0.18
Hourly Wage at Age 35	0.07	0.03	0.08	0.13	0.06	0.14
Hours Worked at Age 35	0.01	0.03	0.04	0.03	0.02	0.03
Jail by Age 35	0.03	0.02	0.04	0.06	0.06	0.09
Welfare at Age 35	0.01	0.00	0.01	0.03	0.01	0.03
Married at Age 35	0.01	0.05	0.05	0.04	0.03	0.06
BA Degree by Age 35	0.12	0.08	0.16	0.19	0.10	0.22
Depression in 1992	0.01	0.05	0.05	0.04	0.04	0.06
Adj, $R^2$ Cog, Personality		0.07			0.17	

Notes: † Uses mean GED subtest scores

‡ Uses a general GED factor

**Table 7:** Predictive Validities in Outcomes that Matter (Adjusted R-Squared) (cont.)

Males	GPA Sample		
	GPA	Personality	Both
Earnings at Age 35	0.09	0.06	0.12
Hourly Wage at Age 35	0.07	0.06	0.09
Hours Worked at Age 35	0.02	0.01	0.02
Jail by Age 35	0.03	0.03	0.04
Welfare at Age 35	0.01	0.00	0.01
Married at Age 35	0.03	0.03	0.04
BA Degree by Age 35	0.14	0.10	0.18
Depression in 1992	0.02	0.04	0.04
Adj, $R^2$ Cog, Personality		0.11	

Notes: † Uses mean GED subtest scores

‡ Uses a general GED factor

**Table 7:** Predictive Validities in Outcomes that Matter (Adjusted R-Squared) (cont.)

Females	<i>IQ Sample</i>			<i>AFQT Sample</i>		
	IQ	Personality	Both	AFQT	Personality	Both
Earnings at Age 35	0.01	0.03	0.03	0.09	0.05	0.11
Hourly Wage at Age 35	0.05	0.03	0.06	0.12	0.05	0.14
Hours Worked at Age 35	-0.00	0.02	0.02	0.00	0.01	0.00
Jail by Age 35	-0.00	0.01	0.00	0.01	0.02	0.02
Welfare at Age 35	0.02	0.04	0.05	0.10	0.05	0.12
Married at Age 35	0.03	0.03	0.05	0.05	0.04	0.07
BA Degree by Age 35	0.10	0.08	0.14	0.17	0.09	0.20
Depression in 1992	0.02	0.05	0.05	0.04	0.05	0.07
Adj, $R^2$ Cog, Personality		0.10			0.15	

Notes: † Uses mean GED subtest scores

‡ Uses a general GED factor

**Table 7:** Predictive Validities in Outcomes that Matter (Adjusted R-Squared) (cont.)

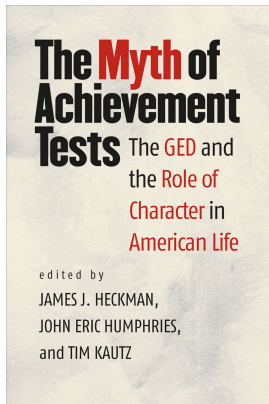
<b>Females</b>	<i>GPA Sample</i>		
	GPA	Personality	Both
Earnings at Age 35	0.05	0.04	0.07
Hourly Wage at Age 35	0.06	0.04	0.08
Hours Worked at Age 35	0.00	0.01	0.01
Jail by Age 35	0.01	0.01	0.02
Welfare at Age 35	0.05	0.05	0.07
Married at Age 35	0.03	0.03	0.05
BA Degree by Age 35	0.10	0.08	0.13
Depression in 1992	0.02	0.05	0.05
Adj, $R^2$ Cog, Personality		0.10	

Notes: † Uses mean GED subtest scores

‡ Uses a general GED factor

**James J. Heckman, John E. Humphries,  
and Tim Kautz**

**The Myth of Achievement Tests: The GED and the Role of  
Character in American Life  
University of Chicago Press, 2014**



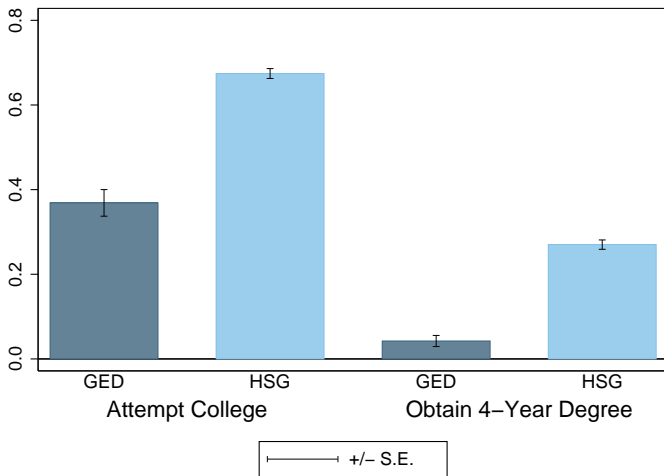
**Table 8:** Traditional Validities of GED Test

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)
American College Test (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)

Notes: † Uses mean GED subtest scores

‡ Uses a general GED factor

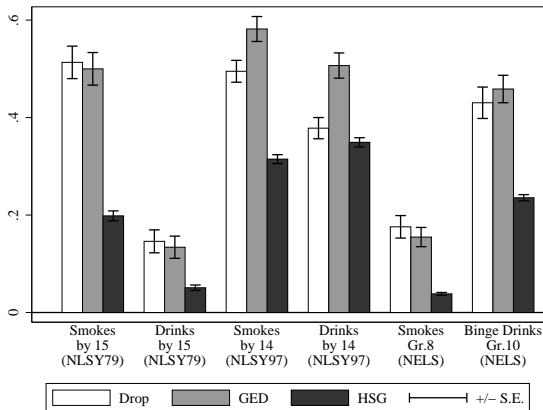
**Figure 17:** Postsecondary Educational Attainment across Education Groups through Age 40





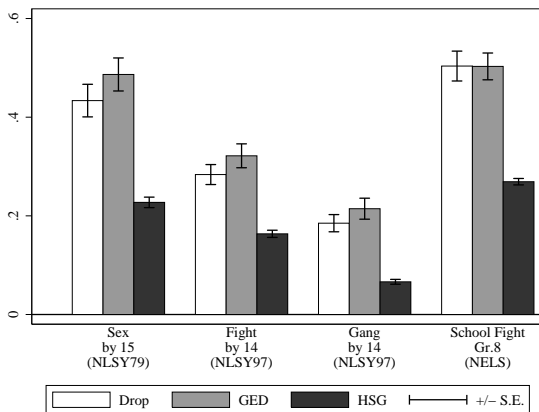
- **GEDs earn wages of dropouts controlling for their greater cognitive ability**
- **Drop out of marriage, jobs, military – same rates as dropouts**

**Figure 18:** Measures of Adolescent Behaviors for Male Dropouts, GED Recipients, and High School Graduates: Smoking and Drinking



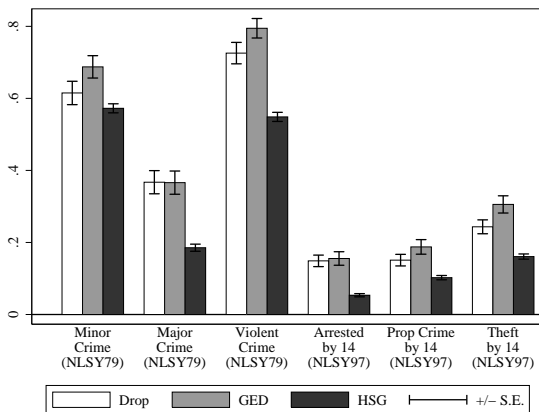
Notes: Heckman et al. (2012, Chapter 3).

**Figure 18:** Measures of Adolescent Behaviors for Male Dropouts, GED Recipients, and High School Graduates: Sex and Violent Behavior



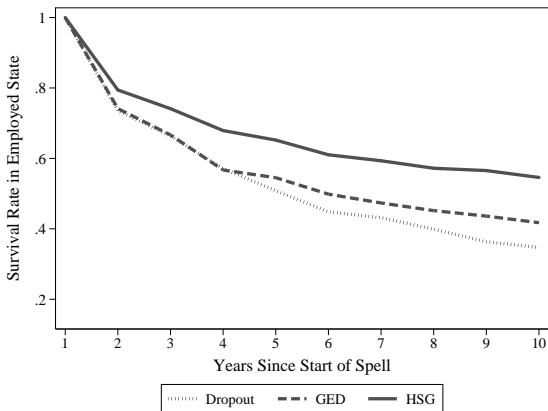
Notes: Heckman et al. (2012, Chapter 3).

**Figure 18:** Measures of Adolescent Behaviors for Male Dropouts, GED Recipients, and High School Graduates: Criminal Behavior



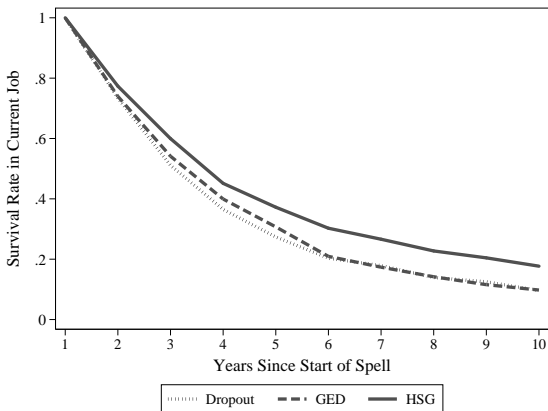
Notes: Heckman et al. (2012, Chapter 3).

**Figure 19:** Survival Rates in Various States for Male Dropouts, GED Recipients, and High School Graduates: Survival Rate in Employment



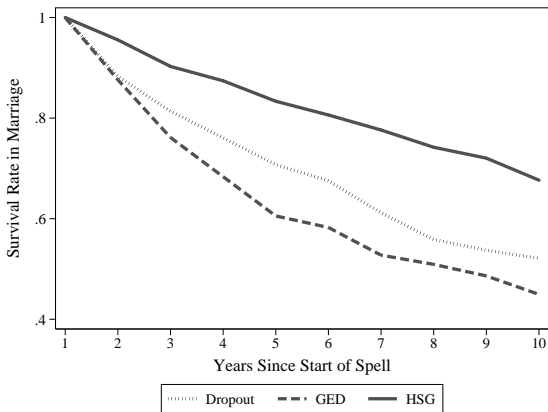
Notes: Heckman et al. (2012, Chapter 3).

**Figure 19:** Survival Rates in Various States for Male Dropouts, GED Recipients, and High School Graduates: Survival Rate in Staying on a Job



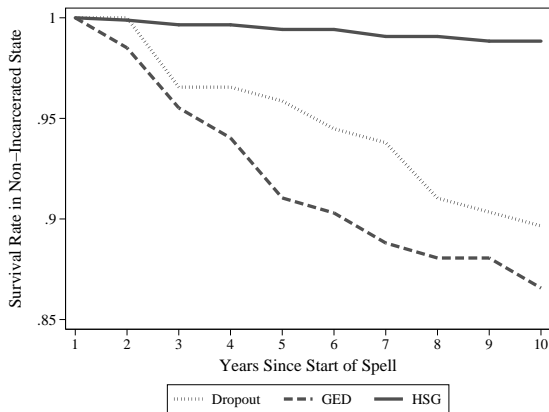
Notes: Heckman et al. (2012, Chapter 3).

**Figure 19:** Survival Rates in Various States for Male Dropouts, GED Recipients, and High School Graduates: Survival Rate in Marriage



Notes: Heckman et al. (2012, Chapter 3).

**Figure 19:** Survival Rates in Various States for Male Dropouts, GED Recipients, and High School Graduates: Survival Rate in Staying Out of Jail



Notes: Heckman et al. (2012, Chapter 3).



Outcomes( $Y, B$ )

Table 9: Outcomes

Outcome	Details
<b>Economic:</b>	
Log Wages	Log Hourly Wage at Age 30
Log P.V. Wage Inc.	Income from age 20 to 40 discounted at 5%
White Collar Emp. Participation	Employed in a White Collar Occupation at Age 30 Any Labor Market Participation at Age 30
<b>Physical Health:</b>	
Smoking	Regular Smoker at Age 30
Physical Health	Self Reported Physical Health by SF-12 at Age 40
Obesity	Clinically obese at Age 30
Heavy Drinker	Binge Drinker at Age 30
<b>Mental Health:</b>	
Depression	Self Reported by CES-D at Age 40
Mental Health	Self Reported Mental Health by SF-12 at Age 40
Self-Esteem	Rosenberg Scale in 2006 when individuals are in their 40s
Self-Mastery	Pearlin Scale in 1993
<b>Social:</b>	
Welfare Use	Any Welfare from 1996 - 2006
Trust	Usually or Always Trusting People in 2006
Voted	Voted in 2006
Divorce	Divorced by 2008 Conditional on Being Married



## Instruments and Controls

**Table 10:** Control Variables and Instruments Used in the Analysis

<b>Variables</b>	<b>Measurement Equations</b>	<b>Choice</b>	<b>Outcomes</b>
Race	x	x	x
Broken Home	x	x	x
Number of Siblings	x	x	x
Parents' Education	x	x	x
Family Income (1979)	x	x	x
Region of Residence	x	x	x
Urban Status	x	x	x
Age	x		x
Age Squared	x		x
Local Long-Run Unemployment		x	x
<b>Instruments</b>			
Local Unemployment at Age 17 <sup>a</sup>		x	x
Local Unemployment at Age 22 <sup>b</sup>		x	x
GED Test Difficulty <sup>c</sup>		x	
Local College Tuition at Age 17 <sup>d</sup>		x	
Local College Tuition at Age 22 <sup>e</sup>		x	

[Link to Appendix 1](#)

[Link to Appendix 2](#)

[Link to Appendix 3](#)

# Early Behaviors as Predictors of Later Behaviors

- Let  $\theta^C$  and  $\theta^{SE}$  denote the levels of cognitive and socioemotional endowments and suppose  $\theta = (\theta^C, \theta^{SE})$ .
- Allow  $\theta^C$  and  $\theta^{SE}$  to be correlated.
- $t_{m,s}^C$ . The  $m^{\text{th}}$  cognitive test score and  $t_{m,s}^{C,SE}$  the  $m^{\text{th}}$  measure influenced by both cognitive and socioemotional endowments, all measured at schooling level  $s$ .
- Parallel to the treatment of the index and outcome equations, we assume linear measurement systems for these variables:

$$t_{m,s}^C = \mathbf{X}_{m,s}^C \boldsymbol{\beta}_{m,s}^C + \theta^C \alpha_{m,s}^C + e_{m,s}^C, \quad (1)$$

$$t_{m,s}^{C,SE} = \mathbf{X}_{m,s}^{C,SE} \boldsymbol{\beta}_{m,s}^{C,SE} + \theta^C \tilde{\alpha}_{m,s}^C + \theta^{SE} \tilde{\alpha}_{m,s}^{SE} + e_{m,s}^{C,SE}. \quad (2)$$

- For nonparametric, nonlinear factor model identification, see Cunha, Heckman, and Schennach (2010).

- *The structure assumed in Equations (1) and (2) is identified even when allowing for correlated factors, if we have one measure that is a determinant of cognitive endowments ( $t_{m,s}^C$ ) and at least four measures that load on both cognitive ability and socioemotional ability, and conventional normalizations are assumed.*



## Measurement System

## Cognitive Factors

- Sub-tests from the Armed Services Vocational Aptitude Battery (ASVAB) are used as measures of cognitive ability.
- Arithmetic Reasoning, Coding Speed, Paragraph Comprehension, World Knowledge, Math Knowledge, and Numerical Operations.

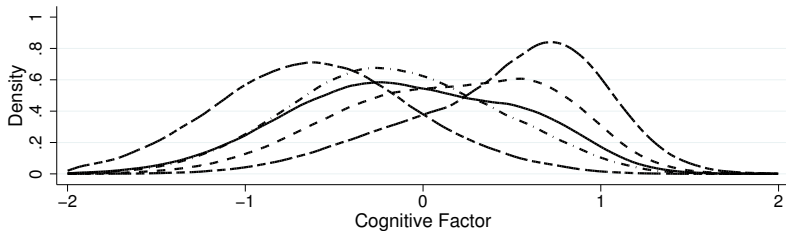
## Socioemotional Factor

- To identify the socioemotional factor, we use participation in minor risky or reckless activity in 1979 in the measurement system for the socioemotional endowment.
- In order to identify the distribution of correlated factors, risky behavior is restricted to not load on the cognitive factor.

- As a robustness check for our measure of socioeconomic endowments, we include five additional measures of adverse adolescent behavior to check interpretations of the non-cognitive factor.
- Violent behavior in 1979 (fighting at school or work and hitting or threatening to hit someone), tried marijuana before age 15, daily smoking before age 15, regular drinking before age 15, and any intercourse before age 15.
- For violent behavior, we control for the potential effect of schooling.
- We estimate the cognitive and socioemotional distributions jointly with the educational choice system to account for the effect of schooling at the time of the measurement on measures of ability following the procedure developed in Hansen et al. (2004).

Figure 20: Distribution of factors by schooling level

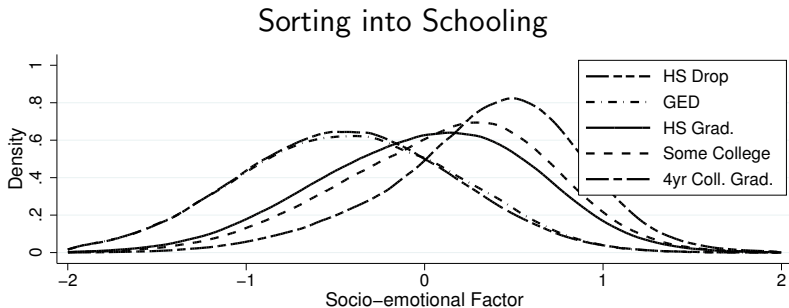
### Sorting into Schooling



*Note:* The factors are simulated from the estimates of the model. The simulated data contain 1 million observations.

*Source:* Heckman et al. (2015).

Figure 20: Distribution of factors by schooling level (cont.)



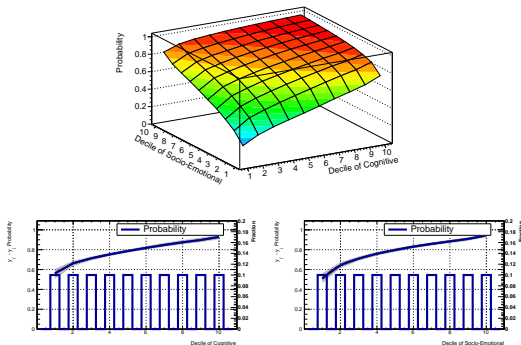
*Note:* The factors are simulated from the estimates of the model. The simulated data contain 1 million observations.

*Source:* Heckman et al. (2015).

# The Direct Effect of Endowments on Outcomes

## Figure 21: The Probability of Educational Decisions, by Endowment Levels

### A. Dropping from HS vs. Graduating from HS

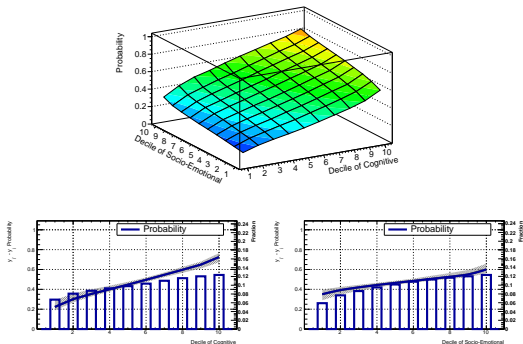


Source: Heckman et al. (2015).



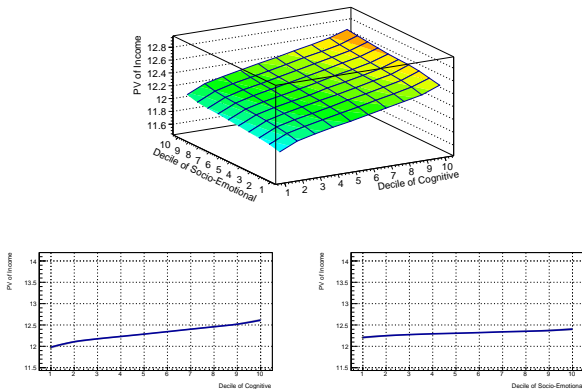
**Figure 21:** The Probability of Educational Decisions, by Endowment Levels (cont.) (Final Schooling Levels are Highlighted Using Bold Letters)

### C. HS Graduate vs. College Enrollment



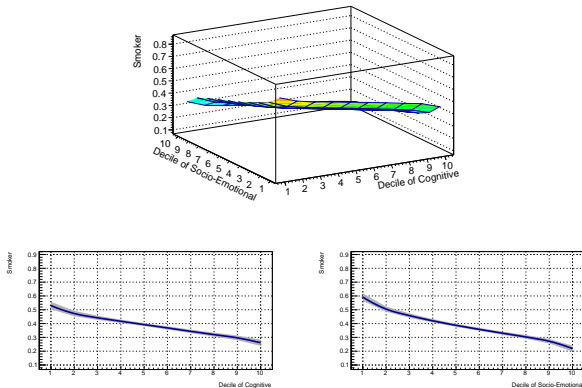
Source: Heckman et al. (2015).

## Figure 21: The Effect of Cognitive and Socioemotional Endowments on Log PV of Wage Income



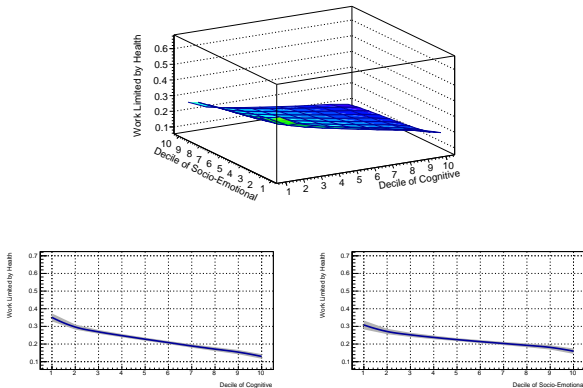
Source: Heckman et al. (2015).

## Figure 21: The Effect of Cognitive and Socioemotional Endowments on Smoking during Adulthood



Source: Heckman et al. (2015).

## Figure 21: The Effect of Cognitive and Socioemotional Endowments on Work Limited

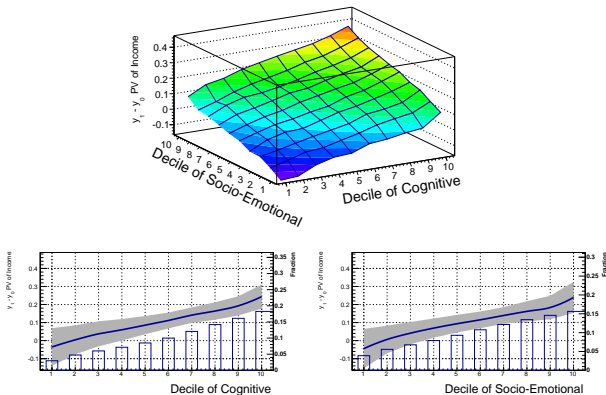


Source: Heckman et al. (2015).

# The Effect of Endowments on Treatment Effects

**Figure 21:** Average Treatment Effect of Education on Present Value of Wages, by Decision Node and Endowment Levels (cont.)

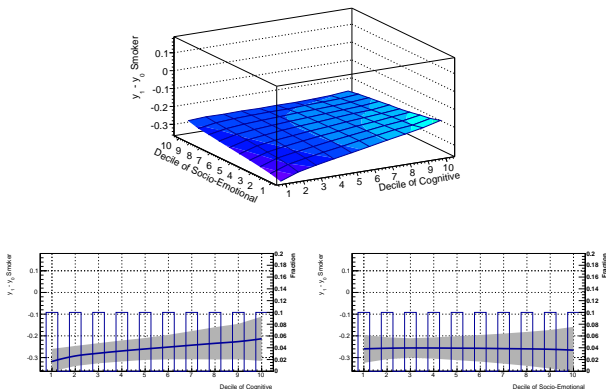
### D. Some College vs. 4-year college degree



Source: Heckman et al. (2015).

## Figure 22: Average Treatment Effect of Education on Smoking, by Decision Node and Endowment Levels

### A. Dropping from HS vs. Graduating from HS



Source: Heckman et al. (2015).

## Broader Notions of Personality Skills

- (a) Risk aversion
- (b) Trust
- (c) Empathy and social preference
- (d) Ambiguity aversion
- (e) Time preference
- (f) Positive and negative reciprocity



- They predict numerous life outcomes
- Not closely related to Big Five:
- They capture dimensions of human capabilities

- Correlations between Big Five and broader notions of preference

**Table 11:** Pearson correlation structure experimental data set

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism	LoC
Time	0.0370	0.0057	-0.0084	0.1026**	-0.0518	0.0847
Risk	-0.0379	-0.0611	0.0762*	0.0202	-0.1201***	0.0434
Positive reciprocity	0.1724***	0.0140	0.0211	0.2042***	0.0361	0.0152
Negative reciprocity	-0.0885*	-0.0393	0.0943*	-0.1451***	-0.0136	-0.1418**
Trust	0.1232***	-0.1300***	0.0004	0.1665***	-0.0134	-0.0140
Altruism	0.1242**	-0.0979*	0.0249	0.1911***	0.0847*	0.0480

The asterisks indicate significance at the 10% (\*), 5% (\*\*), and 1% (\*\*\*) levels. Correlations between economic preferences and the Big Five were calculated using 394–477 observations. Correlations between economic preferences and the locus of control (LoC) were calculated using 254–315 observations. All measures are standardized.

*Source:* Becker et al. (2012).

**Table 12:** Correlation structure between personality measures and economic preferences from SOEP observations

	Openness	Conscientiousness	Extraversion	Agreeableness	Neuroticism	LoC
Time	0.0183**	0.1122***	-0.0415***	0.3122***	-0.0584***	0.0681***
Risk	0.2793***	-0.0400***	0.2601***	-0.1454***	-0.0996***	0.1521***
Positive reciprocity	0.1814***	0.2520***	0.1473***	0.1842***	0.0872***	0.0954***
Negative reciprocity	-0.0522***	-0.1558***	-0.0264***	-0.3756***	0.0612***	-0.2154***
Trust	0.1272***	-0.0680***	0.0575***	0.0945***	-0.1919***	0.2094***
Altruism	0.1756***	0.1495***	0.1670***	0.2557***	0.0908***	0.0874***

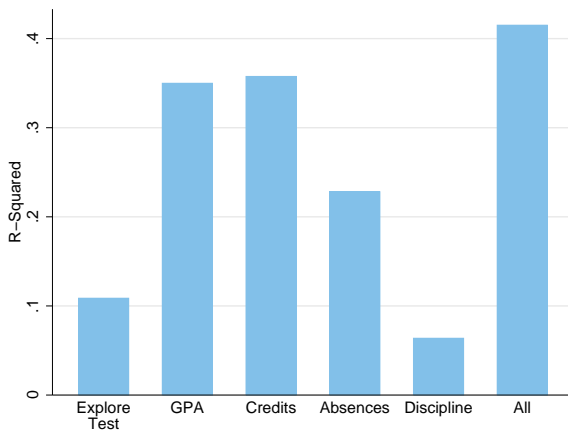
The asterisks indicate significance at the 10% (\*), 5% (\*\*), and 1% (\*\*\*) levels. Correlations are calculated using 14,243 observations. All measures are standardized. Abbreviation: LoC, locus of control.

*Source:* Becker et al. (2012).

**Better and often more easily implemented ways to measure personality have been developed**

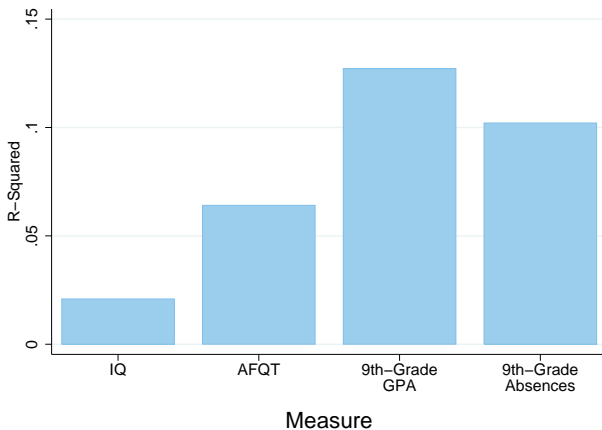
- GPA is a better predictor of success in college than SAT (Bowen et al., 2009)
- Grades capture personality

**Figure 23:** Predictive Validities of Measures of Cognition and Character in Secondary School Graduation (Explained Variance)



Source: Kautz and Zanoni (2015)

## Figure 24: Predictive Validities of Measures of Cognition and Character in Secondary School Graduation (Explained Variance)



Source: Heckman et al. (2015).



## Character Can Be Fostered

- See OECD report

## Conclusion #1: There is More Evidence that Early Programs are Effective

- Early childhood programs have been shown to be more effective
- Adolescent programs are less well-studied and the evidence is mixed
- Adolescent interventions that teach personality skills in the workplace (or specific context) are promising

## Conclusion #2: Long-Term Follow-Ups are Vital

- Many programs have short-term effects but no long-term effects
- Others have no short-term effects (for some measures) but long-term effects

## Conclusion #3: Non-Cognitive Skills are an Important Channel Throughout Early Childhood and Adolescence

- Only interventions that started before age 3 had a long-term effect on IQ
- Many interventions starting after age 3 have effectively improved outcomes by improving non-cognitive skills
- Adolescent interventions that teach personality skills in the workplace (or specific context) are promising

# Appendix 1

## Outcomes Appendix ( $Y, B$ )

### Social Outcomes

We include several social outcomes that, while normative, commonly align with the goals of education as reported by educators. We include:

#### 1 Divorce

- 1 a binary outcome for ever being divorced, which is conditional on having been married by 2008

#### 2 Welfare Use

- 1 a binary variable for any welfare use which is one if individual received any welfare between 1996 and 2006 and is otherwise zero

#### 3 Trust

- 1 a binary variable for if the individual reported trusting people. The variable is one if individual reported “always” or “most of the time” for trusting people in 2008, and is otherwise zero.

#### 4 Voting

- 1 a binary variable for if the individual reported voting in 2006.

## Outcomes Appendix ( $Y, B$ )

### Schooling Levels

We consider four different transitions and five final schooling levels. The transitions studied are

- 1 enrolled in high school deciding between graduating from high school and dropping out from high school,
- 2 high school dropouts deciding whether or not to get the GED,
- 3 high school graduates deciding whether or not to enroll in college, and
- 4 college students deciding whether or not to earn a 4-year degree.

## Outcomes Appendix ( $Y, B$ )

Consequently, the final schooling levels are

- 1 High school dropout,
- 2 GED,
- 3 High school graduate,
- 4 Some college, and
- 5 Four-year college degree.



## Outcomes Appendix ( $Y, B$ )

Education at age 30 is treated as respondent's final schooling level. Schooling levels are not an ordered set, calling into question the standard procedure of using years of schooling in analyzing the benefits of education. Thus, following the notation introduced in Section 2.1, the indicator variable for a college graduate is defined as  $s = 4$  if and only if  $D_{0,1} = D_{1,3} = D_{3,4} = 1$ .

## Measurement System Appendix

- The cognitive and socioemotional factors in the model are identified from the joint estimation of the educational choices of agents as well as a supplemental measurement system of tests and other early-life outcomes.
- Sub-tests from the Armed Services Vocational Aptitude Battery (ASVAB) are used as measures of cognitive ability.
- Specifically, we consider the scores from Arithmetic Reasoning, Coding Speed, Paragraph Comprehension, World Knowledge, Math Knowledge, and Numerical Operations.
- To identify the socioemotional factor, we use participation in minor risky or reckless activity in 1979 in the measurement system for the socioemotional endowment.
- In order to identify the distribution of correlated factors, risky behavior is restricted to not load on the cognitive factor.

## Measurement System Appendix

- Many psychologists use a socioemotional taxonomy called the Big Five (John et al., 2008). This is an organizing framework that categorizes personality traits into 5 categories. The five traits are extraversion, agreeableness, conscientiousness, neuroticism, and openness. A growing body of work suggests that these traits and other socioemotional traits play key roles in academic success. Borghans et al. (2011) and Almlund et al. (2011) show that the principal determinants of the grade point average are personality traits and not cognition. Similarly, Duckworth and Seligman (2005) find that self-discipline predicts GPA in 8th graders better than IQ. Duckworth et al. (2010) report three studies to show that self-control predicts grades earned in middle school better than IQ across racial and socioeconomic groups. Farsides and Woodfield (2003), Conard (2006), and Nofhle and Robins (2007) find that Big 5 traits positively predict grades and academic success. These studies find predictive power after controlling for previous grades or test scores. In these studies, the benefits of personality traits are mediated through behaviors such as increased attendance or increased academic effort. A meta-analysis by Credé and Kuncel (2008) finds that study habits, skills, and attitudes have similar predictive power as standardized tests and previous grades in predicting college performance. They find that study skills are largely independent of high school GPA and standardized admissions tests, but have moderate correlations with personality traits.

## Measurement System Appendix

- The evidence that academic success (such as GPA) depends on cognitive ability, but also depends strongly on socioemotional traits such as conscientiousness, self-control, and self-discipline, motivates our identification strategy of including both a cognitive and socioemotional factor in 9th grade GPA. Much of the variance not explained through test scores has been shown to be related to socioemotional traits. Socioemotional skills are measured in part by their contribution towards 9th grade GPA in reading, social studies, science, and math.
- GPA by grade and subject is constructed from high school transcript records. Up to 64 courses were recorded from school transcripts and included year taken, grade level taken, a class identification code, and the grade received. Using the class identification code, we identified all courses taken in either reading, social studies, science, or math in 9th grade and constructed subject level GPAs.

## Measurement System Appendix

- As a robustness check for our measure of socioeconomic skills, we include five additional measures of adverse adolescent behavior to check our interpreting of the non-cognitive factor. We consider violent behavior in 1979 (fighting at school or work and hitting or threatening to hit someone), tried marijuana before age 15, daily smoking before age 15, regular drinking before age 15, and any intercourse before age 15. For violent behavior, we control for the potential effect of schooling. We estimate the cognitive and socioemotional distributions jointly with the educational choice system to account for the effect of schooling at the time of the measurement on measures of ability following the procedure developed in Hansen et al. (2004).

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## Appendix 2

## Appendix for Instruments and Controls

- The variables used to control for observed characteristics depend on the timing and nature of the decision being made. In every outcome, measure, and educational choice, we control for race, broken home status, number of siblings, mother's education, father's education, and family income in 1979. We additionally control for region of residence and urban status at the time the relevant measure, decision, or outcome was determined.<sup>1</sup> For log wages at age 30, we additionally control for local economic conditions at age 30. When region of residence or urban status are not available for the age of a particular measure or outcome, the answer from previous or following surveys are used.



## Appendix for Instruments and Controls

- The educational choice models include additional choice-specific covariates. Following Carneiro et al. (2011), we control for both long run economic conditions, and contemporaneous deviations from those conditions. Controlling for the long-run local economic environment, local unemployment deviations capture contemporaneous economic shocks. The model for the choice to GED certify additionally controls for the difficulty of getting the GED within the state of residence in 1988.<sup>2</sup> The choices to enroll in college and graduate from college control for local 4-year college tuition at age 17 and 22 respectively.<sup>3</sup> When an instrument is missing for a particular age, the value from the previous or proceeding year is used.

## Appendix for Instruments and Controls

- The equation system for GPA controls for the variables used in all of our analyses, except for region dummies which are not available prior to 1979. The GPA model alternatively controls for urban status at age 14 and Southern residence at age 14. The ASVAB test scores models control for the standard controls, age, and age squared. As previously noted above, the ASVAB tests are estimated separately by education at the time of the test. Risky behavior in 1979 model controls for the standard controls, age and age squared. The risky behavior measure is also estimated by educational group, but due to data limitations pools high school graduates and those enrolled in college in 1979.
- The equations for log wages at age 30 controls for race, parents' education, broken home status, number of siblings, region of residence at age 30, and local unemployment rates at age 30. Smoking at age 30 includes the same controls, but excludes unemployment rates. Physical health and Rosenberg self-esteem at age 40 control for the same variables as smoking, but use region of residence at age 40 rather than 30.

**Table 13:** Control Variables and Instruments Used in the Analysis

<b>Variables</b>	<b>Measurement Equations</b>	<b>Choice</b>	<b>Outcomes</b>
Race	x	x	x
Broken Home	x	x	x
Number of Siblings	x	x	x
Parents' Education	x	x	x
Family Income (1979)	x	x	x
Region of Residence	x	x	x
Urban Status	x	x	x
Age	x		x
Age Squared	x		x
Local Long-Run Unemployment		x	x
<b>Instruments</b>			
Local Unemployment at Age 17 <sup>a</sup>		x	x
Local Unemployment at Age 22 <sup>b</sup>		x	x
GED Test Difficulty <sup>c</sup>		x	
Local College Tuition at Age 17 <sup>d</sup>		x	
Local College Tuition at Age 22 <sup>e</sup>		x	

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## Appendix 3

- This analysis uses the 1979 National Longitudinal Survey of Youth (NLSY79), a nationally representative sample of men and women born in the years 1957-64. The NLSY79 includes both a randomly chosen sample of 6,111 U.S. youth and a supplemental sample of 5,295 randomly chosen Black, Hispanic, and non-Black non-Hispanic economically disadvantaged youth. Both of these samples are drawn from the civilian population.
- In addition, there is a small sample of individuals (1,280) who were enrolled in the military in 1979.
- The respondents were first interviewed in 1979 when they were 14-22 years of age.

- The NLSY surveyed its participants annually from 1979 to 1992, and has surveyed them biennially since 1992.
- The NLSY measures a variety of later-life outcomes including labor market flows, asset and transfer income, and health outcomes. The survey measures many other aspects of the respondents' lives, such as scores on achievement tests, fertility, educational attainment, high school grades, and demographic information.
- This paper uses the core sample of males, which, after removing observations with missing covariates, contains 2242 individuals.

- As a baseline, our National Longitudinal Survey of Youth 1979 dataset uses the NLSY79 dataset used in Heckman et al. (2006), Urzúa (2008), and Heckman (2001).
- We use instruments from Carneiro et al. (2011).
- We supplement this baseline dataset with grades from high school transcripts, risky behaviors at young ages, and later life outcomes that were not previously available, such as physical health at age 40.



**Table 14:** NLSY79 Data Set Construction and Effect of Deletions

Observations	Details
3,002	Core representative male NLSY population
2,975	require schooling defined (GED or HS) for 12 years completed
2,905	Not employed by military
2,763	Not enrolled in education at 30 years old
2,242	Require no missing education, covariates, ASVAB, Rosenberg, and, instruments (Heckman et al. (2006) sample)

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